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Argument alternations in Italian verbs: a computational study

1 INTRODUCTION

Syntactic subcategorization frames generalize over the different syntactic contexts required by a verb[1], and represent the possible syntactic expressions of its semantic arguments, i.e. its *argument realization* properties (Levin and Rappaport Hovav 2005). The core structure of a verb syntactic frame typically consists of a (possibly empty) set of labeled *slots*, representing the number and types of its syntactic dependencies (e.g., subject, direct object, prepositional complements, etc.). Verbs are normally associated with several syntactic frames, each marking different types of syntagmatic contexts in which the verb may appear. This phenomenon is typically referred to as *multiple argument realization*. For instance, the verb *believe* can appear both in a syntactic frame including a finite clausal slot introduced by the complementizer *that* (e.g., *John believes that Mary is nice*), and in a syntactic frame that includes an oblique complement introduced by the preposition *in* (e.g., *John believes in God*). A particular instance of syntactic polymorphism is represented by *argument alternations* (Levin 1993). In this case, a verb has more than one syntactic frame that overtly realizes a single set of semantic arguments, and in each syntactic variant the same semantic argument is expressed in different syntactic slots. This is nicely shown by (1), a case of the well-known dative alternation in English, in which the verb *give* is associated both with a prepositional frame "NP_{subj} V NP_{obj} *to* NP" and with a double object frame "NP_{subj} V NP_2 NP_{obj}":

(1)   a.   *The man gave the book to the girl*.
           b.   *The man gave the girl the book*.

In this example, the argument expressed as the indirect complement introduced by the preposition *to* in the first variant is realized as the first object in the double object variant:

The range of syntactic frames is not an idiosyncratic property of a verb. Instead, similar argument realization properties tend to be shared by verbs that are similar for core aspects of their meaning. The crosslinguistic empirical confirmation of this correlation brings support to the assumption that the argument realization properties of verbs are by and large predictable from their meaning (Levin and Rappaport Hovav 2005). Obviously, the plausibility of this assumption depends to the extent to which classes of predicates that realize their arguments in similar ways do indeed form equivalence classes from the semantic point of view. Actually, a crucial role in this scientific enterprise is played by multiple argument realizations and more specifically

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[1] For the sake of this paper, we restrict the discussion to the case of verbs, but similar considerations hold true for other types of predicates as well, i.e. adjectives, deverbal nouns etc.

by argument alternations. In fact, argument alternations are typically manifested by sets of semantically related verbs. For instance, the dative alternation is also possible with verbs like *feed*, *render*, *rent*, *lend*, *sell*, etc. that show a clear "family resemblance" with the verb *give*. Consequently, argument alternations have become the cornerstone of a general methodology to investigate the syntax-semantics interface and verb meaning in general. According to this approach, once we have identified a number of significant argument alternations, we can group together verbs alternating in similar ways. These verb classes are then analyzed to identify the aspects of meaning that are shared among their elements and that can plausibly be deemed responsible for licensing their particular patterns of argument realizations. Levin (1993) has been the first one to implement this methodology on a large scale, assembling a rich inventory of argument alternations in English, and constructing an influential semantic classification of English verbs based on shared syntactic alternations.

The investigation of argument alternations, within the general quest for the principles governing the organization of the verb lexicon and the syntax-semantic interface, raise at least the following major issues:
1. *which alternations exist in a language?*
2. *which verbs share the same alternations?*
3. *which verb semantic classes can be defined on the ground of shared alternations?*
4. *which meaning differences exist between each syntactic variant?*
The latter question is motivated by the fact that, although argument alternations are typically defined as alternative realizations of the same semantic argument of a verb, each syntactic variant is typically accompanied by a shift in meaning. As we will see later, the extent and nature of this shift is often hard to determine, but it is surely an aspect that can not be ignored when we investigate argument alternations. Levin's analysis represent a important attempt to provide an answer to these issues for English verbs. On the other hand, Italian still lacks a wide-spectrum survey of possible argument alternations, comparable to Levin's one. Jezek (2003) has used lexicographic sources to analyze transitive-intransitive alternations such as the causative/inchoative one and split intransitivity, and has proposed a classification of verbs that behave similarly with respect to these alternations.

The investigation of argument alternations and their use as a probe for semantic verb classification has raised much interest also in computational linguistics. In this case, efforts have mostly focused on the automatic corpus-based analysis of argument alternations. Computational methods have been applied to distinguish classes of verbs depending on the particular type of alternations in which they participate (Merlo and Stevenson 2001), to extend Levin's classification to new verbs (McCarthy 2000, Korhonen and Briscoe 2004), and to verify Levin's assumptions in languages other than English (Schulte im Walde 2006). Computational approaches have a twofold role in this domain: first of all, they provide an invaluable help to extend the research to lexical areas and languages not yet or only partially addressed. Secondly, and perhaps even more importantly, they allow us to anchor the investigation of argument alterations and the construction of verb classes on the empirical data extracted form large corpora. This can be achieved thanks to the increasing availability of large-scale corpora and to the possibility of applying advanced methods for text processing and statistical analysis, to extract information useful to address the core issues concerning argument alternations. It is worth remarking that the contribution offered by computational analysis is not only

to boost research *extensively* (e.g. by augmenting the range of verbs and constructions that can be investigated) but also *intensively*, by providing us with an unprecedented range of data concerning word usages in linguistic contexts (e.g., syntagmatic patterns, prototypical arguments of predicates, etc.; cf. below), which can be used to gain new light on verb behavior at the syntax-semantics interface, and to perform more in-depth analyses of argument alternations.

The aim of this paper is to carry out a computational investigation of argument alternations in Italian, using Natural Language Processing (NLP) and corpus-based methods. This research is part of a long term project with the twofold goal of using (mainly) corpus-derived information to draw a "map" of argument alternations in Italian, and defining semantic classes of verbs on the grounds of their distributional properties. Here, we will focus on a particular type of argument alternations in Italian: *object/oblique alternations*. Object/oblique alternations (Levin 1993, Beavers 2006) are a family of argument alternations in which a single argument of a verb may be realized either as a direct argument of the verb (i.e as its direct object) or else as an oblique. Some instances of this type of alternations in English are the *Spray/Load Alternation* (2), the *Conative Alternation* (3-4) and the *Preposition Drop Alternation* (5):

(2)   a.   *John loaded the hay onto the wagon.*
      b.   *John loaded the wagon with hay.*

(3)   a.   *John ate his sandwich.*
      b.   *John ate at his sandwich.*

(4)   a.   *John wrote his dissertation.*
      b.   *John wrote on his dissertation.*

(5)   a.   *Martha climbed up the mountain.*
      b.   *Martha climbed the mountain.*

The purpose of this paper is to extract automatically from a large corpus of Italian information about the statistical distribution of a large sample of Italian verbs in various syntactic constructions, and to use this information to address three specific issues, which are actually specific instances of those we have exposed above:
i.) *which verbs in Italian undergo the object/oblique alternation*, i.e. can alternatively realize one of their argument either as a direct object or as a prepositional complement?;
ii.) *which semantic classes can be carved out of this group of verbs*, i.e. which meaning invariants share the verbs undergoing this alternation?
iii.) *what is the differential semantic contribution of each variant*, i.e. what semantic shifts result from realizing an argument as a direct object or as an oblique?

After providing the details of the particular computational methods adopted to carry out this investigation (section 2), we will present and discuss the results of the corpus-based analysis in section 3. In section 4, we will analyze the main aspects of the object/oblique alternation in Italian, and in section 5 we will discuss some general issues about the nature of argument alternations on the grounds of the computational analysis of corpus data.

2   USING COMPUTATIONAL METHODS TO IDENTIFY ARGUMENT ALTERNATIONS

The main hypothesis guiding the computational explorations presented in this paper is that we can identify argument alternations by measuring the degree of *slot overlap* between two syntactic frames of the same verb, i.e. the degree to which two slots in different syntactic frames share the same nouns occurring as their fillers. The hypothesis that slot overlap can be used as a feature to identify alternating verbs has been successfully used in computational works on verb classification, such as Merlo and Stevenson (2001), Joanis (2002), and Joanis *et al*. (2008). This hypothesis directly descends from the very definition of argument alternations, as the property of a verb to realize the same semantic argument in different syntactic ways. If a verb undergoes a particular alternation involving two syntactic slots, say *A* and *B*, then it is expected that *the sets of nouns found in the two slots overlap to a certain degree*. This is also shown by the examples in (1-5) above, in which the same noun arguments appear in the alternant syntactic slots in the two possible variant frames. Therefore, a measure of the overlap between the nouns occurring in slot *A* and those occurring in slot *B* can be used as a distributional clue to identify whether a verb allows an argument alternation involving the slots *A* and *B*.

The computational analysis that we will present below has been performed on *La Repubblica Corpus* (Baroni *et al*. 2004), a corpus of ca. 390 million word tokens of newspaper texts. The corpus was first lemmatized and part-of-speech tagged with the ILC-UniPi Tagger (Dell'Orletta *et al*. 2007), and then dependency-parsed with MaltParser, a state-of-the-art stochastic dependency parser (Nivre *et al*. 2007). Computational identification of potential argument alternations included two phases, which will be described in the following sections: 1. extracting verb syntactic frames from the corpus; 2. measuring the distributional overlap between syntactic slots of potentially alternant frames.

2.1   *Syntactic frame extraction*

We will assume here that verb syntactic frames include two sorts of elements:
1. a (possibly empty) set of *slots*, labeled with the following types of syntactic dependencies: subject, direct object, prepositional complement, infinitival clause, finite clause, predicate. Prepositional complements are also further distinguished depending of their prepositional head.
2. for each (non-clausal) slot, the set of its *fillers*, i.e. the nouns that can appear as its argument.

It is worth noticing that this definition of syntactic frame differs from the format typically adopted by subcategorization and valence lexicons (cf. for instance Blumenthal and Rovere 1998, Herbst *et al.* 2004), which do not provide information about the nouns filling particular syntactic slots (with the notable exceptions of VALEX by Korhonen *et al.* 2006, and of Corpus Pattern Analysis, by Hanks and Pustejovsky 2005). Instead, information about the typical noun fillers of a slot has a crucial role to identify argument alternations. As we will see, it is an essential condition to achieve a better understanding of alternations themselves and of the fine-grained semantic of the alternant frames (cf. below section 4).

Starting from the dependency-parsed version of *La Repubblica Corpus*, we automatically extracted the frequency distribution of verbs with various syntactic frames. Moreover, for each syntactic slot in each frame, the statistical distribution of its noun fillers was also extracted. The following is an example of the syntactic frames (represented in an XML format) that were automatically extracted from the parsed corpus:

```
<v name="discutere" freq="45212" >
   <fr name="subj#obj_d#" freq="7826" >
      <s name= "subj" >
         <f name="consiglio" freq= "126" > <f name="parlamento"
         freq="90" > <f name= "commissione" freq="76" >...</s>
      <s name="obj_d >
         <f name="problema" freq="400" > <f name= "proposta" freq=
         "227"> < f name="questione" freq="208" >... </s>
   </fr>
</v>
```

Figure 1 – Example of syntactic frame extracted from the corpus

Verbs are associated with a number of syntactic frames (the XML element `<fr>` in Figure 1), labeled with the slots they contain. For each frame, its co-occurrence frequency with the verb is specified (attribute `freq` in the element `<fr>`). For instance, according to the example above, the verb *discutere* "discuss" occurs in the corpus with a transitive frame – formed by a subject slot and a direct object slot – 7,826 times, out of the total verb frequency of 45,212. For each frame slot, (represented by the XML tag `<s>` in Figure 1), the types and frequency of its noun fillers (each represented by the XML tag `<f>` in Figure 1) are also specified. For instance, the syntactic frame reported in Figure 1 reports that the noun *problema* "problem" occurs 400 times as direct object of the verb *discutere*, and that the noun *parlamento* "parliament" occurs 90 times as subject in the same transitive frame.

At the end of this phase, we extracted the co-occurrence distributions of the 3,931 most frequent verbs in the corpus (min. freq. = 100; max. freq. = 835,617) with 97 frame types[2]. These frames types were hand-selected within the 100 most frequent syntactic dependencies combinations extracted from the corpus.

2.2 *Measuring slot overlap*

The object/oblique alternation involves the expression of the same semantic argument in two different syntactic slots, i.e. either as a direct object or as complement introduced by a preposition. We can then expect that, if a verb undergoes this alternation, then the set of nouns that in a corpus appear in the two alternant slots should overlap to a certain degree. Various measures for syntactic slot overlap have indeed been proposed in computational linguistics (McCarthy 2000, Merlo and Stevenson 2001, Joanis 2002, Joanis *et al*. 2008). However, these researches typically focus on the automatic classification of English verbs. That is to say, Levin classes are presupposed as a sort of verb ontology, and the degree of slot overlap is used as one of various distributional features used to automatically classify English verbs with respect to Levin

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[2] For more details about the process of verb syntactic frame extraction see Lenci *et al.* (2010).

classes. In the present work, the measure of slot overlap is instead used as *an exploratory tool to discover which verbs in Italian participate in the object/oblique alternation*.

The specific measure of slot overlap we have adopted in the present work is the *cosine similarity* (Manning and Schütze 1999). Given two syntactic slots *A* and *B*, *cosine slot similarity* can be defined in the following way:

$$(6) \qquad cosine(A,B) = \frac{\left| fillers_A \cap fillers_B \right|}{\sqrt{\left| fillers_A * fillers_B \right|}}$$

In this formula, *fillers_A* and *fillers_B* refer to the *noun types* that occur respectively as fillers of the slot *A* and as fillers of the slot *B*. Therefore, the cosine measures the degree of overlap between the fillers of the two slots. Its highest value is 1, when the two slots have exactly the same fillers, and 0 when their intersection is empty, i.e. when they do not share any filler. The highest the cosine between two syntactic slots, the highest the number of noun fillers they can share. Therefore, given the assumption of the correlation between slot overlap and argument alternations, high values of cosine represent a quantitative cue of the fact that the syntactic frames of the two slots form a syntactic alternation.

The measure of slot overlap we adopted for the present analysis only considers the distribution of noun filler *types*, ignoring their token frequency in the corpus (i.e. a noun n_1 occurring 100 times and a noun n_2 occurring only twice contribute to formula in (6) exactly in the same way). The reason for this choice is due to the fact that the measure is not influenced by the skewed, Zipfian distribution of slot fillers, with few slot fillers occurring with very high frequency and a very long cue of nouns occurring with very low frequency. If we had used token frequency, high frequency noun fillers could have biased the measure of slot overlap. This is even more true, because many of these high frequency fillers form idiomatic construction with the verb (e.g. *corda* "rope" as object of the verb *tagliare* "cut" forms the idiomatic expression *tagliare la corda* "cut the rop"). Using the distribution of filler types, the degree of slot overlap depends on the number of different nouns the two slots share as fillers, rather than on the number of times a specific noun occur as filler of one slot. This way, it is possible to abstract from the fact that two syntactic slots may share some nouns as fillers, although these may differ for the token frequency with which they occur in each slot. Some preliminary experiments in which the measure of slot overlap had been applied to the token frequency of slot fillers, had indeed shown that type distribution looked more promising and avoided some of the "noise" induced by token distribution. It is part of ongoing research to experiment with more sophisticated measures of slot overlap, using also association scores (e.g. mutual information, log-likelihood ratios, etc.; cf. Manning and Schütze 1999) instead of raw frequency to estimate the statistical salience of a given noun as filler of a particular syntactic slot (cf. Lenci *et al*. 2010).

It is worth emphasizing that the idea of measuring the filler overlap between two syntactic slots to estimate the degree to which they are different syntactic realization of the same semantic argument is just a particular instance of the so-called *Distributional Hypothesis*. This is shared by a large family of approaches to semantics that assume that the statistical distribution of words in context plays a key role in characterizing their

semantic behavior (Lenci 2008). According to the Distributional Hypothesis (Harris 1954, Miller and Charles 1991), the *semantic similarity* between two linguistic constructions is a function of the linguistic contexts they share. For instance, the near-synonymy between *oculist* and *eye-doctor* depends on the possibility to use these words interchangeably in most linguistic contexts (Harris 1954: 157). Not very differently from this, the measure of slot overlap we have adopted allows us to estimate in a quantitative way the degree to which two syntactic slots can be used interchangeably with the same slot fillers. Therefore, if we assume the Distributional Hypothesis, *de facto* measuring the slot overlap can be regarded as a distributional, corpus-based measure of the degree of semantic similarity between syntactic slots. Since syntactic alternations are intrinsically defined as cases in which the same semantic argument is alternatively realized by two or more different syntactic slots, the semantic similarity between syntactic slots can be used as an exploratory, distributional cue of the fact that the frames they belong to are indeed alternative variants of the same argument structure, and therefore that the verb participates in a certain type of alternation[3].

To explore the range of distribution of the object/oblique alternation in Italian, starting form the syntactic frames extracted form *La Repubblica Corpus* (cf. section 2.1), for each verb we selected all the frames with two slots, whose non-subject slot was either a direct object or as an oblique, prepositional complement. Then, we discarded all the frames whose frequency was lower than 50 and that covered less than 1% of the whole occurrences of a given verb. For the remnant frames, we applied the formula in (6) to measure for each verb the overlap between the noun fillers of the direct object slot, and the noun fillers appearing in the oblique slots. The cosines were then used to identify the extension and the possible typology of object/oblique alternations in Italian, as well as to understand the common semantic properties shared by the verbs that can realize the internal argument either as a direct object or as an oblique complement.

3   OBJECT/OBLIQUE ALTERNATIONS AND VERB CLASSES IN ITALIAN

In this paper, we will report and discuss only a subset of the data extracted with the computational method described above, i.e. those concerning the cases in which the direct object argument alternates with oblique complements headed by the prepositions *su* and *a*. The verbs with the highest overlap (measured with the formula in (6)) between the direct object slot and the slots headed by these prepositions were selected and then manually analyzed. We verified their actual possibility to undergo the object/oblique alternation (thereby also evaluating the reliability of the cosine measure as a distributional indicator of potential alternant frames), and - following the methodology adopted by Levin (1993) – we grouped the verbs in semantic similarity classes, with the aim at identifying the semantic properties shared by verbs participating in the same type of object/oblique alternation.

The results of our analysis and verb classification are reported in Appendix A and B, respectively for the *object/oblique "su"* (obj/*su*) and the *object/oblique "a"* (obj/*a*) alternations. We identified 40 verbs participating in the obj/*su* alternation. These represent the 15% of the 269 verbs extracted from *La Repubblica Corpus* that have a syntactic frame containing a prepositional slot headed by *su*, and whose frame

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[3] For another application of distributional semantics and slot similarity to a different type of alternation (i.e. causative/inchoative one) see Baroni and Lenci (2009).

frequency exceeds the adopted thresholds (cf. section 2.1). For the obj/*a* alternation, we identified 46 alternating verbs. These represent the 5% of the 926 verbs extracted from *La Repubblica Corpus* that have a syntactic frame containing a prepositional slot headed by *a*, and whose frame frequency exceeds the adopted thresholds (cf. above). The skewed distribution of the two alternation types is obviously due to the much larger frequency of prepositional complements headed by *a* in Italian. Verb classes were obtained through a manual partition of alternating verbs based on their semantic similarity. As the reported data clearly show, the degree and type of this similarity greatly differs from class to class, ranging from (near-)synonymy to a much looser relations of "affinity" between the events or situations expressed by the verbs. Besides an informal description of the semantic properties characterizing their elements, each class comes with an example of the target alternation, a tentative link to the possible corresponding English alternation (if any) in Levin (1993), and a (non-exhaustive) list of verbs that, although they are prima facie semantically very close to the class members, nevertheless do not undergo the same alternation. This analysis and the proposed verb classification therefore represents a first attempt at sketching a map of object/oblique alternation in Italian.

The obj/*su* alternation in Italian (cf. Appendix A) seems to cover a smaller number of verb semantic classes, the largest of which is the *Discutere* verbs (class 1). This includes various types of (often near synonymous) verbs referring to communication and epistemic events involving the expression of some information content (e.g. *decidere* "to decide", *tacere* "to be silent about", *argomentare* "to argue", etc.). The second largest class is represented by the *Spingere* verbs (class 2), expressing the exertion of force on a surface, followed by the *Sorvegliare* verbs (class 3), expressing control or surveillance over an entity (e.g. *sorvegliare* "to supervise", *comandare* "to command", etc.). Other verbs undergoing the same alteration, include verbs expressing saving or earning (*Risparmiare* verbs, class 4), verbs referring to the creation or use of some information recorded in an artifact (*Scrivere* verbs, class 5), and verbs participating in the well-known Locative Spray / Load Alternation (Levin 1993), such as *caricare* "load" and *spruzzare* "spray" (*Caricare / Spruzzare* verbs, class 6). In the latter case, the oblique complement introduced by *su* expressing a location, can also be realized as the verb direct object, with the noun expressing the content or the moved object expressed with the preposition *di* (cf. *Gianni ha caricato il furgone di fieno* "John loaded the truck with hay" vs. *Gianni ha caricato il fieno sul furgone* "John loaded the hay onto the truck"). Besides this class, the only Italian verb class that has an equivalent in English is class 2, i.e. *Spingere* verbs, which overlaps with Levin's class 12 (*Verbs of Exerting Force*), whose verbs participate in the conative alternation (e.g. *John pushed (on) the button*). *Prima facie*, a similar parallelism with English could be claimed for *Scrivere* verbs (class 5) too, since *write* undergoes the object/oblique alternation (cf. (4) above; Beavers 2006). However, at a closer inspection, we can see that the Italian case is rather different. In fact, the alternation of *write* is accompanied by a clear change of meaning in the two variants, since in the oblique variant the event is detelicized, i.e. *John wrote on his dissertation* means that John worked on his dissertation, without entailing that the dissertation was completed, as instead we can infer from the direct object variant. On the hand, the corresponding Italian alternation shows a rather different semantic contrast:

(7)   a.   *Gianni ha scritto la tesi.*
        b.   *Gianni ha scritto sulla tesi.*

In (7b), the oblique complement introduced by *su* has a clear locative interpretation, i.e. the dissertation is the place John put some graphic marks on[4]. This fact suggests that the Italian and the English alternations should not be confused, with only the latter to be properly described as a case of conative alternation. The possibility for the Italian verbs in the *Scrivere* class to participate in the obj/*su* alternation should rather be ascribed to the particular semantics of the prototypical noun fillers of these verbs. In fact, these nouns can systematically be used to refer both to the information content of some semiotic artifact (cf. *This book is very interesting*) and to its physical support (cf. *This book is heavy and red*). Indeed, the possibility of being realized either as direct object or as an oblique with these verbs seem to be restricted only to nouns of this semantic type, which show a regular polysemy alternation between a physical entity and information (cf. the *phys*info* complex types in the Generative Lexicon terminology; Pustejovky 1995, 2001). We can therefore consider the obj/*su* alternation of verb 5 as the by-product of the regular polysemy of their noun arguments. Indeed, we might even wonder whether it is right to consider this a true case of object/oblique argument alternation. Whatever answer we may give to this question, this case shows the complex interaction between the semantics of noun arguments and verb alternations, as it will emerge even more clearly in the next sections.

Appendix B reveals that the range of semantic types of the verbs undergoing the obj/*a* alternation is more spread and various. The largest group is represented by the *Rimproverare* verbs (class 14), including verbs typically referring to events in which somebody expresses feelings (e.g. reproach, forgiveness, etc.) or opinions (e.g. advise) about an action performed by somebody else. This is the recipient of the event expressed by the verb, and can syntactically be realized either as a direct object (8a) or as an oblique headed by *a* (8b):

(8)   a.   *Maria ha rimproverato <u>la squadra</u> (per la sconfitta).*
               "Mary reproached the team (for the defeat)"
        b.   *Maria ha rimproverato la sconfitta <u>alla squadra</u>.*
               "Mary reproached the defeat TO the team"

Other verbs sharing the same obj/*a* alternation express events of fulfilling or disobeying to some rule, duty or obligation (*Adempiere* verbs, class 7), acts of correcting a fault or mistake (*Rimediare* verbs, class 9), expression of consensus for somebody or something (*Applaudire* verbs, class 10). Finally, there are a number of fairly sparse verb classes that refer to quite specific event types and contain a small number of representatives (often near-synonyms or antonyms): verbs expressing attendance and control over an event (*Presenziare* verbs, class 8), some epistemic verbs expressing imagining (*Pensare* verbs, class 11), verbs expressing resistance to something or somebody (*Reggere* verbs, class 12), events of eluding from a danger (*Fuggire* verbs, class 13), and granting a permission to somebody (*Autorizzare* verbs, class 15).

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[4] The same sentence has also the interpretation that John wrote something *about* his dissertation. In this case, the oblique argument has the semantic role of topic of the event expressed by the verb.

4 UNDERSTANDING THE OBJECT/OBLIQUE ALTERNATION

One of the major goals in studying argument alternations is to identify which aspects of verb meaning may be regarded as responsible for licensing the alternative syntactic realizations of a given semantic argument. However, as it emerges clearly from the verb classification presented in Section 3, this is not an easy task, at least for the case of the object/oblique alternation in Italian. Verbs sharing the same alternation can be grouped into semantically coherent classes, but the global distribution of the verbs undergoing the object/oblique alternation is actually multifarious, and classes cover various aspects of event semantics. In fact, the same alternation may be shared by epistemic verbs and by verbs expressing the exertion of force, by verbs expressing reproaching and by verbs expressing obeying to something, etc. In other terms, if the *intra-class similarity* (i.e. among verbs belonging to the same class) seems to be fairly high, the *inter-class similarity* (i.e. among verbs sharing the same alternation, but belonging to different semantic classes) is indeed very low.

Rather than attempting a quite hopeless operation of searching for common semantic properties, it is therefore more promising to start the investigation in a "negative" way. That is to say, rather than looking at what Italian verbs undergoing the object/oblique alternation have in common, we can ask for what semantic aspects they *differ* from other Italian transitive verbs whose direct object can not be alternatively realized as an oblique (we will henceforth refer to these verbs as *non-alternating* verbs). In fact, the most striking fact shown by all the verbs reported in the Appendixes is that alternating verbs in general do not belong to the *core set* of prototypical transitive verbs (Levin and Rappaport Hovav 2005). The internal argument of these verbs is a sort of "weak object", using the terminology of Levin (1999). That is to say, it is *not* inherently affected by the event, it is *not* inherently caused, etc. Moreover, although it is hard to find out specific semantic dimensions common to alternating verbs, nevertheless it is a striking fact that verbs undergoing the object/oblique alternation in Italian belong to semantic classes that show a high interlinguistic variability in transitivity. That is to say, the corresponding verbs in other languages vary whether their internal argument is realized as a direct object or as an oblique. These classes include, *obey* verbs (Blume 1998), verbs of ruling (cf. Russian; Nichols 1984), verbs of surface contact, epistemic and communication verbs, perception verbs, etc. As Levin (1999) claims, these verbs with such a high degree of interlinguistic variability in transitivity have "weak objects", exactly like the Italian verbs we have identified.

It is interesting to notice that there is also a high *intralinguistic* variation within the semantic classes to which alternating Italian verbs belong. As reported in the class descriptions in the Appendixes, there are many near-synonyms of the alternating verbs that indeed do not alternate: e.g. *riparare* "repair" (class 9) and *trasgredire* "to infringe" (class 7) undergo the obj/*a* alternation, but *aggiustare* "fix" and *violare* "violate" do not alternate.

A *prima facie* exception to the generalization above that the internal argument of alternating verbs is a "weak object" is represented by the verb *riparare* "repair" (class 9):

(9)   *Gianni ha riparato (al) il danno.*
        "John repaired (to) the damage"

This verb expresses a change of state, is causative, telic, and the object argument is deeply affected by the event. Therefore, the object of *riparare* has all the properties of "strong objects", and (9) seems to falsify the generalization that the object/oblique alternation is restricted to verbs with "weak objects". However, a more careful analysis shows that this is not the case, and that the generalization is indeed confirmed despite the behavior of *riparare*. Evidence for this conclusion comes from the analysis of the noun fillers that in the corpus *La Repubblica* occur only in either of the two variants, but, crucially, not in both (i.e. these fillers form the complement set of the overlap between the object and the oblique slots). A sample of the most frequent fillers appearing only in one of the two variants of *riparare* is reported below:

(10)   a.   direct object fillers: *ferita* "wound", *telefono* "telephone", *tessuto* "fabric", *nave* "ship", *stazione* "station", *vela* "sail", *apparecchio* "device", *bicicletta* "bicycle", *gomma* "wheel", etc.

       b.   oblique fillers (*a*): *decisione* "decision", *imbarazzo* "embarassment", *silenzio* "silence", *morte* "death", *sgarbo* "snub", *peccato* "sin", *deficienza* "deficiency", *deficit* "deficit", *scandalo* "scandal", *abuso* "abuse", *pregiudizio* "prejudice", *comportamento* "behavior", etc.

As these data clearly show, the fillers occurring in the corpus only in the oblique variant are mostly abstract nouns. This suggests that when it realizes its non-subject argument as an oblique, the verb *riparare* assumes a figurative interpretation. Such hypothesis is also confirmed by the following sentences, extracted from *La Repubblica*:

(11)   a.   *Verranno potenziati i telefoni pubblici; ridotti i tempi per riparare i guasti.*
            "Public telephones will be improved; the time to repair the faults will be reduced"
       b.   *La DC si chiede come potrà riparare ai guasti prodotti da Cossiga.*
            "DC wonders how it will be possible to repair the errors made by Cossiga"

The same noun *guasto* "fault, error" occurs in the two variants, and yet it has different interpretations. In fact, while in (11a) the noun refers to some fault of some apparatus or device, in (11b) it generically refers to errors or mistakes performed by a person. Interestingly, only the oblique variant can be paraphrased with the support verb construction *mettere riparo a* (lit. "to solve"). In this sense, the oblique argument is not literally acted upon or affected by event, or at least in a very different sense with respect to the direct object variant. The figurative interpretation disappears, if the oblique is replaced by the direct object, often producing an anomalous interpretation (cf. *riparare allo scandalo* "repair to the scandal" vs. ?? *riparare lo scandalo* "repair the scandal").

4.1 Syntactic variants and semantic contrasts

The case of *riparare* raises the more general issue of the semantic differences of each variant in a given syntactic alternation. The very definition of alternation is based on the idea that the same semantic argument can have multiple alternative realizations at the syntactic level. However, the notion of alternative realization does not entail a *meaning preserving* alternation. The definition of alternation does not exclude the fact that each syntactic variant is accompanied by specific semantic and pragmatic inferences, that determine a change in the interpretation of a sentence depending on the way the same argument is realized at the syntactic level. As we said in section 1, it is one of the core research issues in the study of argument alternations to determine the extent of this meaning changes, as well as the type of specific semantic inferences associated with each syntactic variant.

A strong position on this point is defended by Beavers (2006), who argues for the following principle:

(12)   *The Principle of Contrast for Alternations*
            Every alternation expresses some contrast

According to this hypothesis there is indeed no meaning-preserving syntactic alternation, and actually there is always some type of inference expressed by one of the variants but not by the other. However, the problem is that it is not clear whether the same semantic contrast can be identified across the various types of object/oblique alternations. For instance, in the case of *riparare* and of the other verbs of class 9, the two variants differ for the degree of affectedness of the non-subject argument, as well as for the possibility of a figurative reading. Affectedness is actually a parameter of semantic variation between the alternative syntactic realizations in other classes as well (Beavers 2006). An example is provided by the verbs of class 2 – *Spingere* verbs, as shown by the following examples:

(13)   a.   *Gianni ha spinto il Presidente.*
                "John pushed the President"
        b.   *Gianni ha spinto sul Presidente.*
                "John pushed ON the President"

The object variant entails that John touched the President and exerted some physical pressure on him. Conversely, the oblique variant does not entail that John touched the President, but rather that he exerted some possibly indirect or non physical action on him. Similarly to the case of *riparare*, the fact that the indirect argument is not directly affected by the event makes the oblique variant very likely to assume a figurative interpretation. Therefore, *spingere* loses the meaning of physical action, to acquire the abstract reading of exerting the agent's influence on somebody else to perform some action. Indeed, it is hard to determine clearly which of these two effects should be regarded as having priority over the other, i.e. whether the figurative interpretation is the consequence of the lack of affectedness or rather the other way around.

In other classes, the semantic contrast between the two alternants involve a different type of semantic entailment, for instance *telicity*. In fact, in some verbs the oblique

argument does not "measure-out" the event (Tenny 1994, Jackendoff 1996), which remains therefore atelic. This is the case, for instance, of a verb like *discutere* (class 1), as shown by the reduced compatibility between the oblique variant and the telic adverbial *in X time*:

(14) a. *Il Parlamento ha discusso l'ammissibilità del referendum in un'ora.*
          "The Parliament discussed the acceptability of the referendum in an hour"
      b. ?? *Il Parlamento ha discusso sull'ammissibilità del referendum in un'ora.*
          "The Parliament discussed on the acceptability of the referendum in an hour"

When the noun *ammissibilità* "acceptability" occurs as direct object of *discutere*, it measures the event, acting as its incremental theme, so that after one hour the issue was totally over. On the other hand, (14b) does not have the same entailment. Rather than measuring the development of the event, the oblique noun simply describes the topic of the discussion, and the event is now atelic.

However, the picture is made more complicated by the fact that the same contrast telic vs. atelic does no hold for other verbs of the same class, as for instance *decidere* "decide":

(15) a. *Il Parlamento ha deciso l'ammissibilità del referendum in un'ora.*
          "The Parliament decided the acceptability of the referendum in an hour"
      b. *Il Parlamento ha deciso sull'ammissibilità del referendum in un'ora.*
          "The Parliament decided on the acceptability of the referendum in an hour"

In this case, both the object and the oblique variants are telic. That is to say, the realization of the non-subject argument of the verb as an oblique is not able to change the Aktionsart of the event. The different way in which *discutere* and *decidere* interact with the obj/*su* alternation may depend on their different actional value. In fact, *discutere* is an activity verb, i.e. atelic and durative (cf. *Il consiglio ha discusso per un'ora.* "The council discussed for an hour" vs. * *Il consiglio ha discusso in un'ora.* "The council discussed in an hour"), while *decidere* is an achievement, i.e. telic and non durative (cf. * *Il consiglio ha deciso per un'ora.* "The council decided for an hour" vs. *Il consiglio ha deciso in un'ora.* "The council decided in an hour"). We can therefore argue that, as it is customary with many activities, when the non-subject argument is realized as a direct object with *discutere* it comes to express an incremental theme and turns the event into a telic one. On the other hand, this change does not occur with *decidere*, since it is already telic at the lexical level. However, since the contrast between (15a) and (15b) can not be accounted in terms of the telic vs. atelic opposition, it remains to be better understood the precise terms of the contrast, if any, between the object and the oblique variant with a verb like *decidere*. This might be related to the notion of "control", as revealed by the different interpretation of the following sentences:

(16) a. *L'assemblea ha deciso l'acquisto della società.*
          "The assembly decided the purchase of the company"
      b. *L'assemblea ha deciso sull'acquisto della società.*
          "The assembly decided on the purchase of the company"

While in (16a) the assembly directly controls and performs the purchasing event, (16b) is perfectly compatible with a reading in which this same event is performed by somebody else and the assembly just decides whether it approves the purchase or not. Actually, this contrast is also confirmed by the fact that *decidere* + direct object in (16a) can be paraphrased with *decidere* + infinitival clause (e.g., *L'assemblea ha deciso di acquistare la sociè* "The assembly decided to purchase the company"), and *decidere* + *su* in (16b) can instead be paraphrased with the support verb construction *prendere una decisione su* (e.g., *L'assemblea ha preso una decisione sull'acquisto della società* "The assembly took a decision on the purchase of the company"). We will leave this to a further investigation, but it is worth emphasizing that, even within a specific semantic class, it is not always clear the type of semantic contrast exhibited by the syntactic alternants. Sometimes, as in the case of *decidere*, it may pertain to subtle pragmatic and semantic entailments, which can hardly be explained in terms of general categories like for instance telicity.

A similarly hard-to-pin-down contrast seems at play with the verbs in class 14 (*Rimproverare* verbs), as exemplified by the following sentences:

(17) a. *Gianni ha rimproverato suo padre per questo.*
          "John reproached his father for this"
      b. *Gianni ha rimproverato questo a suo padre.*
          "John reproached this to his father"

In the object variant, the father is "directly" reproached by John, while this entailment does not hold for the oblique variant. This contrast is also confirmed by the fact that (17a) would sound anomalous if John's father were dead, while in the same situation (17b) would be perfectly acceptable. Although it is evident that the two variants differ from the semantic point of view, it is not easy to make explicit the neat semantic import of such a difference. As we said, something like "direct involvement" seems to be at stake here, and this might suggest that "affectedness" is again the crucial semantic factor. However, this interpretation would require us to stretch the meaning of affectedness well beyond its standard (fairly high) vagueness and polysemy, thereby impairing its reliability as a truly explanatory notion in semantics.

To sum up, the particular instances of object/oblique alternations in Italian that we have analyzed in this paper (i.e. obj/*su* and obj/*a*) do not appear to be meaning-preserving. Beavers' Principle of Semantic Contrast seems therefore to be largely confirmed, although the source and the scope of such contrast are not clear. As we saw above, various semantic classes of alternating verbs (and sometimes even verbs within the same class) greatly differ for the interpretations associated with each alternant. In some cases, this opposition can sometimes be interpreted in terms of well-known semantic categories (e.g. telicity), but in others very subtle pragmatic and semantic differences are at stake. We can speculate that these different types of contrast might be subsumed under a more general and abstract principle such as the *Morphosyntactic*

Alignment Principle (MAP) proposed by Beavers (2006). According to the MAP, in object/oblique alterations, direct argument variants imply *more properties about the alternating participant* than oblique variants. Notice that this principle does not specify the relevant type of property for which the variant differ, but only that there is *some* property that the direct argument variant is entailed to have (e.g. completeness, affectedness, etc.), while the same entailment does not hold true for the oblique variant. Indeed, it seems that the MAP is confirmed by the Italian data that we have analyzed: direct arguments are *more* affected, *more* "directly involved", etc. than their oblique corresponding variant. If this approach is correct, the argument/oblique alternation in Italian could therefore be explained as a particular instance of a general strategy for languages to grammatically encode a contrast in some relevant properties that characterize an entity *in its role of* argument of a particular event. The specific type of property relevant for this contrast would then be verb or verb-class specific, possibly tied to very complex pragmatic and semantic aspects of event conceptualization.

4.2 Figurative readings in argument alternations

Discussing the so-called *Swarm Alternation*, Dowty (2000) notices that one of the two syntactic variants (specifically, the one in which the location is realized as subject, e.g., *The garden swarms with bees*) is much more prone to assume a figurative interpretation, e.g. *Her voice dripped with sarcasm* vs. ?*Sarcasm dripped from her voice*. Actually, Dowty's observation is also widely confirmed within the range of verbs undergoing the object/oblique alternation in Italian. This is exactly the same phenomenon we observed with *riparare* "repair" (10,11), and with *spingere* "push" (13). In both cases, the oblique variant is more associated with metaphorical readings. Another interesting example is provided again by a verb of class 2, *premere* "press, once we focus on the noun fillers that occur in the corpus *only* in one of the two variants. In (18a), we have reported the most frequent noun fillers that in *La Repubblica* corpus appear only in the direct object variant, while in (18b) we have reported the most frequent noun fillers that in the same corpus appear only in the oblique variant:

(18) a. <u>direct object fillers</u>: *pulsante* "button", *telecomando* "remote control", *pistola* "gun", *foglio* "sheet", *tappo* "plug", *dispositivo* "device", etc.

b. <u>oblique fillers (*su*)</u>: *autorità* "authority", *transenna* "barrier", *squadra* "team", *importazione* "import", *città* "town", *confine* "border", *ministro* "minister", etc.

The contrast is self-evident: the direct object noun fillers typically refer to the physical sense of pressing, i.e. pushing a device or exerting some physical forces on a flat surface. Conversely, the oblique fillers suggest a more figurative interpretation, i.e. exerting some form of pressure (not necessarily a physical one), moral suasion, etc. Again, these data confirm the strong bias of the oblique variant for non-literal interpretations.

Interestingly, a similar contrast can be observed with the verb *caricare* (class 6), which participates in the *Spray/Load Alternation*, as its English counterpart *load*:

(19) a.   *Gianni ha caricato il fieno sul camion.*
          "John loaded the hay onto the truck"
      b.   *Gianni ha caricato il camion di fieno.*
          "John loaded the truck with hay"

The *Spray/Load Alternation* can be regarded as the transitive variant of the *Swarm Alternation*, both being instances of the *Locative Alternations*, involving alternative realizations of the location and of the so-called locatum argument. Both arguments can be realized as an oblique or as the direct object. When the location is realized as the direct object (19b), the locatum appears in Italian as an oblique headed by the preposition *di*. When the locatum is realized as the direct object (19a), the location is realized as an oblique headed by a locative preposition, e.g. *su*. In the literature, it has often been noted that, despite their close semantic similarity, the two variants in (19) do differ for some crucial aspects. In fact, (19b) entails that the truck has been entirely "affected" by the loading event and that has been completely filled up with hay, while this same entailments of completeness lacks in (19a). Levin (1993: 118) calls this the "holistic/ partitive effect":

> The direct object in the *with* variant – the location argument – is associated with what has been called a "holistic" or "affected" interpretation; that is, the location is understood to be in some sense *completely* affected by the action.

However, the data from the corpus suggest that this is not the whole story and that the two syntactic variants may show a greater semantic distance than what appears *prima facie*. We have reported in (20a) the most frequent noun fillers that in the parsed corpus appear only as oblique complements headed by *su* in the *obj+obl/su* variant (the same as in (19a)), and in (20b) the most frequent noun fillers that in the corpus appear only as direct object in the *obj+obl/di* variant (the same as in (19b)):

(20) a.   oblique fillers in the *obj+obl/su* variant: *auto* "car", *camion* "truck", *spalla* "shoulder", *furgone* "van", *airplane* "aereo", *pullman* "bus", etc.

      b.   direct object fillers in the *obj+obl/di* variant: *voto* "vote", *personaggio* "character", *scelta* "choice", *settore* "sector", *evento* "event", *giocatore* "player", etc.

The nouns in (20b) occur in figurative contexts such as the following:

(21) a.   *caricare il voto di significato politico*
          "load the vote with political meaning"
      b.   *caricare il giocatore di troppe responsabilità*
          "load the player with too many responsabilities"

These data suggest that, like with other types of alternations, one of the two syntactic variants is more prone to acquire a figurative interpretation. Moreover, the data also suggest that the meaning contrast within the *Spray/Load Alternation* might be bigger than usually acknowledged. In fact, the key fact is that not all the possible noun

arguments of a verb like *caricare* can be alternatively realized as a direct object or as a prepositional complement headed by *su*. Only some noun fillers can legitimately appear in either variant, while others seem to be restricted just to one of the two possible syntactic forms. Indeed, the nouns in (20b) (i.e. those that in the corpus occur only as direct objects in the *obj+obl/di* variant) give rise to an anomalous or highly marked interpretation when realized as an oblique prepositional complements headed by *su*:

(22)   a.   *caricare la vita umana di significato*
                "load human life with meaning"
        b.   ?? *caricare il significato sulla vita umana*
                "load the meaning onto the human life"

A possible explanation of this contrast is that the two variants – *obj+obl/di* and *obj+obl/su* – actually differ for the role they assign to their arguments. The argument that alternates between a direct object and the oblique headed by *su* is commonly regarded as expressing a location role (cf. Levin's quotation above). However, the data we have reported might suggest that this statement needs to be refined. For instance, we might speculate that if in (19a) the noun *camion* "truck" expresses a true *location* onto which the locatum is moved, the same noun has a different role in (19b), e.g., the one of *container* in which the locatum is filled. Similarly, the notion of locatum also appears to be different in the two variants: the locatum in (19a) is an object that is moved from one place to the other, while in (19b) the locatum is rather some *material* or *substance* that fills the container. This latter supposition is also confirmed by the fact that in the *obj+obl/di* frame the locatum is typically expressed without the article (23a,b) and that a singular count noun can not be the locatum in this same variant (23c,d):

(23)   a.   *caricare il camion di fieno/libri/carbone/latte/sabbia*
                "load the truck with hay/books/coal/milk/sand/"
        b.   *caricare il/la/i fieno/libri/carbone/latte/sabbia sul camion*
                "load the hay/books/coal/milk/sand on the truck"
        c.   *caricare la televisione/statua sul camion*
                "load the tv/statue on the truck"
        d.   * *caricare il camion di televisione/statua*
                "load the truck with tv/statue"

Rather than expressing alternative realizations of identical semantic arguments, the two variants would therefore express different conceptualizations of the same event, and different conceptualizations of their participants. The fact that nouns like *camion* "truck" and *fieno* "hay" may appear in either variant may be simply due to the fact that they the former can be conceptualized either as a location or as a container, and the latter either as a moved object or as the material filling a container. If this hypothesis is true, we may therefore explain the constraint on the type of noun fillers that appear in a particular variant. For instance, we may plausibly imagine that more abstract nouns like *voto* "vote", *vita* "life" o *scelta* "choice" can be figuratively interpreted as containers – thereby being able to be realized as direct objects in the *obj+obl/di* variant -, but they are more difficultly conceptualized, even if only figuratively, as locations. Similarly, an

abstract noun like *significato* "meaning" is easily re-interpreted as the abstract content filling a figurative container like life. This would explain the contrast in (22a,b).

5   ARGUMENT ALTERNATIONS AND LEXICAL POLYSEMY

The results of the computational investigation we have carried out suggest some general consideration about the very status of argument alternations as a key phenomenon of the syntax-semantics interface as well as of the lexicon-grammar interaction. At the outset of this paper, we said that argument alternations are normally defined as a case of multiple argument realization, i.e. the phenomenon for which the same semantic arguments can be realized by more than one syntactic frames. According to this view, argument alternations are just an example of the "syntactic polymorphism" shown by verbs occurring with more than one syntactic frame, and with some of these frames actually expressing the same semantic argument properties (e.g., semantic roles, selectional preferences, and other semantic entailments). However, object/oblique alternations in Italian suggest a rather different situation, i.e. that rather than being a by-product of syntactic polymorphism, argument alternations should instead be conceived as instances of the general phenomenon of what we might refer to as *semantic polymorphism*, i.e. the ability of a verb, like any other lexical item, to express different, but related meanings depending on the context in which it appears. This conclusion is actually consistent with the claim by Dowty (2000: 111) that the very definition of argument alternations as alternative syntactic realizations of the *same* semantic argument structure is just a *fallacy*, deriving from ignoring "the main linguistic phenomenon that ought to be of interest, namely that such 'alternate' forms serve to convey significantly different meanings". Talking about the *Swarm Alternation*, Dowty actually proposes that such phenomenon should rather be investigated as part of the broader phenomenon of sense extensions:

> good reasons can be given to view it as a lexical derivation – analogous to rules of WORD FORMATION on the one hand, and to processes of LEXICAL SEMANTIC EXTENSION (Nunberg 1995) and METAPHOR on the other. [Dowty 2000: 121]

The data from the cases of object/oblique alternations in Italian that we have analyzed seem to largely support Dowty's conclusion, as well as its more specific formulation proposed by Beavers (2006) with his Principle of Semantic Contrast. There are specific different semantic entailments for which the oblique and the direct object variant differ, and in many cases these differences also determine major semantic shifts in the meaning itself of the verb, as for instances in the cases of *riparare* "repair", *premere* "press" we analyzed in section 4. Sometimes, as in the case of *caricare* "load", this shift can even result in larger semantic differences at the level of the semantic roles expressed by the verb. Truly, the interpretation of the two syntactic variants are closely related, possibly up to the point that a number of noun arguments can be shared by the two variants, thereby producing the *prima facie* – but actually fallacious - impression that the two syntactic variants express the same proposition (as in the classical example in (19)). Nevertheless, the relationship between the meaning of two alternative realizations of the same verb seems to be more akin to the relation existing between the different reading of a polysemous verb. Therefore, a more promising line of research should investigate

argument alternations as one of the many products of the generative processes that creatively operate in the lexicon (Pustejovsky 1995).

Concerning the object/oblique alternation in Italian, the data we extracted through the computational corpus-based analysis show a highly complex and multifarious situation. Verbs undergoing this type of alternations greatly vary with respect to their semantic class as well as for the type of semantic inferences associated with each variant. Besides, even if it is possible to group semantically close verbs that share the same alternation (as proved by the classes reported in the Appendixes), for each class there are many verbs that do not alternate, despite their close semantic similarity with the alternating verbs. This casts some general doubt about the standard approach in argument alternations literature to use them as a probe to find common semantic aspects of verbs that might be deemed responsible for a given alternation. These semantic formants, if any, are, at least for the cases we have analyzed in this paper, highly elusive, and surely neither necessary nor sufficient to determine whether a verb can participate in a given alternation or not.

Computational methods to extract lexical information from large corpora can indeed play a crucial role in the research on argument alternations. Most of the current research has focused on trying to map Levin's classification on corpus data, but we believe that a much more promising research avenue should apply such techniques to discover the range of argument alternations in a language, as well as to achieve a better understanding of the relationship between verb distributional behavior and verb semantics. In this paper, we have shown that even a simple quantitative measure of the overlap between the noun fillers of slots in different syntactic frames can provide us with important data to start drawing a map of object/oblique alternations in Italian. However, we should not forget that behind the measure of slots overlap lie the possibility of having pre-processed a large corpus at the syntactic level to identify the syntactic frames of the verbs and the fillers of the potentially alternant slots. Therefore, the results presented in this research have been possible thanks to the conjoined use of a wide array of methods for statistical language processing and lexical analysis, which are part and parcel of the state of the art in computational linguistics. The quantitative analysis of the degree of slot overlap between two syntactic frames have provided us with two types of evidence. On the one hand, it allowed us to identify verbs that do alternate between transitive and oblique realizations of their arguments. On the other hand, it gave us the possibility to highlight fine-grained differences among each syntactic variants.

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1. *Discutere* **verbs** Verbs expressing communication or epistemic events that concern some type of information or topic: a) *Il parlamento ha discusso la nuova legge* "The parliament discussed the new law" b) *Il parlamento ha discusso sulla nuova legge* "The parliament discussed ON the new law" Levin (1993): *Preposition Drop Alternations* (1.4) Comments: Some verbs also alternate with oblique complements headed by *di* Non-alternating verbs (only comp_*su*) *vertere* "to concern", *ironizzare* "to ironize", *discettare* "to debate", *riflettere* "to meditate", *insistere* "to insist", *legiferare* "to make laws", *scherzare* "to joke", etc.	*discutere* "to discuss" *decidere* "to decide" *votare* " to vote" *deliberare* " to approve" *negoziare* " to negotiate" *indagare* "to inquire" *tacere* "to be silent about" *dibattere* "to debate" *riferire* "to tell" *investigare* "to investigate" *testimoniare* "to witness" *fantasticare* "to day-dream" *meditare* "to meditate" *rimuginare* "to brood over" *glissare* "to pass over" *sorvolare* "to pass over" *argomentare* "to argue" *recriminare* "to recriminate"
2. *Spingere* **verbs** Verbs expressing the exertion of force on a surface a) *Il parlamento spinge la nuova legge* "The parliament pushes the new law" b) *Il parlamento spinge sulla nuova legge* "The parliament pushes ON the new law" Levin (1993): *Conative Alternation* and verb class 12 (*Verbs of Exerting Force*) Non-alternating verbs (only comp_*su*) *poggiare* "to rest", *pesare* "to weigh", etc.	*spingere* "to push" *pigiare* "to press" *gravare* "to weigh" *premere* "to press" *picchiare* "to strike" *manovrare* "to manouvre" *battere* "to strike"

3. *Sorvegliare* **verbs** Verbs expressing control or surveillance over an entity a) *Il parlamento sorveglia il rispetto della normativa* "The parliament supervises the enforcement of the new law" b) *Il parlamento sorveglia sul rispetto della normativa* "The parliament supervises ON the enforcement of the new law" Levin (1993): *Preposition Drop Alternations* (1.4) Non-alternating verbs (only obj_d) *controllare* "to control", *verificare* "to verify", etc.	*sorvegliare* "to supervise" *vegliare* "to watch" *dominare* "to dominate" *comandare* "to command"
4. *Risparmiare* **verbs** Verbs expressing saving or earning a) *Il dipartimento risparmia sulla carta* "The department saves ON paper" b) *Il dipartimento risparmia la carta* "The parliament saves the paper" Levin (1993): *Preposition Drop Alternations* (1.4)	*risparmiare* "to save" *lucrare* "to earn" *lesinare* "to save"
5. *Scrivere* **verbs** Verbs referring to the creation or use of some information recorded in an artifact: a) *Gianni ha scritto questo libro* "John wrote this book" b) *Gianni ha scritto su questo libro* "John wrote ON this book" Levin: *Preposition Drop Alternations* (1.4) Comments: The direct object typically presents a regular	*scrivere* "to write" *leggere* "to read" *pubblicare* "to publish" *disegnare* "to draw"

polysemous alternation between information and artifact (cf. Pustejovsky 1995)	
6. _Caricare / Spruzzare_ verbs Load and spray verbs. The location argument can be realized either as a direct object or as an oblique <u>Alternation:</u> a) V **obj_d comp_su_i** b) V **obj_d$_i$ comp_di** a) _Gianni ha caricato i libri sul camion_ "John loaded the books ON the truck" b) _Gianni ha caricato il camion (di libri)_ "John loaded the truck with books" <u>Levin (1993):</u> _Locative Alternation_ (_Spray / Load_) (2.3.1) and verb class 9.7 (_Spray/Load Verbs_)	_caricare_ "load" _spalmare_ "smear" _spruzzare_ "spray"

7. *Adempiere* verbs Verbs expressing events of obeying or disobeying to some rule, duty, etc. a) *Gianni ha adempiuto il suo incarico* "John fulfilled his task" b) *Gianni ha adempiuto al suo incarico* "John fulfilled TO his task" Levin (1993): *Preposition Drop Alternations* (1.4) Comments: Cf. *"Obey" verbs* in Blume (1998) Non-alternating verbs (only obj_d) *violare* "to violate", *rispettare* "to respect", etc.	*adempiere* "to fullfill" *trasgredire* "to infringe" *contravvenire* "to infringe" *ottemperare* " to fulfill" *abdicare* "to abdicate" *assolvere* "to fulfill" (e.g., *assolvere un incarico* "fulfill a task")
8. *Presenziare* verbs Verbs expressing attendance (possibly including some form of control) at an event a) *Gianni ha presenziato la riunione* "John attended the meeting" b) *Gianni ha presenziato alla riunione* "John attended TO the meeting" Levin (1993): *Preposition Drop Alternations* (1.4) Non-alternating verbs (only comp_*a*) *partecipare* "to participate", etc.	*sovrintendere* "to superintend" *presenziare* "to attend" *presiedere* "to preside
9. *Rimediare* verbs Verbs expressing acts of correcting or remedying a mistake. a) *Maria ha rimediato gli errori di Gianni* "Mary remedied John's mistakes" b) *Maria ha rimediato agli errori di Gianni* "Mary remedied TO John's mistakes"	*rimediare* "to remedy" *riparare* "to repair" *supplire* "to make up for" *ovviare* "to make up for" *sopperire* "to make up for"

Levin (1993): *Preposition Drop Alternations* (1.4)	
10. ***Applaudire* verbs** Verbs referring to the expression of consensus to something or somebody a) *Gianni ha applaudito il suo discorso* "John applauded his speech" b) *Gianni ha applaudito al suo discorso* "John applauded TO his speech" Levin (1993): *Preposition Drop Alternations* (1.4)	*applaudire* "to applaud" *inneggiare* "to exalt" *ammiccare* "to wink" *plaudire* "to applaud" *acconsentire* "to consent"
11. ***Pensare* verbs** Verbs of thinking or imagining a) *Gianni ha pensato una strategia* "John thought a strategy" b) *Gianni ha pensato a una strategia* "John thought TO a strategy" Levin: *Preposition Drop Alternations* (1.4)	*pensare* "to think" *ripensare* "to rethink" *guardare* "to look at"
12. ***Reggere* verbs** Verbs expressing resistance to something or somebody: a) *Il muro ha retto l'impatto* "The wall resisted the impact" b) *Il muro ha retto all'impatto* "The wall resisted TO the impact" Levin (1993): *Conative Alternation* and verb class 12 (*Verbs of Exerting Force*) Comments: Cf. *spingere* verbs above	*reggere* "to resist" *resistere* "to resist"

13. *Fuggire* verbs Verbs express events of eluding something dangerous a) *Gianni ha scampato il terremoto* "John escaped TO the earthquake" b) *Gianni è scampato al terremoto* "John escaped TO the earthquake" <u>Levin</u> *Locative Preposition Drop Alternation* (1.4.1) <u>Comments:</u> The intransitive variant requires *essere* "to be" as auxiliary <u>Non-alternating verbs</u> (only obj_d) *evitare* "to avoid", etc.	*fuggire* "to avoid" *sfuggire* "to avoid" *scampare* "to escape"
14. *Rimproverare* verbs Verbs typically referring to events concerning the communication of feelings or opinions about somebody in relation to some action he/she performed <u>Alternation:</u> a) V **obj_d$_i$ comp** b) V **obj_d comp_a_i** a) *Maria ha rimproverato <u>la squadra</u> (per la sconfitta)* "Mary reproached the team (for the defeat)" b) *Maria ha rimproverato la sconfitta <u>alla squadra</u>* "Mary reproached TO the team the defeat" <u>Levin</u> *Possessor-Attribute Alternations* (2.13) <u>Comments:</u> The recipient of the event can be realized either as the direct object or as an oblique	*rimproverare* "to reproach" *delegare* "to delegate" *assicurare* "to assure" *perdonare* "to forgive" *consigliare* "to advise" *invidiare* "to envy" *garantire* "to grant" *contestare* "to contest" *sconsigliare* "to advise against" *scusare* "to apologize" *minacciare* "to threaten" *sollecitare* "to urge" *rimborsare* "to reimburse"
15. *Autorizzare* verbs Verbs referring to events concerning the granting of some permission or the exhortation to act to	*autorizzare* "to authorize" *istigare* "to instigate"

somebody Alternation: a) V **obj_d**$_i$ b) V **obj_d comp_***a*$_i$ a) *Maria ha autorizzato la partenza (di Gianni)* "Mary authorized (John's) departure" b) *Maria ha autorizzato Gianni alla partenza* "Mary authorized John TO the departure" Levin *Possessor-Object* (2.13.1) Comments: The theme of the event can be realized either as the direct object or as an oblique	