No, No, and No

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Abstract It is often assumed in the community of linguists that a formal logical treatment of negation is not able to account for negation in natural language. The present talk wants to argue that, on the contrary, a proper treatment should be able to render the plurality of negations—whether sentential or not, through a unique theory of basic speech-acts. Five main theses will be defended about the meaning of negation for this purpose, with the help of a formal semantics of questions–answers: *Question–Answer Semantics* (thereafter, **QAS**), inspired by Searle's speech-act theory while assuming a primary set of speech-acts: *affirmation* (yes-answer) and *denial* (no-answer). This formal device enlarges the meaning of negation beyond the usual criterion of incompatibility and endorses rejectivism: negation has to be explained in terms of a primary speech-act of denial, rather than the contrary.

Keywords Denial · Implicature · Litote · Logical value · Negation

Mathematics Subject Classification (2010) Primary: 03B35; Secondary: 03B05, 03B65

1 Introduction

It is often assumed in the community of linguists that a formal logical treatment of negation is not able to account for negation in natural language; for example, Moeschler takes logical negation to be an operator that merely turns the truth-value of sentences (respectively, true or false) into another one (respectively, false or true) [7]. Besides, logical negation is said to be a sentential negation, whereas linguistic negation would be applied to sentential components, only. The present talk wants to argue that, on the contrary, a proper treatment should be able to render the plurality

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J.-Y. Béziau et al. (eds.), *Logic in Question*, Studies in Universal Logic,
https://doi.org/10.1007/978-3-030-94452-0_25

of negations—whether sentential or not, through a unique theory of basic speech-acts.

Six main theses will be defended throughout the paper.

(i) There are three distinctive occurrences of negation, namely, as a speech-act of denial (no-answer), as a *quantifier* embedded into a predication, and as the resulting content of a negative sentence (the classical operator of negation).

(ii) A representation of this tridimensional aspect of meaning requires a special formal semantics: a *Question–Answer Semantics* (thereafter, **QAS**) with alternative, non-Fregean logical values; these are ordered answers to corresponding questions about arbitrary objects, and the result is a set of finite bitstrings that individuate objects in terms of related differences.

(iii) The primacy of speech-acts in **QAS** also brings out the self-defeating character of self-referential expressions like "Do not obey!" or "It is forbidden to forbid." Beyond the famous Liar Paradox, we attempt to show that there is a common, illocutionary flaw behind all these negative iterated expressions. These could be summarized by the basic statement "Do you answer *no* to this (very) question?".

(iv) Our algebraic framework is based on a theory of opposition that helps to throw some light on a variety of negations like neg-raising ("Julie is not beautiful" meant as "Julie is ugly"), litote ("Julie is not beautiful" as "Julie is gorgeous"), and the like; we see how these lead to a set of five negative expressions, including three unary difference-forming operators and two additional metalinguistic negations.

(v) Finally, the mainstream distinction between sentential and term negation is overcome into our more fine-grained semantics of opposite-forming operators; the same calculus occurs in both cases, and we give a sample of affixal negations to display our uniform theory of logical negation through a many-dimensional theory of meaning.

(vi) A general conclusion for the preceding is that **QAS** favors a pragmatic approach to logical constants, borrowing from Searle's illocutionary logic and Rumfitt's non-bivalent semantics [10] while assuming a primary set of speech-acts: *affirmation* (yes-answer), and *denial* (no-answer). Finally, it enlarges the meaning of negation beyond the usual criterion of incompatibility and endorses rejectivism: sentential negation ("not") has to be explained in terms of a primary speech-act of denial ("no"), rather than the contrary side.

2 Pragmatics and Logic

The gap between natural and formal languages is reduced by the process of *regimentation*, in order to find some channel translation between them. A good reason to do so is the variety of ambiguous expressions for common thoughts, and the following sample of questions–answers relates to the meaning of yes- and no-answers.

2.1 Affirmations and Negations

Consider a mother and her son in a restaurant, the first querying the second about whether he appreciates his dish. Then, different expressions occur for one and the same common attitude of disliking, depending upon both the sentential content of the *question* (affirmative or negative) and the form of the *answer* (affirmative or negative). Let us compare the diversity of such answers in four natural languages, namely, English, French, German, and Russian.

English	Q1 - You *dis*like this?	
	A1.1 -Yes, I do.	A1.2 - *No*, I do*n't*.
	Q2 - You do *not* like this?	
	A2.1 - *No*, I do*n't*.	A2.2 - Yes, I do.
French	Q1 - Ça te *dé*plaît?	
	A1.1 - Oui, ça me *dé*plaît.	A1.2 - *Non*, ça ne me *dé*plaît *pas*.
	Q2 - Ça *ne* te plaît *pas*?	
	A2.1 - Non, ça *ne* me plaît *pas*.	A2.2 - Si, ça me plaît!
German	Q1 - *Miss*fällt das dir?	
	A1.1 - Ja, das *miss*fällt mir.	A1.2 - *Nein*, das *miss*fällt mir *nicht*.
	Q2 - Gefällt das dir *nicht*?	
	A2.1 - *Nein*, das gefällt mir *nicht*.	A2.2 - Doch, das gefällt mir!
Russian	Q2 - Tebie eta *nie* nravitsa?	
	A2.1 - Da, *nie* nravitsa.	A1.2 - *Niet*, mnie nravitsa!

The complexity of natural negation occurs under a number of expressions: predicates and predicate terms in the questions, together with a subtle difference between affirmative answers to negative questions and negative answers to affirmative questions. All negative expressions are italicized here above for the sake of clarification, occurring both in questions and in answers. In particular, negation can appear within an affirmative question whenever it is embedded into the verb to form an affixal negation (e.g., the negative predicate term *dis*like). Then, a positive answer is given by the son to confirm that he *denies* to like his dish, thereby affirming his disliking it. And conversely, the same attitude of disapproval is expressed by the opposite no-answer to deny the affirmative predicate (e.g., like) whenever there is no such affixal negation embedded into the verb. In other words, "yes" and "no" can be used in different circumstances to express the same thought. Their occurrence depends upon the logical form of the sentential question, let be affirmative (including a negative predicate term like, e.g., "dis-") or negative (including a negative predicate "not")

A sort of iterated negation may arise in this question–answer game, viz. when negative answers are given to questions expressed with negated predicates (e.g., "do not like"). Exclamation marks are used to bring out disagreement between the sentential question and the following answer. Two main differences arise between natural languages in this respect. First, French and German resort to a special word in order to express disagreement about negative sentential questions ("si" in French and "doch" in German). Second, Russian agreement and disagreement may make use of opposite answers when the question serves as a confirmation-seeking device: "da" confirms the negative sentence of the question, while "niet" expresses a disagreement toward the latter.

In order to clarify this complex set of combined questions–answers, let us make use of a common algebraic formalism throughout the chapter. Borrowing from the Aristotelian theory of opposition, we assume that any question including negative predicate terms (e.g., "dislike") and negative predicates (e.g., "not like") are, respectively, contrary and contradictory to the corresponding basic predicate (e.g., "like"). This means that any yes-answer given about a negative term predicate entails a yes-answer about the negative predicate ("yes, I dislike it" entails "yes, I do not like it"), while the converse need not hold: I may not like a dish without disliking it, in case I do not eat anything at all.

Let p be the sentential content "I like this dish," assuming that the context of utterance makes good sense of its indexical components ("I" and "this") in the mother's questions and the son's answers. Then, we can reconstruct the previous question–answer games as follows in a so-called *Question–Answer Semantics* (thereafter, **QAS**): $\mathbf{q}_i(p)$ is a question-function about the sentence p, while $\mathbf{a}_i(p)$ stands for a corresponding answer-function. Symbolizing by 1 and 0 any yes- and no-answers, respectively, all this results in this common framework:

QAS	Q1	$\mathbf{q}_1(p)$		
	A1.1	$\mathbf{a}_1(p) = 1$	A1.2	$\mathbf{a}_1(p) = 0$
	Q2	$\mathbf{q}_2(p)$		
	A2.1	$\mathbf{a}_2(p) = 1$	A2.2	$\mathbf{a}_2(p) = 0$

It should be clear that there is no logical difference between "dislike" and "not like," both being equally opposed to "like" in a one-sided or direct way. In this sense, we agree that $\mathbf{q}_1(\neg p) = \mathbf{q}_2(p)$ and $\mathbf{a}_1(\neg p) = \mathbf{a}_2(p)$. At the same time, there is a difference in meaning in the lexical answers given by the son, depending upon whether the sentential question is of an affirmative or a negative form. The corresponding statements "yes" and "no" helped to grasp the "pragmatic" import of negation, both as a logical constant and as a vernacular expression. In this respect, action contributes to the meaning of a logical constant insofar as answers are parts and parcels of it. By an "action," it is meant what is famously known as a speech-act or, borrowing from Searle [12], what is referred to under the heading of *illocutionary* acts. Searle classified the latter in a set of five main classes, namely, assertives, directives, commissives, declaratives, and expressives, each one purporting to express a specific action by a speaker through an initial sentential content. In this chapter, any such speech-act can be referred to inside our question–

answer game, and we will not insist upon their different felicity conditions. At the same time, we assume that there are basic speech-acts upstream Searle's five classes of speech-acts, namely, *affirmation* and *denial*.[1]

A special focus is to be made upon one logical constant, hereby negation. More especially, three main theses can be expressed about it. Firstly, there is a variety of negations, i.e., one illocutionary and one locutionary negation. Secondly, there is no distinction between linguistic and logical negation. Thirdly, negation is a difference-forming operator. The next sections aim at justifying these three statements.

2.2 Self-contradiction as a Pragmatic Contradiction

Negation is closely related to the concept of contradiction, to be expressed thus far by the word "not" of predicate negation. What is the meaning of such a relation between sentences, from a pragmatic point of view? Let us consider a sample of so-called "pragmatic contradictions" or *self-contradictions*, which speech-acts within one single expression.

(1) a. Do not obey!
b. This sentence is false
c. It is forbidden to forbid.
d. I know that I do not know anything.
e. Do you answer "no" to this question?

(1a) is an order addressed by a given speaker S to a hearer H. If H obeys S, then H does not obey S by doing so. If H does not obey S, then H does obey S by doing so. Self-contradiction.

(1b) is an assertion made by a speaker S. If S asserts the truth of (1b), then S does not assert the truth of (1b) by doing so. If S does not assert the truth of (1b), then S does assert the truth of (1b) by doing so. Self-contradiction.

(1c) is a negative order, i.e., a forbiddance addressed by a speaker S to a hearer H. If H obeys (1c), then H does not obey (1c) by doing so. If H does not obey (1c), then H does obey (1c) by doing so. Self-contradiction.

(1d) is a negative assertion made by a speaker S. If H asserts (1d), then H does not assert S by doing so. If H does not assert (1d), then H does not assert (1d) by doing so. Self-contradiction.

[1] A clear-cut difference is to be made between affirmation and assertion, the former being an arbitrary yes-answer, while the second expresses a commitment by the speaker about the truth of the sentential content; symbolically, in any speech-act of the form $F(p)$, affirmation is the value 1 in $\mathbf{a}_i(p) = 1$, whereas assertion is T in $F(p) = T(p)$. The main difference lies in the felicity conditions associated with affirmation and assertion: the latter requires what Searle called a "direction of fit" from word to world, whereas affirmation requires no such direction of fit because of its being a purely subjective act.

(1e) is an interrogative version of (1b), addressed by a speaker S to a hearer H. If H answers "yes" to (1e), then H answers "no" to (1e) by doing so. If H answers "no" to (1e), then H answers "yes" to (1e) by doing so. Self-contradiction.

What makes the statements (1a)–(1e) pragmatically self-contradictory is their illocutionary force F, both affirmed and denied by the speaker in the form $F(p) \wedge \neg F(p)$. Each of these various speech-acts includes a sentential content p, whereas the whole statement $F(p)$ combines the sentence p and an illocutionary force F. The self-referential import of their pragmatic contradiction can be rendered by an illocutionary version of the Tarskian equivalence scheme, such as

(SR) $Sr(p) =_{df} (p \leftrightarrow Fp)$

Replacing the general force-indicator F by its instantiations of order O, assertion T, and affirmation A in (1a)–(1e), an application of (SR) can be formalized by showing a peculiar link between the negative *iteration* of F and its *distribution* over conjunction.

(1′) a. $O\neg Op \leftrightarrow O\neg p \wedge \neg O\neg p$
b. $T\neg Tp \leftrightarrow T\neg p \wedge \neg T\neg p$
c. $O\neg Op \leftrightarrow O\neg p \wedge \neg O\neg p$
d. $T\neg Tp \leftrightarrow T\neg p \wedge \neg T\neg p$
e. $A\neg Ap \leftrightarrow A\neg p \wedge \neg A\neg p$

The left-hand side of (1′a)–(1′e) brings out the systematic self-contradictoriness of self- referential statements, $F\neg Fp$, while the right-hand side expresses their contradictory conjuncts, Fp and $\neg Fp$. How to account for these logical equivalences, $F\neg Fp \leftrightarrow F\neg p \wedge \neg F\neg p$? An answer to this question can be given through a general formal framework, provided that three main biases be clearly identified and discarded as to the relationship between logic and linguistics. The first bias is that logical negation is reducible to linguistic negation, whereas the converse does not hold. The second bias is that logical negation is a truth-functional operator applied to truth-values. The third bias is that negation has essentially to do with exclusion and incompatibility. A way to depart from these assumptions is to illustrate an application of our formal semantics to the following "non-logical" negations, where parenthetical contents make explicit what is meant by the statements preceding them:

(1) Pragmatic contradictions (see (1a)–(1e) above)	
(2) Julie is *not* beautiful (She is ugly.)	Neg-raising
(3) Julie is *not* beautiful (She is gorgeous.)	Litote
(4) Julie is rather beautiful (She is *not* really beautiful.)	Implicature
(5) Julie is *not* beautiful (I do *not* know any Julie.)	Presupposition
(6) Julie is *not* odd (She is *not not*-odd, either.)	Category mistake

3 A Formal Semantics of Questions–Answers

The semantic framework we propose to make sense of "linguistic negations" is **QAS**. This formal semantics includes a set of correlated questions–answers with a finite number of *non-Fregean* values, assuming that the meaning of any object is given by *yes–no* answers to corresponding questions about its relevant properties.

3.1 Meaning as Predication

The reason why our suggested logical values are not "Fregean" is because of our amendment of Frege's theory of sense and reference [2]. Taking an arbitrary meaningful object ξ, its *sense* $\mathbf{Q}(\xi)$ is given by a set of relevant questions assigning properties to it or not; its *reference* $\mathbf{A}(\xi)$ is the resulting set of such answers to corresponding questions, either by means of yes- or no-answers.

Now the capacity to give answers relies upon several context-dependent parameters (who, what, when, how), so that an object appears to be a set of superposed questionings. Take this table on which I am writing now, as an example. It is a meaningful object whose meaning is given by a set of standing properties. But how these properties are made standing ones depends upon context-dependent features like its properties in space and time, as well as the speakers able to deal with it as a matter of fact.[2]

Take the speech-act of assertion, where the speaker asserts the truth of the declared sentence. A truth-value is normally assigned to the latter: truth, if the speaker succeeds in making his point, or falsity otherwise, as a mark of infelicity. But where does a truth-value come from, and how can the speaker have a control on the so-called direction of fit from word to world required by Searle to satisfy the felicity condition of the whole assertion? Moreover, sentences are used to include qualitative and quantitative data when they express words like modal or existential quantifiers. In both cases, *scalar quantification* can be resorted to as a technical device to express how a property relates to an object. Thus, quantification tells something about how often, how many, or how long a predicate is said to be true of a subject in a given sentence. Once the description is made exhaustively within a complete sentence, the so-called "truth-value" is a second-order property assigned to it through a normative assent, by the speech-act of assertion $Fp = Tp$: "p is true." Now who is entitled to make such an assignment, if not a set of speakers directed by a common rule of agreement within a social community? Unless the latter believes

[2] We will not address the issue of the difference between *types* and *tokens*, related to the difference between particular and general terms. That this table differs from the concept of table has to do with spatiotemporal and subjective features; yet this does not make general terms something else than generalized attributes based on common norms of meaning. The question–answer game always lurks behind predication, at any rate.

in a Fregean “third realm” of objective entities, truth-values are nothing but abstract things like Frege’s propositions (*Gedanken*) whose assertive force depends upon the degree of abstraction of the correlated sentence. If we are saying right here, “truth” expresses the act of assent or assertion about a given predication (“yes, ξ is so-and-so”), while “falsity” expresses the contrary act of dissent or rejection (“no, ξ is not so-and-so”). But the justification of such second-order properties as material truth and material falsity is not pre-established and can be updated afterward.[3]

3.2 An Algebraic Logic of Term-Oppositions

QAS is about a first-order language $\mathfrak{L}$, i.e., a set of sentences whose meaning is specified by non-Fregean logical values. But sentences are not the basic vehicles of meaning in this first-order language, and a free ontology is interpreted in terms of bare *terms* (either individuals or concepts).

We take $\mathfrak{A} = \langle\{\mathbf{Q}, \mathbf{A}\}, \{1, 0\}, \{-, \sqcap, \sqcup, \sqsubset\}, \{\top, \bot\}, \mathsf{op}\rangle$ to be an algebraic model for $\mathfrak{L}$.

The first pair $\{\mathbf{Q}$,$\mathbf{A}\}$ contains the question- and answer-functions: $\mathbf{Q}$ is an interpretation function assigning a finite set of n questions to an arbitrary object ξ of $\mathfrak{L}$, such that this object is to be defined as $\mathbf{Q}(\xi) = \langle \mathbf{q}_1(\xi), \ldots, \mathbf{q}_n(\xi)\rangle$; $\mathbf{A}$ is a value function assigning a logical value, viz. a finitely ordered set of n answers to the ordered set of questions $\mathbf{Q}(\xi)$ such that $\mathbf{A}(\xi) = \langle \mathbf{a}_1(\xi), \ldots, \mathbf{a}_n(\xi)\rangle$ individuates the object ξ in a sentence p.

The second pair $\{1$,$0\}$ corresponds to the single Boolean values assigned to the predications of ξ, i.e., 1 for yes-answers and 0 for no-answers (where $1 > 0$).[4]

The third pair $\{-, \sqcap, \sqcup, \sqsubset\}$ is a set of Boolean constants connecting objects ξ, ζ together inside an arbitrary sentence p. The unary operator $-$ is complementation such that, for any single value, $\mathbf{a}_i(\xi)$, $-(\mathbf{a}_i(\xi)) = 0$ if and only if $\mathbf{a}_1(\xi) = 1$. The other three constants are binary operators: intersection $\sqcap$, such that $\mathbf{a}_i(\xi \sqcap \zeta) = min(\mathbf{a}_i(\xi), \mathbf{a}_i(\zeta))$, i.e., taking the minimal value among $\mathbf{a}_i(\xi)$ and $\mathbf{a}_i(\zeta)$; union $\sqcup$, such that $\mathbf{a}_j(\xi \sqcup \zeta) = max(\mathbf{a}_j(\xi), \mathbf{a}_j(\zeta))$, i.e., taking the maximal value among $\mathbf{a}_i(\xi)$ and $\mathbf{a}_j(\zeta)$; and inclusion $\sqsubset$, such that $\mathbf{a}_i(\xi \sqsubset \zeta) = 1$ iff $\mathbf{a}_i(\zeta) = 1$ whenever $\mathbf{a}_i(\xi) = 1$.

The fourth pair $\{\top, \bot\}$ corresponds to the two constant values of truth and falsity assigned to sentences, where top is a set of exclusively affirmative answers and $\bot$ is a set of exclusively negative answers. Thus, $\mathbf{A}(p =$ “ξ is ζ'') $= \top$ iff $\mathbf{a}_i(\xi \sqsubset \zeta) = 1$ for every $\mathbf{a}_i$, while $\mathbf{A}(p =$ “ξ is ζ'') $= \bot$ iff $\mathbf{a}_j(\xi \sqsubset \zeta) = 0$ for every $\mathbf{a}_i$.

[3] The object ξ is the grammatical subject of any sentence p rather than the usual individual variable x, because we do not assume any ontological hierarchy between simple and complex objects. Our semantics is holistic, imposing no total ordering between objects and their properties.

[4] We stick throughout to the binary values 1 and 0, because our quantified view of sentences skips the intermediary sort of answer: abstention, which stands between assent and dissent.

Finally, op is a class of opposite-forming operators characterizing various relations of opposition Op between any two objects ξ and ζ, such that $\mathsf{Op}(\xi, \zeta) = \mathsf{Op}(\xi, \mathsf{op}(\xi))$. “Opposition” is meant in the broad sense of difference throughout the chapter, given that any two objects are made different with each other by being opposed with respect to *at least* one single property. The number of relations between objects exceeds the well-known Aristotelian relations of opposition, by including the additional case of logical *independence*. Our definitions are given by purely Boolean operations applied, not to sentences (as oppositions are traditionally understood), but to objects.

Contrariety: ct
$\zeta \sqsubset \mathsf{ct}(\xi)$ iff $\mathbf{A}(\xi) \sqcap \mathbf{A}(\zeta) = \bot$ and $\mathbf{A}(\xi) \sqcup \mathbf{A}(\zeta) \neq \top$

Contradiction: cd
$\zeta \sqsubset \mathsf{ct}(\xi)$ iff $\mathbf{A}(\xi) \sqcap \mathbf{A}(\zeta) = \bot$ and $\mathbf{A}(\xi) \sqcup \mathbf{A}(\zeta) = \top$

Subcontrariety: sct
$\zeta \sqsubset \mathsf{sct}(\xi)$ iff $\mathbf{A}(\xi) \sqcap \mathbf{A}(\zeta) \neq \bot$ and $\mathbf{A}(\xi) \sqcup \mathbf{A}(\zeta) = \top$

Subalternation: sb
$\zeta \sqsubset \mathsf{sb}(\xi)$ iff $\mathbf{A}(\xi) \sqcap \mathbf{A}(\zeta) = \mathbf{A}(\xi)$ and $\mathbf{A}(\xi) \sqcup \mathbf{A}(\zeta) = \mathbf{A}(\zeta)$

Logical independence: id
$\zeta \sqsubset \mathsf{id}(\xi)$ iff $\mathbf{A}(\xi) \sqcap \mathbf{A}(\zeta) \neq \bot$ and $\mathbf{A}(\xi) \sqcup \mathbf{A}(\zeta) \neq \top$

How many oppositional relations there can be depends upon the number of operations that can be made with such Boolean operands. It is worthwhile to note that subalternation is not a basic relation, in the light of its above definition: it is not defined in terms of truth $\top$ and falsity $\bot$; rather, it is depicted in terms of one object being contained or included into another one.

3.3 A Three-Dimensional View of Logical Values

Be this as it may, our suggested semantics requires a revision of logical values as structured referents of meaningful entities (let these be individuals, predicates, or sentences).

In **QAS**, logical values are three-dimensional objects combining three dimensions of meaning. The first, *predicative* dimension is introduced by questions and corresponds to a finite set of properties assigned to the object ξ, in a sentence of the form “ξ is ζ.” The second, *judicative* dimension is a finite set of answers to the predicative questions. The third, *indexical* dimension is a finite set of parameters w at which properties are assigned and according to where, whom, or when a predication is made.

We already referred to the pair of yes- and no-answers, but other intermediary answers could be devised: just as indeterminacy has been introduced in many-valued logics as a third three-value between truth and falsity, "maybe" could be equally introduced as a third answer between "yes" and "no." However, there are at least two reasons not to do so. On the one hand, the bivalent framework of yes–no answers is made sufficient by taking quantified parameters into account. On the other hand, we assume the existence of two sorts of rejection: a *strong* one, where the speaker asserts the truth of a negative sentence and thereby gives a yes-answer to the question whether a given sentence is false, and a *weak* one, where the speaker does not assert the truth of any sentence, whether affirmative or negative. In order to do justice to this twofold aspect of rejection (or denial), we take the meaning of any sentence p to be a two-faced questioning: the speaker affirms (or not) that the property ζ is true of ξ, so that we have $\mathbf{a}_1(p) = 1$ (or 0) in **QAS**; but also, the speaker may affirm (or not) that the property ζ is not true (i.e., is false) of ξ, so that we have $\mathbf{a}_2(p) = 1$ (or 0) in **QAS**.

The threefold dimension of logical values (see Fig. 1) can be dramatized as follows. Let $\mathbf{A}(\xi) = \langle\langle 110100\rangle, \langle 011011\rangle, \langle 110011\rangle\rangle$, where ξ is to be defined by strict yes–no answers to six ordered predicates $\mathbf{a}_1(\xi), \ldots, \mathbf{a}_6(\xi)$ within three bracketed parameters w_1, w_2, and w_3 for each of them. Each of the three dimensions of meaning is not independent from one another: the judicative dimension corresponds to single answers given to every question from the predicative question; the indexical dimension corresponds to "questions in the questions," viz. a set of ordered quantitative questions in each qualitative question from the predicative dimension (see the definition of $\mathbf{a}_j(\xi)$ in Fig. 1). These quantitative questions may be also split into several parameters w_1, w_2, and so on (one for quantifying over subject-terms ξ in p, another one for quantifying over predicates ζ in p; and the like). For the sake of simplicity, these various parameters may be reduced to a unique normative set of properties holding for everyone, everywhere, and everytime. Nevertheless, some part of quantified data cannot be eliminated without weakening the relevance of information. Borrowing from works by Barwise and Cooper [1], Smessaert [13], and Romoli [9], a scalar quantification over the sentence p = "ξ is ζ" accounts for the number of parameters w: for *wh*om ξ is ζ (w_1: every speaker, most of the

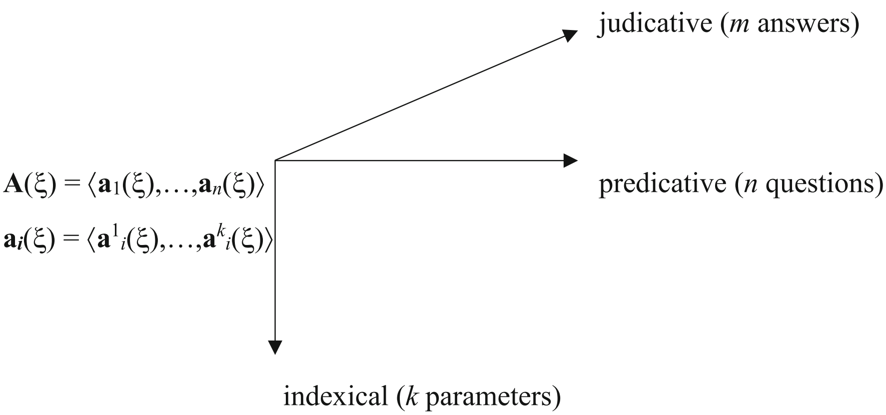

Fig. 1 The three dimensions of meaning (predicative, judicative, and indexical)

speakers, some speakers, no speaker), *wh*en ξ is ζ (w_2: everytime, most of the time, sometimes, never); *wh*ere ξ is ζ (w_3: everywhere, most of the places, somewhere, nowhere).

4 Applications

After describing our semantic framework of questions–answers, let us try to apply it to previous issues having to do with the various uses of negation in natural languages. These uses have been listed in the end of Sect. 2.2.

4.1 Self-contradiction as an Antilogy-Forming Negation

To begin with the case (1), a general explanation is that self-referential statements lead to iterated negative verbs that are self-contradictory. One question was about the reason why the logical equivalence $F\neg Fp \leftrightarrow Fp \wedge \neg Fp$ prevails. It is so because, by virtue of (Sr), speakers S express an illocutionary force F upon a sentence p which includes the force F itself. Thus, "S F-es that p" is equivalent with "S F-es not to F that p," e.g., "S forbids that p" means the same as "S forbids not to forbid that p" whenever p means "p is forbidden" through the illocutionary force of forbiddance (i.e., negative obligation). Roughly speaking, our illocutionary treatment of self-reference is to the effect that the speaker both affirms and denies something of a given sentence p. Importantly, the resulting self-contradictoriness only obtains when the verb expressing an illocutionary force has a *negative* import: forbidding (as not enabling), doubting (as not believing), ignoring (as not knowing), forgetting (as not remembering), hating (as not loving), and the like.

A formal analysis of self-reference in **QAS** runs as follows. In all these cases, the speaker does what she also denies to do through a yes-answer and a no-answer, respectively. Thus, for every statement Fp about a sentence p, both a yes- and a no-answer are given to a question $\mathbf{q}_i(p)$ about p; the illocutionary negation $\neg Fp$ applied to the illocutionary force F thereby leads to a self-contradictory *yes-and-no* answer $\mathbf{a}_i(p) = \{1, 0\}$, rather than a contradictory-forming operator that corresponds to classical sentential negation. Through the expression of negative verbs and negative answers, it clearly appears that antilogy is a *metalinguistic* negation in **QAS**. Each utterance of p includes both basic and opposed acts of affirmation and denial, affirmation being a yes-answer $\mathbf{a}_i(p) = 1$ and denial being a no-answer $\mathbf{a}_i(p) = 0$. Returning to the statement (1e) (see Sect. 3.2), the illocutionary force of affirmation A occurs as a "meta-speech-act," which goes beyond the special case of assertion and any of Searle's five classes of speech-acts (see note 2). It is so, because a speaker always affirms or denies to do something with a sentence and, for a given purpose, the result being a statement Fp by means of a sentence p.

And yet, another analysis of self-reference had been proposed by Parsons [8] with a sensibly different result. According to the author, the statement (1b) “This sentence is false” is not self-contradictory once a proper view of denial is made. For this purpose, Parsons endorses a *rejectivist* view of negation: rejection need not entail assertion, as we already mentioned in a weak sense of denial (see Sect. 4.3). More generally, rejectivism states that negation has to be explained in terms of rejection but not conversely. This entails that the illocutionary aspect of negation as a speech-act is semantically prior to the locutionary constant of negation. Borrowing from our symbolism of **QAS**, we agree with Parsons [8] that there can be two possible views of rejection (or denial). The first is strong rejection, according to which *every* no-answer to the sentential question about p (i.e., whether ξ is ζ) is a yes-answer to the sentential question about $\neg p$. In symbols,

(StrongR) $$\forall \mathbf{a}_i(\xi) : \mathbf{a}_i(\xi) = 0 \text{ iff } \mathbf{a}_i(\neg\xi) = 1.$$

The second is weak rejection, according to which the speaker may deny p without asserting $\neg p$ for all that. In symbols,

(WeakR) $$\exists \mathbf{a}_i(\xi) : \mathbf{a}_i(\xi) = \mathbf{a}_i(\neg\xi) = 0.$$

Now, Parsons argues [8] that self-contradiction is avoided in a weakened version of the Liar:

(1b$''$) This sentence is denied.

The gist of his argument concerns the distinction between denial and assertion: although Tarski’s scheme states a logical equivalence between the occurrence of p in a model and its truth: $p \leftrightarrow Tp$, this does not seem to hold with denial since the latter does not assert anything. If so, then the self-referential sentence $p \leftrightarrow Fp$ does not lead to a speech-act where $p \leftrightarrow Fp \leftrightarrow T\neg p$ but, rather, $p \leftrightarrow Fp \leftrightarrow \neg Tp$. Initially, our formal analysis of (1b) entailed that a self-referential reading of $F\neg Fp$ would be equivalent with $Fp \wedge \neg Fp$, i.e., $T\neg p \wedge \neg T\neg p$. But if the self-denied p is interpreted in the weak sense of $p = \neg Tp$, then (1b$'$) does not include $T\neg Tp$ any longer and, therefore, cannot result in the self-contradictory form of words $T\neg Tp \wedge \neg T\neg Tp$. In conclusion, Parsons claims [8] that a proper reading of denial helps to block the introduction of truth by avoiding the Tarskian equivalence scheme between a sentence and its *assertion*. Here is an illocutionary treatment of the Liar Paradox, in its weakened version (1b$'$).

Against Parsons, we argue that rejectivism is not a sufficient condition to avoid self- contradiction hereby: none of (1a)–(1e) escape to it by combining two opposite speech-acts, whether these include assertion or not. Let A be one interpretation of the force-indicator F that corresponds to the *meta*-speech-act of affirmation (yes-answer). Then, an illocutionary version of Tarski’s scheme is reintroduced by saying that each sentence of a language is affirmed as such: $p \leftrightarrow Ap$. If so, then denying p entails that the self-referential $p = \neg Ap$. Therefore, $A\neg Ap \leftrightarrow Ap \wedge \neg Ap$. Contradiction comes again, so that $\mathbf{a}_i(p) = \{1, 0\}$ cannot be avoided once the distinction between assertion and affirmation is taken into account.

In the following sections, a variety of logical analyses is derived from the same initial sentence $\neg_x p$: “Julie is not beautiful,” where $\neg_x$ symbolizes one unary operator of negation among several ones. The pragmatic feature will result in slightly altered explanations in the use of negation “not.”

4.2 Neg-raising as a Contrary-Forming Negation

A very different aspect of negation is proposed in the other expressions of negation, above blatant cases of contradiction. In (2), negation corresponds to what linguists call by “neg- raising” and what **QAS** renders as a case of non-standard negation. Take the sentence “Julie is *not* beautiful.” According to the neg-raising interpretation of negation, such a sentence is taken to mean the same as “Julie is not beautiful, i.e., Julie is ugly.” In other words, this class of sentences amounts to a negative assertion by conflating negative predicates (is not beautiful) and negative predicate terms (is not-beautiful). By doing so, neg-raising cancels any intermediate property between mediate contraries between beauty and ugliness.

A linguistic analysis of neg-raising can run as follows: negating explicitly produces an emphatic effect of assertive commitment rather than a non-committal rejection or absence of judgment by the speaker. The above example can be compared with the attitude of disbelief as a non-doubt: by saying “I do *not* believe that God exists,” I express more than a mere doubt about the existence of God insofar as I also believe that God does *not* exist. Therefore, external and internal negations are made equivalent in such a statement.

A logical analysis, in the light of **QAS**, is to the effect that neg-raising is not a contradictory-forming but, rather, a *contrary*-forming operator. A proper valuation of neg-raising relies upon the quantitative dimension of logical values, by means of a scalar quantification over how beautiful Julie is. In (2), a unique property ζ is assigned to the object ξ named Julie in a given sentence p, i.e., that Julie is beautiful. The property of being beautiful is not merely denied by the speaker, who is also taken to assert $\neg_1 p$ = “Julie is *really*-not beautiful.” The difference between these i scales or degrees of beauty corresponds to a set of quantitative judgments, in the indexical dimension our three-dimensional picture (see Sect. 3.3).

$\mathbf{q}_1^1$ = “is ξ very beautiful?” $\mathbf{q}_1^2$ = “is ξ merely beautiful?”
$\mathbf{q}_1^3$ = “is ξ not very beautiful?” $\mathbf{q}_1^4$ = “is ξ really not beautiful?”

A partial valuation p can be made with respect to this scalar quantification: $\mathbf{A}(p) = 1100$ and $\mathbf{A}(\neg_1 p) = 0001$. Hence, $p \sqsubset \mathsf{ct}(\neg_1 p)$, given our definition of contrariety (see Sect. 3.2).[5]

[5] The same distinction can be made between truth-values in the field of many-valued logics, when a number of grades is made between plain truth and plain falsity. In such cases, a sentence may be neither true nor false just as Julie might be neither beautiful nor ugly in a plain sense of these words.

4.3 Litote as a Superalternation-Forming Operator

A quite different meaning of negation occurs in the following, currently mentioned by linguists in order to show that logical negation is unable to render the variety of negative expressions in natural languages. Far from expressing incompatibility as is usually the case with negation, (3) negates something of ξ while letting such an operand compatible with the resulting opposed term of being gorgeous. More precisely, the relation between the predicates "beautiful" and "gorgeous" corresponds to an ordered relation of *superalternation* between a general class of gorgeous objects and one of its subparts, beautiful subalterns: every gorgeous girl is also a beautiful girl, whereas the converse need not hold.

A linguistic analysis of (3) is that negation helps to express insufficiency, rather than incompatibility: some property like beautifulness is not enough to give an adequate description of Julie, according to the speaker who denies without asserting that Julie is not beautiful *at all*. From our logical point of view, the use of negation as a litote makes the former a compatibility-operator of reverse superalternation such that "not beautiful" means "not-only beautiful." Recalling that p stands for "Julie is beautiful," the sentence expressed in (3) is not the previous $\neg_1 p$ but, rather, the other sentence $\neg_2 p$: "Julie is *not* beautiful" as equivalent with the quantified "Julie is *not-only* beautiful" or "Julie is more than beautiful." The ensuing exclusion of being merely beautiful entails that $\mathbf{q}_1^2(p) = 0$, so that $\mathbf{A}(p) = 1100$ while $\mathbf{A}(\neg_2 p) = 1000$, and hence $p \sqsubset \mathsf{sp}(\neg_2 p)$ (superalternation sp being the *converse* of subalternation, such that $\mathsf{sp} = \mathsf{sb}^{-1}$).

4.4 Implicature as a Subcontrariety-Forming Operator

Implicature is a famous phenomenon of linguistic negation, according to which there is something wrong or misleading in a purely logical analysis of negation. As a matter of fact, scalar implicature proceeds as a pragmatic operator departing from logical implication. In **QAS**, implicature denies a given sentence in a specific way related to the second dimension of meaning as quantification over predicates. By this way, implicature is a quantified negation whose import is to *minimize* or tamper the truth of an affirmative sentence. More abstractly, scalar implicature over (4) denies the highest quantification applied to the property of being ξ for ζ in any sentence p.

A linguistic analysis of (4) is closely related to Grice's Maxim of Quantity, assuming that the meaning of a sentence should be as informative as possible in a conversational context [3].[6] Unlike litote, such an explanation is to the effect that

[6] See Grice [3: 45]: 1. Make your contribution as informative as required (for the current purposes of the exchange). 2. Do not make your contribution more informative than is required.

the speaker does not want to assign the greatest scale of predication by denying at all.

A logical analysis of scalar implicature in **QAS** is that the former requires a bitstring valuation of sentences to be as precise as possible. By application of the latter, it follows that implicature behaves as a *subcontrariety*-forming operator that does *not* rule out the truth of the sentence p by negating it. Indeed, "being not really" excludes the highest scale of being gorgeous while including some lower scales or degrees of beauty at once. This double process of exclusion and inclusion can be merely accounted for by our ordered set of bits, which is a fine-grained valuation of sentences going beyond the unidimensional domain of plainly truth or false sentences. So if p stands for "Julie is beautiful," i.e., $\mathbf{A}(p) = 1100$, then its implicature is expressed by "Julie is rather beautiful," which is equivalent to the sentence $\neg_3 p$: "Julie is not-really beautiful." Hence that $\mathbf{A}(\neg_3 p) = 0111$, and $p \sqsubset \mathsf{sct}(\neg_3 p)$.

4.5 Two Metalinguistic Negations: Presupposition and Category Mistake

It is usual to say that metalinguistic negation is on a par with the so-called "external" negation $\neg_x$, as, e.g., in the statements introduced by negative expressions "it is not the case that …." But different meanings may be provided by it, and however, the classical, contradictory-forming negation $\neg_0 p$ embedded into "Julie is *not* beautiful" is not meta-linguistic, whereas there may be some more ambiguous meanings behind the broader "It is not the case that Julie is not beautiful."

Roughly speaking, negation can be said to be metalinguistic whenever it does not appear in the object language but, rather, strictly concerns the meta-language and does not proceed as a mapping function like $\neg_x$. Two examples of metalinguistic negations (symbolized by "not-") will be given in the following section, namely, presuppositional negation and negation as a category mistake.

In (5), "Julie is not beautiful" has no entailment about how beautiful Julie is because the speaker ignores who Julie is. In Russell's famous "The present king of France is not bald," negation was not applied internally to the predicate but externally, i.e., to the existential quantifier of the logical translation "There is a x such that x is a king of France and x is bald"; likewise, the statement "Julie is not beautiful" has no corresponding value in **QAS** when the speaker goes on saying "Indeed, I do not know any Julie." After all, how could the latter individuate the object ξ if he has never heard about thus far? In other words, the case of presuppositional negation can be compared to a failure of Frege's criterion of consideration, when the speaker conceives an object by attaching a predicate to it. The previous case of (#5) amounts to a case where this precondition is not satisfied, so that no set of questions–answers is used by the speaker to think about ξ. The resulting sentence not$_1$-p: "ξ is not ζ" does not make sense for the questioner, accordingly, just as the question whether the present king of France is bald cannot make sense if there is none. Therefore, $\mathbf{Q}(\text{not}_1\text{-}p) = \varnothing$, and, hence, $\mathbf{A}(\text{not}_1\text{-}p) = \varnothing$ for *at least one* speaker S of the third indexical dimension of meaning for p.[7] The difference between Russell's famous example and ours, however, is that meaninglessness does not stem there from the same domains of reference: Russell's world is the real, one-sided, and objective world of facts, while our world is the social, many-sided, and intersubjective (or context-dependent) world of speakers. There is no individual to be ranged over by a quantifier, in Russell's paraphrase; there is no object to be questioned, in our interrogative model of **QAS**. Keeping in mind the non-classical valuation of Russell's "The present king of France is bald" in Strawson [14], bivalence also fails at the metalinguistic level of single yes–no answers for want of available questions about the quoted object.

The second example of metalinguistic negation is slightly different from (5), insofar as the object to be specified by a finite of questions is entertained by the speaker. In (6), the property of being beautiful is replaced by being odd and the initial sentence p is thereby replaced by a quite other sentence $\text{not}_2\text{-}p$: "Julie is odd." Furthermore, we assume that the speaker considers Julie and can define her by a number of properties, but the property expressed there (being odd) stands *outside* the lexical field of relevant predicates to individuate Julie in the first, predicative dimension of meaning. Such an explanation of meaninglessness leads to the effect as (5) but does not come from the same cause: (5) was a case in which there is no object ξ to be questioned with the predicate ζ for at least one (but not every) speaker S, whereas (6) is a case in which there is *no* such predicate ζ to be used to question what the object ξ is for every speaker S of the third, indexical dimension of meaning.

The linguistic (Neg) and metalinguistic (MNeg) kinds of negation can be rendered by the same explanation, as follows:

(Neg) For every $\mathbf{A}(p) : \mathbf{A}(\neg_x p) \neq \mathbf{A}(p)$
(MNeg) For every $\mathbf{a}_i(p) : \mathbf{a}_i(not_x\text{-}p) = \varnothing$

Therefore, both the sentences $\text{not}^1\text{-}p$ = "Julie is not beautiful" (under presuppositional negation) and $\text{not}_2\text{-}p$ = "Julie is odd" have no value at all in **QAS**: $\mathbf{A}(\text{not}_1\text{-}p) = \mathbf{A}(\text{not}_2\text{-}p) = \varnothing$ The above various negations of p = "Julie is beautiful" can be displayed into one common set of logical oppositions or mere differences, the multiple occurrence of "not"-expressions being clearly expressed to account for the complex meaning of linguistic negations, while litote is not explicitly negative. It results in a logical octagon of linguistic oppositions (see Figs. 2 and 3), including the linguistic negations $\neg_x$ and their corresponding logical values.

[7] Notice that $\varnothing$ is a "non-value" (the failure of a value) that amounts to a *non-answer* and thereby differs from absolutely negative answer, $\perp$.

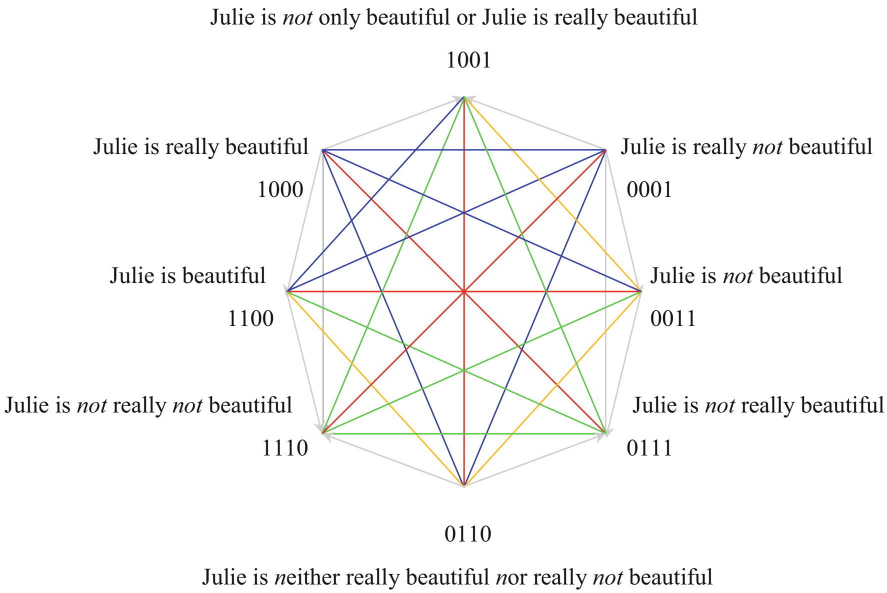

Fig. 2 The lexicalized negations of p = "Julie is beautiful" (blue lines: contrariety; red lines: contradiction; green lines: subcontrariety; arrowed gray lines: subalternation; and orange lines: independence)

5 Affixal Negations

It is taken for granted that not every negation is a sentential operator, as witnessed in the present paper. The difference is thus made in the area of logic between so-called "sentential" and "term" logics. Again, our three-dimensional theory of meaning helps to produce a unified theory of negation in **QAS** without stressing upon the syntactic difference between sentential and term negations. And just as there may be different sentential

negations, there may be different meaning of affixal negation. Let us start with a definition of this categorical term negation, before entering into more detail about their different meanings.

5.1 Definition

By an *affixal* negation, we mean in **QAS** a special opposition-forming operator on *concepts* (or predicate terms), rather than sentences. A scrutinized survey of affixal negations has been made in, e.g., Joshi [6], wherein a basic distinction has been made between direct and indirect negations (following the work of Jespersen [5]). Joshi [6: 53] also referred to Horn [4] to make sense of such a distinction:

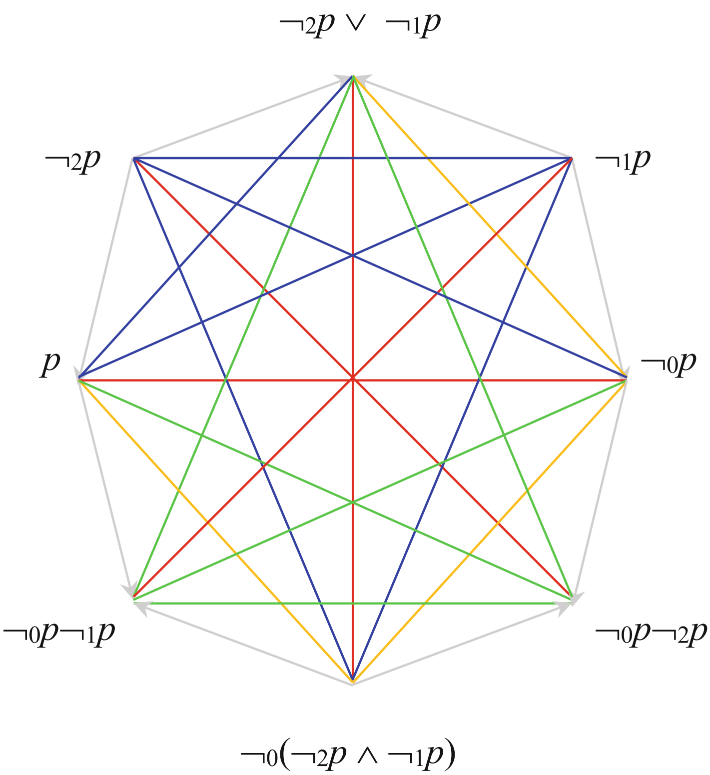

Fig. 3 The oppositional relations between p and its negations

> "The laws of negation as defined in the Aristotelian approach (as cited by Horn [4]) is based on two criteria: Laws of Contrariety (LC) and Law of Excluded Middle (LEM).
>
> The type of negation that obeys both of these laws is termed as 'contradictory' (for example, alive/dead) and the one that obeys only the LC but not the LEM, is termed as 'contrary' (for example, hot/cold). (. . .) The grouping of affixal negation into 'direct' and 'indirect' encompasses these two types of negation."

Then, the author proposes a list of affixal negations in a number of natural languages, including French (dire/*mé*dire, politique/*a*politique, obéir/*dés*obéir, actif/*hyper*actif, parler/*dé*parler, conseiller/*dé*conseiller, faire/*dé*faire) and English (famous/*in*famous, happy/*un*happy, construe/*mis*construe, normal/*sub*normal, matter/*anti*matter). Needless to say that negation is taken in a broad sense of the word when affixal negation is at hand. A non-exhaustive taxonomy of these is attempted by Joshi [6: 55], according to the various functions of these affixes (fr. for French, eng. For English): reversal of action (tie/*un*tie, eng.), inferiority (tension/*hypo*tension, eng.-fr.), insufficiency (normal/*ab*normal, eng.), badness or wrong (conduite/*m*´conduite, fr.), overabundance (active/*hyper*active, eng.-fr.), pejorative (drunk/drunk*ard*), opposition (terrorist/*anti*-terrorist), removal (bud/*de*bug).

We can consider logically at least three kinds of affixes in the above list, throughout its enumeration of context-dependent functions: (i) *modal* affixes, where affixes correspond to modes of judgment or moral assessments (e.g., *mé*dire, fr.), (ii) *dynamic* affixes, indicating a change of state within a temporal process (e.g., *un*tie, eng.), and (iii) *scalar* affixes, consisting in a gradation of differences for a common property (e.g., *hyper*calorique, fr.). Just as we argued from the outset that every linguistic negation is a proper logical negation with various constraints on sentences, it makes sense to say anew that every affixal negation is a proper logical negation with various scalar quantifiers on predicate terms. Unlike sentential negations, everything happens in the third dimension of meaning with affixal negations. In the light of **QAS**, the following distinction between logical and linguistic negation is no more efficient as it seems to be for Joshi [6: 54]:

Indirect negation on the other hand is a bit more peculiar than this. Indirect negation is that type of negation which may not look a logical negation but is still a negation in terms of *connotation*.

Let us see now how a logical treatment of affixal negations can be made in **QAS**.

5.2 *Affixal Oppositions*

Affixal negations are properly logical negations only if they are treated as opposite-forming operators, rather than operators mapping on classical truth-values. In this respect, a short reflection leads to the same general result as with sentential sentences. Thus, the discrepancy between direct and indirect negations marks the difference between contradictoriness and the rest of oppositions: the former is only a contradictory-forming operator $\mathsf{cd}(\xi)$ attached to an initial predicate term ξ, whereas indirect negation can be either $\mathsf{ct}(\xi)$, $\mathsf{sct}(\xi)$, $\mathsf{sb}(\xi)$, or $\mathsf{sb}^{-1}(\xi) = \mathsf{sp}(\xi)$.

The simplest case is that of scalar affixes: "hyper," "hypo," "sub," "super," and the like. In all these cases, negation occurs as a subalternation-forming operator. For instance, 'hyperactive' entails being active while saying *more* than being merely active; actually, "hyper-" is a superalternation-forming operator such that (hyperactive $\sqsubset$ sp(active)), while "hypo-" is a subalternation-forming operator such that (hypoactive $\sqsubset$ sb(active)), among indefinitely many ways of quantifying the predicate inside the third, indexical dimension of meaning ("super-," "archi-," "mega-," and so on).

Likewise, modal affixes may introduce moral or deontic considerations into the meaning of predicate terms. Take the case of "médire" (fr.). On the one hand, it is a subalternation-forming operator: (médit) = sb(dit), since backbiting (*médire*) presupposes saying something (*dire*) and saying is a precondition of it (whoever "médit" thereby "dit" something). On the other hand, "médire" is opposed contrarily to "dire du bien," which is itself another subaltern of "dire." Therefore, we seem to have (médire) sb(dire), (médire) $\sqsubset$ ct(dire du bien), and (dire du bien) $\sqsubset$ sb(dire). But the following hexagon of oppositions based on the concept "dire" (see Fig. 4) shows that a deep confusion is made hereby between entailment and presupposition:

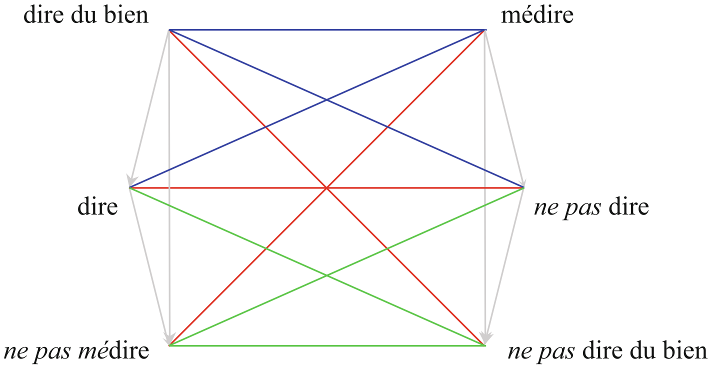

Fig. 4 A wrong hexagon of affixal negations around "dire" (Fr.)

For while it is true that the French-speaking contradictory of "dire" (saying) is "*ne pas* dire" (not saying), it is plainly wrong to conclude from it that "médire" entails "ne pas dire." Actually, both contrary concepts presuppose saying something just as the Russellian sentences presuppose the *existence* of their subject-term (see Sect. 4.5), or just as deontic statements presuppose the *occurrence* of a corresponding action to be assessed. The third, indexical dimension of meaning accounts for this semantic confusion by affording a set of restricted questions. To take the case of modal alethic sentences, at least three questions may be asked to make sense of such concepts as necessity, impossibility, and contingency; now in all these, the question whether the basic sentence p is the case (i.e., p is true) or not (i.e., p is false), and how often it is so (i.e., always, sometimes, or never), does not preclude the mere entertainment of p as a precondition for the meaning of p. In other words, the conceivability of p stands out of the range of questions, just as "saying" stands out of the range of questions to make sense of "médire" in **QAS**.

All this shows that a logical analysis of affixal negation requires a broader framework to account for the meaning of negation, beyond the sole occurrence of contradiction rendered by classical sentential negation. No univocal meaning can be assigned to affixal negations, correspondingly, and these should be used to afford a better description (rather than regimentation) of natural languages.[8]

[8] Joshi [6: 61] argues for this polysemy of affixal negations; but unlike us, he took any logical analysis for an a priori or normative account of operators like negation:
"One can observe that the groups 'direct negation' and 'indirect negation' are not mutually exclusive. An affix that forms a derivative of one type may also form a derivative of the other (e.g., the derivatives of the English prefix 'mis-': 'to *mis*fire' is the direct negation of 'to fire' (a gun), whereas 'to *mis*understand' is a case of indirect negation of 'to understand'. Hence it is not possible to predict a priori the distribution of the derivatives of a particular affix into the groups of direct or indirect negation."

6 Conclusion: The Three Dimensions of Meaning

Our general result is an analysis of negation in its linguistic occurrences. Three main results may be done to summarize our point.

Firstly, the three dimensions of any no-answer are the following:

(a) "No!" as an attitude of rejection. In **QAS**, it corresponds to a no-answer with the value 0 and is not an operator but, rather, an operand of the *judicative* dimension of meaning.
(b) "No" as a nil quantifier, i.e., a parameter that refers to the quantifying aspect of the *indexical* dimension of meaning and has to do with scalar quantification.
(c) "No?" as a negative sentence, which is a unary operator $\neg_x$ applied to a sentence in the *predicative* dimension of meaning and changing its logical value in a variety of ways.

Secondly, we identified three main ways of negating a linguistic expression as three distinctive operations in **QAS**. With self-referential expressions, yes- and no-answers are given to one and the same predication. With neg-raising, litote, and implicature, difference-forming operators are applied to a given sentence. With presupposition and category mistake, negation lies at the meta-level by excluding the predicate ζ of a sentence "ξ is ζ" from the range of relevant questions characterizing the sense of ξ.

Thirdly, such an analysis leads to a *rejectivist* account of negation. This means that assertion and denial are two independent speech-acts, while the mainstream or unilateral view of logic reduces all meaningful inferences to assertive acts. In a blatant plea for anti-rejectivism, Textor argued [15] that the negative expression "no" is nothing but a "pro-sentence" that merely serves as a placeholder for "it is not the case that ...." This rules out the *illocutionary* aspect of negation as a force-indicator of rejection. According to this view, denial is just negative assertion and every occurrence of (a)–(b) can be reduced to a classical use of (c). Against this perspective, our plea for rejectivism makes (a) independent from (b) and (c). Because of this prominent role of no-answers as independent acts in the analysis of negation, we want to revert Textor's argument and say that "not" is a pro-statement for "no" expressing the attitude of a speaker by means of an impersonal negative sentence. By extension, the connection between sentences and propositions is explained by the fact that a sentence plays the role of a *pro-position* in a dialogue, that is, the expression of what may come to be asserted ("yes, I assert p") or denied ("no, I deny p"). The further difference between "no, I deny p" and "yes, I assert p" cannot be made without rejectivism.[9]

True, all this may complicate the general depiction of negation. Now assuming that exhaustiveness primes over simplicity in any abstract theory, the plurality of negations does not entail the failure of its logical analysis.

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[9] For a reply against Textor's view [15] and for rejectivism, see, e.g., [11].

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