

Annotating Propositional Attitude Verbs and their Arguments

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Abstract

This paper describes the results of an empirical study on attitude verbs and propositional attitude reports in Italian. Within the framework of a project aiming at acquiring argument structures for Italian verbs from corpora, we carried out a systematic annotation that aims at individuating which verbs are actually attitude verbs in Italian. The result is a list of 179 argument structures based on corpus-derived pattern of use for 126 verbs that behave as attitude verbs. The distribution of these verbs in the corpus suggests that not only the canonical *that*-clauses, i.e. subordinates introduced by the complementizer *che*, but also direct speech, infinitives introduced by the complementizer *di*, and some nominals are good candidates to express propositional contents in propositional attitude reports. The annotation also enlightens some issues between semantics and ontology, concerning the relation between events and propositions.

Keywords: propositional attitude verbs, events, semantic types

1. Introduction

The object of this paper are propositional attitude reports, and precisely attitude verbs and propositional contents. Propositional attitude reports can be defined as sentences concerning cognitive relations people bear to propositions (see Nelson (2022) for an overview), such as:

- (1) a. Jean believes what you said.
- b. Jill hopes to be invited to the party.
- c. Jack knows you are lying.

By attitude verbs, we mean the verbs that express that relation. By propositional content (or simply proposition) we indicate the propositional argument of an attitude verb. Syntactically, they are typically expressed by a clause. Semantically, they depend on verbs expressing a relation between humans and propositions: a propositional content is prototypically a human’s mental representation, claim, assumption, question (Asher, 1987).

Traditionally, attitude verbs are identified in light of their behaviour concerning two puzzles (Pearson, 2015). The first is known as “Frege’s puzzle”, and concerns substitution failures with co-referring terms. For example, in sentences in the example (2):

- (2) a. John believes that Joe Biden is eating a sandwich.
- b. John believes that the President of the US is eating a sandwich.

it is clear that, even if the expressions Joe Biden and the President of the US refer to -at least at the moment we are writing - the same entity in the real world, (2-a) does not necessarily imply (2-b) - since John might not know that Joe Biden is actually the president of US. This is not true when the proposition is an independent clause, e. g. for verbs like *see* - ‘John saw Joe Biden’

logically implies ‘John saw the president of US’.

The second puzzle concerns the possibility to establish the truth value of a sentence with empty predicates, as in (3):

- (3) a. A unicorn is in the garden.
- b. Sally believes a unicorn is in the garden.

Indeed, *unicorn* is an empty predicate, which makes it puzzling to determine the truth values of (3-a). However, the non-existence of unicorns in the real world does not affect the truth value of (3-b), which can be true or false depending on the mental representations of Sally – not on whether unicorns do or do not exist in the real world.

Even though these puzzles cannot be considered as acceptability tests (at least in linguistic terms), observing the behaviour of verbs in these contexts has been useful to identify attitude verbs.

Thus, we used these puzzles to verify whether some verbs were actually attitude verb or not applying them as tests, in the format:

- TEST 1: “John **verb** that Joe Biden is eating a sandwich” entails “John *verb* that the president of US is eating a sandwich”? If yes, **verb** is an attitude verb.
- TEST 2: The truth value of “Sally **verb** that **NP** is in the garden” changes whether **NP** refers to an entity that does not exist in the real world? If not, **verb** is an attitude verb.

Coherent systems of classification of attitude verbs have been proposed based on their syntactic and semantic behaviour. Pearson (2015) considers as prototypical the classes of *think*-like, *say*-like and *want*-like verbs. White et al. (2018) provide a reliable overview of the literature, summing it up in a classification based on the intersection of binary semantic

features - namely: representational, preferential, factive, assertive, communicative, perception. We return on these features while discussing our data in section 4.

However, we believe that establishing which verbs are in fact attitude verbs is to some extent a language-specific issue, and thus it can be addressed in an empirical fashion. This is where our contribution to the debate is framed.

In this work, we approached the issue of propositional attitude reports in the context of an annotation task of typed predicate-argument structures of Italian verbs. The point where the issue arose was how to semantically annotate the propositional arguments of attitude verbs avoiding syntactic labels. We integrated our system of semantic types with a new label, [Proposition]¹. Then, since argument structures are acquired for more than 1100 Italian verbs, our purpose was to systematically annotate attitude verbs. The result of this process is a list of 179 argument structures based on corpus-derived patterns of use of 126 attitude verbs for Italian.

Based on our dataset of verbs and patterns of use involving propositions, it is possible to make some generalizations on the syntax and the semantics of propositional attitude verbs. In this paper, we overview the main syntactic configurations we found in the dataset, discussing why we consider them all as different syntactic realizations of the same semantic type for the argument - i. e. [Proposition]. The analysis of the lexical items that populate the arguments and the regularities in the alternation between different semantic types found in our patterns also provides supportive results towards the existence of the complex type (or dot type in Pustejovsky (1998)) Event • Proposition.

The paper is structured as follows. In section 2 we describe the methodology and the framework of the annotation process. Results and discussion of the annotation are provided in sections 3 and 4 respectively. In section 4.1 we discuss the classes of verbs we found; we discuss syntax issues in section 4.2 and semantics and ontology issues in sections 4.2 and 4.3 respectively. In section 5 we provide some concluding observations.

2. Annotation Framework

2.1. T-PAS

The annotation work is framed within the T-PAS project² (Ježek et al., 2014), a resource for Italian that provides argument structures annotated with the semantic type of the argument (Typed-Predicate Argument Structures). Argument structures appear as corpus derived patterns³, and they are obtained through a procedure called Corpus Pattern Analysis (Hanks,

¹We use square bracket notation for semantic types.

²<https://tpas.sketchengine.eu/>.

³Henceforth we are referring to these argument structures as patterns of use, or simply patterns.

2004) based on co-occurrence statistics of syntactic slots in corpus instances⁴.

The target corpus is a reduced version of ItWac (Baroni and Kilgarriff, 2006). An example of two patterns for the verb *guidare* ('to drive') is provided in Figure 1, in which the patterns, the sense descriptions, and some sentences that instantiate each pattern are reported⁵.

[Human] guidare ([Road Vehicle]) [Human] conduce, pilota ([Road Vehicle])
1. Si fa nuovamente appello agli automobilisti di guidare con estrema prudenza . 2. Questa volta il furgone era guidato da un estraneo , da uno sconosciuto . 3. Guidando in quelle condizioni avrebbe potuto causare una strage . 4. Guidavo io , di sicuro , perche Margherita non lo ha ancora fatto .
[Human1] guidare ([Human2]) [Human1] conduce, accompagna, mostra la strada a [Human2] precedendolo
1. Ciechi che guidano ciechi , sordi che sentono muti . 2. Allora la fidanzata mi guida fino al duomo dove nei pressi ci sono le Cantine Squarciafico . 3. Mi guidò l' avvocato torinese Attilio Begey , che mi fu confidente affettuoso per tutta la vita . 4. Una gentile signorina mi guidò in una stanza dicendomi : " Qui dovresti trovare qualcosa " .

Figure 1: Two patterns of the verb *guidare* ('to drive' in the first pattern, 'to guide' in the second), provided with sense description and corpus instances.

Patterns are intended to be sense-stable objects, i. e. sentences where all the words are disambiguated. Since they are acquired from a random sample of 250 instances for each verb, they should provide a reliable overview of all the attested meanings of the constructions of each verb.

Syntax is also encoded in the system, although it is not visible in figure 1. Syntactic slots are subject, object, prepositional complement and clausal complement, and each argument occupies one syntactic slot (e. g. in the first pattern in figure 1, [Human] is in the subject slot, [Road Vehicle] is in the object slot).

2.2. System of Semantic Types

The annotation of the semantic types is performed manually: the annotator chooses which semantic type better generalizes over the set of lexical items that populates each argument slot. Semantic types are thus corpus-driven categories. They are organized in a hierarchy based on IS-A ("is a kind of") relations - e.g. [Human] is a kind of [Animate]; [Animate] is a kind of [Physical Entity], etc. An extract of the system is reported in Figure 2.

2.3. The [Proposition] type

The issue of propositional attitude reports arises from the labelling of the arguments expressing propositional contents in sentences such as (1-a), (1-b) and (1-c), or, to give a real corpus example in Italian:

- (4) 'Pensavamo veramente che si avvicinasse un disastro.'⁶

⁴For an explanation of how the pattern extraction and the semantic annotation is done, see (Ježek et al., 2014)

⁵We use round brackets to signal optional arguments.

⁶We use quotes to signal real corpus examples.

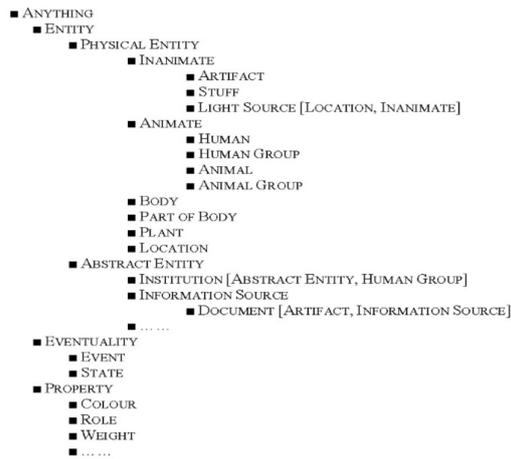


Figure 2: Top-level of the Semantic Type System with a selection of leaf types.

Eng: ‘We truly thought that a disaster was approaching.’

In T-PAS, each argument should be labelled with the correct semantic type from the system. Here the issue is to find the correct type for the propositional argument ‘che si avvicinasse un disastro’ (Eng: ‘that a disaster was approaching’).

First annotators (Ježek et al., 2014) alternatively used different strategies. One strategy way was to avoid the problem by applying labels whose definition was assigned on a syntactic basis. A type [Clause] was created and used for sentences introduced by complementizers. So, examples as (4) would have been generalized by patterns like:

- (5) [Human] pensare che [Clause]
Eng: [Human] think that [Clause]

Similarly, [Quote] was used to label direct speech introduced by colons, as in:

- (6) [Human] rispondere: [Quote]
Eng: [Human] answer: [Quote]

This was also the solution followed in the PDEV (Hanks, 2013) open-access dictionary. However, we preferred keeping the type system as a semantics-based categorization, and thus avoid any syntax-based definition for types.

Another strategy was to use the label [Event]⁷ or [Eventuality]⁸ - eventualities in Bach (1986) sense, i. e. including both states and events. Since every clause has a temporal structure, this choice could be considered as correct - as long as encoding information about the

⁷Definition: “An [Eventuality] that involves movement, change, or development, unlike a [State]. An [Event] can either be a volitional [Activity] or a non-volitional [Process]”

⁸Definition: “It can either be an [Event] involving movement, change or development or a fixed [State]”

temporal structure is the essential property of eventualities.

However, considering the semantics of sentences like (4), the object of the act of thinking is not properly the eventuality, but rather what we defined thus far as propositional content. For this reason, we decided to use the semantic type [Proposition] that we defined as “a propositional content that is the object of an attitude verb, i.e. the content of a belief, a wish, a mental representation, a saying, etc.”

Given that the system of semantic types should describe the relations between types, the position of the type in the system says something about the type itself. The [Proposition] type is positioned under the [Abstract Entity] > [Concept] branch.

One might be surprised that the position of the type under the [Concept] branch do not represent the relation between [Eventuality] and [Proposition]. Of course, propositions are expressed by clauses, and clauses, since they are tense phrases, involve temporal information, and thus they express eventualities. The point is that [Proposition] should be considered as a class of a higher order logic with respect to [Event] or [Eventuality]. However, so far only IS-A relations are represented in the system, thus the relation between [Eventuality] and [Proposition] is not traced yet in the system. However, the issue is worth to be discussed: we return to the relation between [Eventuality] and [Proposition]s in section 4.3.

3. Annotation results

We provide the complete list of annotations⁹, i.e. of all the verbs that we consider as attitude verbs in Italian based on their patterns of use in corpus. As referenced in 1, the label [Proposition] was assigned to 178 patterns of use for 126 verbs. In Table 1 we provide a small excerpt.

One thing should be clarified concerning syntactic and semantic alternation. Patterns are induced on a semantic basis, i. e. they each capture a different sense of the verb. Syntactic alternations are signalled with the pipe, e. g. for the pattern of *giurare*, ‘swear’: ‘[Human] giurare che | di [Proposition] | : [Proposition]’ means that the [Proposition] can be introduced by the complementizer *di*, *che* or through direct speech, indicated by the double colon. Semantic alternation is also signalled by the pipe, and it is used when more than one semantic type generalize over the lexical items that populate the argument slots of corpus instances. For example, in ‘[Human] | [Institution] ritenere che | di [Proposition]’, the arguments in subject position are nouns denoting [Human]s or [Institution]s -and not, for example, other [Animate]s that are not [Human]s.

⁹available at <https://github.com/Rapazebu/Attitude-verbs-in-Italian>.

Verb	Pattern
annunciare ‘announce’	[Human] annunciare [Event] che di [Proposition]
apprendere ‘learn’	[Human] apprendere [Information] che [Proposition]
comprendere ‘understand’	[Human] comprendere [Abstract Entity] che [Proposition]
concludere ‘infer’	[Human] concludere che [Proposition]
credere ‘believe’	[Human] credere (che di [Proposition])
dire ‘say’	[Human] [Institution] dire che di [Proposition]
dimostrare ‘prove’	[Human] dimostrare che [Proposition]
domandare ‘ask’	[Human] domandarsi chi come cosa perchè se [Proposition] : [Proposition]
giurare ‘swear’	[Human] giurare che di [Proposition] : [Proposition]
immaginare ‘imagine’	[Human] immaginare che [Proposition]
imparare ‘learn’	[Human] imparare come a [Activity] che [Proposition]
pensare ‘think’	[Human] pensare che di [Proposition]
raccontare ‘tell’	[Human1] raccontare [Concept] [Event] che di [Proposition] (a [Human2])
ricordare ‘remember’	[Human] ricordarsi che di [Proposition] di [Anything]
ritenere ‘believe’	[Human] [Institution] ritenere che di [Proposition]
sapere ‘know’	[Human] sapere [Information] come quale cosa [Proposition]
sentire ‘feel’	[Human] sentire che [Proposition]
spiegare ‘explain’	[Human1] spiegare : [Proposition] (a [Human2])
...	...

Table 1: An excerpt of the annotation results, consisting of verbs and respective corpus-derived argument structures (patterns).

4. Discussion

In this section, we overview the classes of attitude verbs (4.1), together with the syntactic configurations (4.2) we found in our data, and some issues between semantics and ontology (4.3).

4.1. Classes of Attitude Verbs

We found many cases of what we called prototypical attitude verbs, i.e. verbs whose meaning is similar to those in the literature for English. However, we also found less prototypical cases, whose inclusion ought to be discussed here. In the discussion that follow, we refer to the classes used in White et al. (2018).

- Communication verbs like *dire*, ‘to say’; *affermare*, ‘to state’; *ricordare*, ‘to remind’; *raccontare*, ‘to tell’; *spiegare*, ‘to explain’ are very common in the dataset. We considered as communication verbs also verbs like *rispondere*, ‘to answer’; *gridare*, ‘to shout’; *scrivere*, ‘to write’, i.e. verbs that introduce a proposition of the type “statement” just like ‘say’, but some additional information is also encoded in their meaning : ‘to say as an answer’, ‘to say out loud’, ‘to say in writing’.
- Representational verbs like *pensare*, ‘to think’, *credere*, ‘to believe’, *sapere*, ‘to know’ are also very common.
- Similar to the prototypically representational verbs are also *verificare*, ‘to verify’; *dimostrare*,

‘to demonstrate’, *concludere*, ‘to infer’, which refer to mental activities like reasoning and verifying truth conditions. Indeed, they roughly mean, respectively, ‘to verify whether the propositional content is true’; to prove that [Proposition] is true’ and ‘to infer [Proposition] as the conclusion from some premises’.

- A (small) class of verbs that might be considered as communication and representational is that of the predicates of learning and teaching, which express a sort of transfer of some mental content from a person to another: *insegnare*, ‘to teach’; *imparare*, ‘to learn’; *apprendere*, ‘to learn’. One should notice that patterns annotated with [Proposition] express epistemic knowledge, or knowledge-that, but not knowledge-how (Ichikawa and Steup, 2018). Consider as an example the verb *insegnare* that has patterns in which it is used for epistemic knowledge, as in example (7):

(7) [Event] insegnare che [Proposition] (a [Human2])
‘Le varie esperienze insegnano, però, che è bene affrontare alcuni aspetti essenziali.’
Eng: ‘However, various experiences teach us that is better to address some important issues.’

but also patterns that express knowledge-how, as example (8). We claim that this latter meaning does not involve attitude verbs, and thus we an-

notate the patterns with knowledge-how meaning with [Event] as object, as in:

- (8) [Human1] insegna a [Activity]¹⁰ (a [Human2])
 ‘Pomi mi ha insegnato a partire mettendo in leggero movimento la moto.’
 ‘Pomi taught me to start the motorbike by slightly moving it.’

- Verbs of perception do not fall under the traditional definition of attitude verbs (Frege, 1892), (Moltmann, 2013), even though starting from Barwise and Perry (1981) some of them - such as *see* - are included (see also White et al. (2018)). It is plausible to assume that, in order to express an attitude towards a [Proposition], the [Human] should be an agent, while humans involved in argument structures of perception verbs are instead experiencers. We found some perception verbs that actually seem to behave like attitude verbs, especially in some patterns: *sentire*, ‘feel (that)’ and also ‘hear (that)’, *notare*, ‘to notice’. However, in our view, these cases are instead some particular kinds of representational and communication verbs, since the meanings of the patterns are, respectively: ‘to know by feeling (that)’, ‘being told by someone (that)’, ‘to get aware (that)’.

4.2. Syntactic configurations

Attitude verbs and propositions are semantics labels. However, as with any linguistic issue that is analysed in terms of argument structure, it is hard to detach syntax from semantics. Here we explore to what extent this is possible. In the following sections, we illustrate all the syntactic configurations we found in the dataset. We claim that these cases are different syntactic realizations of the same semantic type for the argument, which represents the propositional content as the object of an attitude verb.

For sake of clarity, in the examples we provide the patterns complete with alternations, keeping in bold only the argument that are actually realized in the sentence of the example.

4.2.1. Complementizer *CHE* + finite

The most prototypical and well-known case, for explicit, finite-tense subordinate clauses whose subject can be different from the superordinates:

- (9) **[Human] pensare che** | di **[Proposition]**
 ‘Pensavamo veramente che si avvicinasse un disastro.’
 Eng: ‘We truly thought that a disaster was approaching.’

¹⁰Note that [Activity] is a subtype of Event.

4.2.2. Complementizer *DI* + non-finite

For implicit, non-finite tense subordinate clauses whose subject should be the same of the superordinate’s.

- (10) **[Human] pensare che** | di **[Proposition]**
 ‘Saro’ poco brillante , ma penso di essere pienamente nella media.’
 Eng: ‘I’m probably not very smart, but I think that I’m [lit. ‘to be’] perfectly on average’

4.2.3. Embedded questions with *COME, DOVE, QUANDO, QUANTO, SE, CHI, COSA, etc.*

Like the complementizer *che*, many words behave as complementizers that introduce the so-called embedded questions, that are finite-tense subordinate clauses¹¹.

- (11) **[Human1] domandare (a [Human2]) chi** | **come** | cosa | perché | se | di **[Proposition]** | : [Proposition]
 ‘La gente lo assale domandandogli come ha fatto a entrare.’
 Eng: ‘People assault him asking how could he come in.’
 ‘E se mi domando chi è lei , le risposte sono davvero deludenti’.
 Eng: ‘And if I ask myself who is she, answers are disappointing, really’.

We are not claiming, of course, that the meaning of these words is identical to that of the complementizer *che*: they all convey some additional information, such as place (*dove*, ‘where’), time (*quando*, ‘when’), person (*chi*, ‘who’), reason (*perché*, ‘why’); some are semantically compatible with some types of attitude verbs and not with others (e. g. ‘chiedi se vengono stasera’, ‘ask if they are going to come tonight’, and ‘*ordina se vengono stasera’¹², ‘*order if they come tonight’), et cetera. However, these differences do not concern the attitude of a [Human] towards a [Proposition], and thus we consider them the same in their ability to introduce propositional contents.

4.2.4. Direct Speech

As it is well known, many attitude verbs, and especially communication verbs, also allow direct speech:

- (12) **[Human] domandarsi** chi|come | cosa|perchè| se [Proposition] | : **[Proposition]**
 ‘Piero si domanda : ho fatto la scelta giusta?’
 Eng: ‘Piero asks himself: did I make the right choice?’

¹¹We are aware of the large literature distinguishing *that*-complements from embedded questions. We considered both structures as propositional complements if they satisfy the definition of proposition we are following in this paper

¹²Asterisk * is used here also to indicate semantic unacceptability.

4.2.5. Deverbal nouns

Propositions have been explored mainly when they are expressed by clauses, as in the examples we proposed thus far. However, some nouns express the propositional content that is the object of an attitude verb, as in the examples (13-a) and (13-b) from Pustejovsky (2005) and (14) from our data:

- (13) a. John's belief is obviously false.
b. I doubt John's promise of marriage.
- (14) **[Human1] suggerisce [Proposition]**¹³ | :
[Proposition] (a Human2)
'Non dobbiamo suggerirgli le risposte.'
Eng: 'We shouldn't suggest to him the answers.'

We will further discuss these cases in 4.3.1 in light of their semantic properties. By now, one should limit oneself to notice how also nouns can express propositional contents.

To conclude this section, in Table 2 we provide a summary of the syntactic configurations we found, provided with the number of patterns that show that configuration. Note that each pattern can have (and usually does have) more than one configuration, due to alternation.

Syntactic Configuration	n°	%
CHE + finite	134	76%
DI + non finite	122	69%
COME + finite	19	10%
QUANTO + finite	2	1%
SE + finite	10	%
CHI + finite	2	1%
COSA + finite	8	4%
PERCHE' + finite	4	2%
Direct speech	38	21%
Deverbal nouns	25	14%

Table 2: Syntactic configurations of [Proposition]s in argument position. Note that many patterns have alternations, thus they licence more than one configuration (e. g. many patterns allow both the *che* and the *di* construction)

4.3. Ontological issues: Events and Propositions

Once we move from syntax to semantics, some issues between semantics and ontology also arise. What are the relations between the semantic type [Proposition] and other semantic types – especially [Eventuality] and its subtypes?

¹³Here expressed by a noun.

4.3.1. The dot type Event • Proposition

The study of propositions expressed by nouns (see 4.2.5) enlightened the existence of complex types, or dot-types (Pustejovsky, 1998) whose facets are an [Eventuality] (or a subtype of) and a [Proposition]. Pustejovsky (2005) overviews these cases as an Act • Proposition dot type (also studied in Asher and Lascarides (2001)), as in:

- (15) a. I heard John's quick promise (**[Event]**) from yesterday.
b. John's promise (**[Proposition]**) took months to realize.

and as a State • Proposition dot type (also discussed in Asher (1993)), as in:

- (16) a. Nothing can shake John's belief (**[State]**).
b. John's belief (**[Proposition]**) is obviously false.

We found several cases of this type, i. e. several lexical items that, based on the pattern, may be [Eventuality]s or [Proposition]s. Some examples of these items are *richiesta*, 'request'; *domanda*, 'question', *risposta*, 'answer', *affermazione*, 'statement', etc. They are, in fact, names of speech acts -intended as in the traditional sense (Searle, 1969), i. e. activities which are performed through words and have an illocutionary force; but they are also the propositional content of the speech act. Since speech acts do take place in time, [Speech Act], defined in this way, is a subtype of [Event] in T-PAS. Examples (17-a) and (17-b) are cases in which the word *affermazione* 'claim' is used as a [Proposition] or as a [Speech Act] respectively.

- (17) a. **[Human] | [Institution] smentisce [Proposition]**
'Ma il sindaco ha smentito le affermazioni contenute nel documento.'
Eng: 'But the mayor has denied the claims contained in the document.'
- b. **[Human] interrompe [Speech Act]**
A interrompere le affermazioni del segretario del Partito è proprio il Prefetto.
Eng: 'the one that interrupts the claims of the secretary of the Party is the Prefect himself.'

However, one should note that not only words referring to speech acts in the traditional sense can instantiate different facets of the [Event] • [Proposition] dot type, but also any word that refers to an object of an attitude verb: *pensiero*, 'thought', *frase*, 'sentence', *discorso*, 'speech' et cetera, e. g.:

- (18) a. 'Ma il sindaco ha contestato il discorso (**[Proposition]**) del Prefetto'.
Eng: 'But the mayor has denied the Pre-

fect's speech'

- b. 'A interrompere il discorso ([Event]) del sindaco è proprio il prefetto'.
Eng: 'The one that interrupts the major's speech is the Prefect himself'.

4.3.2. The alternation [Eventuality] | [Proposition]

As one could notice from the patterns of table 1, type alternations are present in the great majority of our patterns. Alternations are also insightful to analyse more complex semantic issues. In this matter, an interesting and very frequent alternation is that between nominal [Eventuality] -or its subtypes- and clausal [Proposition], as in:

- (19) [Human1] | [Institution] annunciare [Event] | che | di [Proposition] (a [Human2])

Note that this issue is different from the issue discussed in 4.3.1 concerning the dot-type [Event] • [Proposition]; facets of dot types are activated by different selecting verbs, as in examples (17-a)-(17-b); while here we are discussing alternations with the same verb.

The fact that not all the verbs license all the three syntactic realizations (nominal proposition, verbal proposition, nominal event) is also puzzling:

- (20) Annunciare l'arrivo del treno/che il treno è in arrivo/di stare arrivando/una notizia
Eng: 'to announce the arrival of the train'/'that the train arrived'/'to be arriving'/'a piece of news'
- (21) Sapere che il treno è in arrivo/di arrivare/*le affermazioni di Marco/* l'arrivo del treno
Eng: 'knowing that the train is arriving'/'to be arriving'/'Marco's claims'/'to arrive'

The phenomenon is not easy to classify. We did not find enough evidence to consider this alternation as a coercion - assuming that the [Event] becomes a [Proposition] when coerced by the attitude verb's semantics - or as a very abstract kind of metonymy - in which the [Event] would be used instead of [Proposition] that expresses the [Event] itself. We then simply signal these cases as alternations, leaving them available for further investigation.

5. Conclusions

Annotating propositional arguments in a way that is coherent with the semantic annotation of any other verbal argument is not a trivial issue. That is the purpose of our work, framed in the context of the T-PAS annotation project. Through a procedure of automatic induction of argument structures (or patterns of use) from corpora, manually annotated with the semantic type of the arguments, we obtained 179 patterns for 126 verbs in which the [Proposition] type appears. Since T-PAS

covers argument structures for about 1100 verbs in Italian, the results of our annotation should provide a reliable overview of what verbs are actually attitude verbs in Italian.

Generalizing on corpus data, we outline the main syntactic configurations of propositional arguments. The distribution of propositional arguments also enlightens ontological issues concerning the relation between events and propositions, and specifically the dot type [Event] • [Proposition]. Further study may refine this analysis.

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