Identifying actional features through semantic priming: cross-Romance comparison*

ABSTRACT

This paper reports four priming experiments in Italian and Spanish, whose main goal was to empirically verify the psychological reality of two aspectual features crucially involved in event type classification, resultativity and durativity. The participants performed two semantic decision tasks targeting these features: in the durativity task, they were asked whether the verb referred to a durable situation, and in the resultativity task whether it denoted a situation with a clear outcome. The results obtained prove that both features are involved in online processing of the verb meaning: achievements and activities (respectively classified as [+resultative, -durative] and [-resultative, +durative]) were processed faster in certain priming contexts. This suggests that resultativity and durativity belong to the mental representation of verbal semantics. The pattern of priming effects obtained in the Romance languages presents some striking similarities (in the resultativity task, only achievements benefited from priming) alongside some intriguing differences, and clearly contrasts with the behaviour of another language tested, Russian, whose aspectual system differs in significant ways. Two hypotheses can be proposed to account for these results, both pointing to some sort of processing advantage for the achievements. The first hypothesis invokes the nature of the features involved: durativity is continuous and contextually malleable, whereas resultativity is binary and hence more stable. The second hypothesis focuses on the ontology of events, predicting that priming emerges when the target verb is actionally ambiguous. In this respect, transitively used activity verbs should occasionally yield priming, for they may be used as accomplishments. However, transitivity was not systematically controlled in the experiments reported below. Achievements, on the other hand, are inherently ambiguous: they can refer either to the moment at which a change of state occurs or to the resultant state itself.

1. INTRODUCTION

Most current theories of aspect assume a decompositional (i.e. featural) approach to represent the temporal properties of events, regardless of where they place them, lexical semantics or syntax. This approach facilitates developing flexible models of

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Some of the results reported in this paper have been discussed in Zarcone (2008), Zarcone and Lenci (2010), and Batiukova *et al.* (2012).

aspectual interpretation, capable of accounting for a number of intriguing properties of the so-called syntax-semantics interface, and for the notorious variability of aspectual manifestations across languages, both typologically close and distant (see Dölling *et al*. 2008).

Despite their theoretical significance, until relatively recently the assumptions of these theories had not been tested empirically. Many available psycholinguistic studies combine reading tasks with online methodologies (eye-tracking, Event Related Potentials [ERP], magnetoencephalography [MEG], etc.) to investigate a wide range of phenomena, most prominently aspectual coercion (Todorova *et al*. 2000, Pylkkänen and McElree 2006, Bott 2008, Brennan and Pylkkänen 2008, Pylkkänen 2008, etc.), and processing of event types as either monolithic ontological categories (Finocchiaro and Miceli 2002) or as entities of varying degrees of complexity (Gennari and Poeppel 2003). What is important for our purposes is that most investigations presuppose the existence of some kind of internal structure (in terms of sub-events, boundaries, etc.), but none, to our knowledge, has tested the psychological salience at the level of verb semantics[1]. Instead, stress lies on the verb phrase (VP), which is coherent with a compositional approach to aspectual interpretation but has the disadvantage of masking, at least in part, relevant components of verb meaning, since a number of diverse factors come into play (such as number and definiteness of the direct object, time and manner adverbial modifiers, etc.).

This study focuses on two features underlying the classical Vendlerian classification: durativity and telicity (or: culmination and, in one of its meaning, "resultativity"). The experiments reported here were motivated by the following theoretical questions:

– Is a feature-based approach to event types empirically justified?

– Are the speakers able to consciously identify the verbs marked with these features?

– Are the durativity and telicity features a salient component of the mental representation of verb semantics, and as such involved in the on-line processing of verb meaning?

– What are the processing properties of these features in closely related languages (French, Italian, and Spanish), and how do they contrast with a language belonging to another typological group (Russian, whose aspectual characteristics differ from Romance in several crucial respects)?

This paper is structured as follows. Section 2 provides general background on the experimental setting and the procedure of data selection. Section 3 introduces the specifics of the methodology followed in the Italian and Spanish experiments and the statistical analysis of results. Section 4 briefly presents the results of a similar experiment conducted on Russian and compares them with those relating to Romance. Section 5 sums up the findings of this study, offers a qualitative analysis of the data, and assesses their implications for the theory of aspect.

[1] Finocchiaro and Miceli (2002) do include verbs as isolated items in picture comprehension and naming tasks, but they do not invoke the internal composition of events to account for their observations. One reviewer suggested us to mention work by the "Heidelberg group" (e.g., Carroll and Stutterheim (2011), Carroll et al. (2003)). It seems to us, however, that although these scholars addressed with indeed interesting results the comparative conceptualization and construal of different event types by speakers of different languages, the present issue (aspectual features as lexically encoded by verbs) was not dealt with in their studies.

2. THE PRESENT STUDY: AN OVERVIEW

2.1. Background

The general design of our experiments was inspired by the semantic priming technique used in Bonnotte (2008). A semantic priming effect may be defined as "improvement in speed or accuracy to respond to a stimulus [called *target*], when it is preceded by a semantically related stimulus [called *prime*] (e.g., *cat-dog*) relative to when it is preceded by a semantically unrelated stimulus (e.g., *table-dog*)" (McNamara 2005: 3-4).

Bonnotte tested two classes of French verbs, non-durative resultatives and durative non-resultatives (i.e., achievements and activities in Vendler's terms, respectively). The subjects performed two semantic decision tasks: in the durativity task, they had to answer whether the target verb denoted a durable situation; in the resultativity task, they had to decide whether the target verb denoted an event with a clear outcome. From now on, the term "resultative" will be used instead of the possible alternative "telic", both in order to conform to the terminology used in Bonnotte (2008) and, above all, to highlight the contrast between the featural level (durative, resultative) and the event type level (activity, achievement, telic…).

As is customary in priming experiments, each target was preceded by a similar, an opposite or a neutral prime. Similar primes for non-durative resultative targets were non-durative resultatives, while opposite primes were durative non-resultatives. Neutral primes were a non-linguistic string (XXXXXX); they yield the baseline against which the priming effect is evaluated. This can be facilitating, if the prime speeds up the processing of the target, or inhibiting, if it slows it down. Each prime was displayed on the screen for 100ms or 200ms (depending on the experiment) and was followed by the target, which remained on the screen until the participant responded.[2]

The data set included both transitive and intransitive verbs, and was balanced for the variables known to affect the processing cost: frequency (all verbs were frequent) and length (only trisyllabic verbs were included).

In both tasks, a significant facilitating priming effect was detected, as summarized in table (1).

(1) Summary of the results of Bonnotte (2008). One star (*) stands for 'statistically significant effect' ($p<0.05$).

	DUR[3]		RES	
	ACH	ACT	ACH	ACT
opposite		*		
similar		*	*	

[2] SOAs shorter than 300ms are commonly used in semantic priming experiments. On the one hand, short SOAs have been shown sufficient to tap the prime meaning and yield priming effects. On the other hand, they reduce the effects of the so-called strategic processing, associated to longer SOAs. When participants have enough time to become aware of the (un)relatedness of primes and targets, they might build more or less conscious beliefs about what is shown, with undesirable consequences on the experimental results (see McNamara 2005: ch.9, and Bonnotte2008: 206, among others). In our experiments we adopted the 200 ms presentation time to be sure that the prime was indeed (mostly subconsciously) perceived by the participants, without activating any strategic process.

[3] The following abbreviations will be used henceforth: DUR – durativity, RES – resultativity, ACH – achievement, ACT – activity.

In prose, the processing of activities was sped up when preceded by both activities and achievements in the durativity task, while the processing of achievements was only facilitated by achievement primes in the resultativity task. Bonnotte's conclusions pointed out two issues. Firstly, there seems to be a clear relation between the feature activated in each task and its value, since only the positive value of each feature benefited from priming (activities, positively marked for durativity, were primed in the durativity task, while achievements, positively marked for resultativity, were primed in the resultativity task). Secondly, a striking asymmetry between the two features was detected: a significant facilitation was found on activities with both similar and opposite primes, whereas it was observed on achievements with similar primes only. According to Bonnotte, this asymmetry arises because resultativity is a binary feature and durativity a continuous one: the semantic activation of the latter feature is faster and therefore more prone to be affected by priming.

As described in the next section, our Italian and Spanish experiments presented a number of modifications in data selection with respect to Bonnotte's design. These modifications were introduced to minimize any semantic effect not related to aspect, and to protect the aspectual classes tested from any factor that might blur the semantic interpretation (e.g., the dichotomy achievement / punctual).

2.2. Preliminary work on data sets

A well-known fact about verbal semantics is that it is heavily dependent on context. This undoubtedly complicates the task of singling out stable aspectual components to justify the use of verbs in isolation as experimental stimuli. However, it is also undeniable that most verbs possess core aspectual properties, which allow us to classify them, ultimately restricting the possible alternations to a few systematic and predictable patterns (see Finocchiaro and Miceli 2002 for a similar reasoning).

To reduce contextual 'noise' and to make sure that the verb alone would license the aspectual interpretation, we avoided the direct object construction by focusing on intransitive verbs only[4], which were further annotated for event type (activity or achievement[5]).

Activities are quite uncontroversial and relatively easy to define and detect. The class of achievements, however, has been treated differently in different models of aspectual semantics due to its intriguing properties. We will assume here the most common approach, defining achievements as non-durative telic/resultative predicates, implying a culmination or 'change of state' followed by a 'resultant state' (cf. Dowty 1979: §2, Bertinetto 1986, Mittwoch 1991, Smith 1991: §2.4.4., Pustejovsky 1995, Rothstein 2004 and 2007, De Miguel and Fernández Lagunilla 2007, Ramchand 2008: §4, among others). This definition excludes from the class of achievements the so-called punctuals, i.e. non-durative atelic events.[6]

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[4] The same reason justifies the exclusion of accomplishments from the data set. This class is obviously appealing inasmuch as it allows for the testing of the combination of features [+resultative, +durative], but there are few if any lexical (i.e., non-phrasal) accomplishments in Romance.

[5] Originally, both transitive and intransitive verbs were included in the Italian experiment. However, we only report here observations relating to intransitives for consistency. See the conclusions for additional comments.

[6] A radically different position on the nature of achievements is adopted by Piñón (1997). He suggests that achievements represent boundaries (beginnings or endings) of other events ('happenings' in his terminology). As a consequence, according to Piñón true achievements must be punctual and do not

Batteries of tests were run in Spanish to guarantee that there were no punctuals in the data set. Although punctuals represent a relatively small group and resemble achievements in being non-durative, their internal structure (and hence their behaviour and possibly their processing[7]) is different. The most important dissimilarity for our purposes is that punctuals lack an identifiable resultant state[8].

The presence of a resultant state makes it possible for the achievements to combine with *for*-adverbials. Even though achievements are [-durative], the extent of their resultant state can be measured (provided it defines a reversible state, of course, as in (2a)). Punctuals, by contrast, do not have a resultant state phase and thus reject *for*-adverbials (as in (2b)).

(2) a. Se sent-ó {cinco minutos / un rato}
Sit down-PRET-3S five minutes / a while
'He/she sat down {for five minutes / for a while}'
b. *La bomba estall-ó {cinco minutes / un rato}
The bomb explode-PRET-3S five minutes / a while
*'The bomb exploded {for five minutes / for a while}'

Another test used was the <*estar* + past participle> construction ('*to be/stay* + past participle'), which targets the resultant state, whether reversible or not. Again, this construction is out with punctuals.

(3) a. Estar sentado / estar asustado
Be sitted / be afraid
b. *Estar estallado / *estar descarrilado
Be exploded / be derailed

The preparation of the data sets included the counterbalancing of materials, to avoid the interference of factors other than the mere semantic actionality-based relation between primes and targets. Two such factors are word frequency[9] and length. They were controlled for in such a way that no significant difference could be noted between the mean values of both actional groups (activities and achievements), neither in Italian (length, Kruskal-Wallis: df =1; χ_2 =0; p=1; frequency, Kruskal-Wallis: df = 1; χ_2 = 1.683; p = 0.2) nor in Spanish (length, Kruskal-Wallis: df =1; χ_2 =0.7148; p=0.3978; frequency, Kruskal-Wallis: df = 1; χ_2 = 0.698; p = 0.4034).

One non-quantitative parameter known to affect semantic priming is general semantic relatedness of primes and targets (cf. McNamara 2005: 54). It is worth mentioning that this variable was not controlled for in Bonnotte's original design. To prevent any interference, we took care to pair up verbs belonging to different semantic classes. Semantic class labels partially correspond to WordNet's topnodes categorization.

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denote change of state by themselves, although they do presuppose it. Marín and McNally (2011) applied this event semantics to Spanish psych verbs.

[7] There is at least one experimental study we are aware of, where punctuals were separated from achievements, namely Finocchiaro and Miceli (2002).

[8] The other major distinguishing feature of punctuals is that, unlike achievements, they cannot express an imminential meaning, encoded by the preparatory phase. This is why they can only have ongoing interpretation in progressive form; compare *The bomb is exploding* ('right now': slow motion or ongoing interpretation) with *We are leaving* (which can also be read imminentially: 'we are about to leave'). See Dini and Bertinetto (2000) for details.

[9] Word frequencies were taken from CoLFIS (Corpus e Lessico di Frequenza dell'Italiano Scritto) and from the Spanish Web Corpus, integrated into the Word Sketch Engine.

In the Italian experiment, the condition on prime-target pairs was that they did not belong to the same semantic class (see appendix B). In the Spanish experiment, the requirement was somewhat tighter. Given that several WordNet semantic groups overlap (a direct consequence of the way the lexical system is structured), prime and target were chosen so that they would not belong to semantically close classes: state-emotion-body process, social-communication, change-creation-consumption, motion-contact-possession, and cognition-perception.[10]

3. METHOD

3.1. Participants

The experiments were conducted in Pisa (Scuola Normale Superiore) and Madrid (Universidad Autónoma de Madrid). The participants were 48 Italian and 72 native Spanish speakers (after discarding 8 participants due to exceedingly high error rate), mostly undergraduate students with little or no background in linguistics or psychology. All had normal or corrected-to-normal vision.

3.2. Materials

A total of 30 verbs were used for Italian and 60 verbs for Spanish (half activities, half achievements, see Appendix B). The general scheme of how verbs from different groups were paired is in (4). As in Bonnotte (2008), activities and achievements were used as both primes and targets. Similar primes belong to the same group as the targets while opposite primes come from the other group. A sequence of Xs was used as a neutral prime (the baseline for comparison).

(4)	PRIMES	ACT	ACH	neutral (XXX)
	TARGETS	ACT	ACH	

A number of lists were constructed, and the same lists were used for both tasks (durativity and resultativity tasks). Each target appeared only once in each list, and was paired with an opposite, a similar or a neutral prime.

In addition to 30 prime-target pairs, each Spanish list included 9 distractor pairs. This addition was deemed necessary since most Spanish achievements are pronominal verbs (i.e., 24 out of 30 verbs end in *-se*), and we did not want the subjects to be guided by morphological cues rather than by the verb meaning. The distractors (both primes and targets) belong to the following categories:

(5) a. Pronominal non-achievements
– Vs used pronominally only: *quejarse* 'complain', *mofarse* 'make fun of someone'…
– Reflexive forms: *ducharse* 'take a shower', *afeitarse* 'shave oneself'…
b. Attenuative-frequentative forms: *golpetear* 'patter', *gimotear* 'whine'…
c. Iteratives: *releer* 're-read', *rehacer* 'redo'…

[10] See Zarcone (2008) for more details on the data preparation for the Italian experiments.

d. Punctuals: *acceder* 'access, agree', *perforarse* 'rupture'…
e. Gradual completion verbs: *ennegrecer* 'blacken'

The lists were structured following the schemes in (6):

(6) a. Structure of the lists: Italian

A		B		C	
prime	target	prime	target	prime	target
3 ACT	3 ACT	3 ACH	3 ACT	XXX	3 ACT
3 ACH	3 ACH	3 ACT	3 ACH	XXX	3 ACH
XXX	3 ACT	3 ACT	3 ACT	3 ACH	3 ACT
XXX	3 ACH	3 ACH	3 ACH	3 ACT	3 ACH
3 ACH	3 ACT	XXX	3 ACT	3 ACT	3 ACT
3 ACT	3 ACH	XXX	3 ACH	3 ACH	3 ACH

b. Structure of the lists: Spanish
(DIS – 'distractor')

A		B		C	
prime	target	prime	target	prime	target
5 ACT	5 ACT	5 ACH	5 ACT	XXX	5 ACT
5 ACH	5 ACH	5 ACT	5 ACH	XXX	5 ACH
3 DIS	3 DIS	3 DIS	3 DIS	XXX	3 DIS
XXX	5 ACT	5 ACT	5 ACT	5 ACH	5 ACT
XXX	5 ACH	5 ACH	5 ACH	5 ACT	5 ACH
XXX	3 DIS	3 DIS	3 DIS	3 DIS	3 DIS
5 ACH	5 ACT	XXX	5 ACT	5 ACT	5 ACT
5 ACT	5 ACH	XXX	5 ACH	5 ACH	5 ACH
3 DIS	3 DIS	XXX	3 DIS	3 DIS	3 DIS

The Italian experiment only used 3 lists (A, B, C); in the Spanish experiment, lists D, E and F were formed by (pseudo-randomly) reversing the order of primes and targets (the targets from lists A, B and C were used as primes in lists D, E and F, and *vice versa*). This was done in order to test more items. Each participant was assigned only one list, in order to prevent undesired enhancing of priming effects.

3.3. Procedure

The participants were tested individually using the Presentation experimental software. The stimuli were presented in white lower-case letters on a black background to reduce eye fatigue. Each trial consisted of a fixation point displayed in the centre of the screen, followed by the prime and the target consecutively. As shown in (7), the timing of each phase was similar in Italian and in Spanish. The only relevant difference is that in the Spanish experiment the prime was displayed for a slightly shorter period of time (in the SOA cell, 'stimulus onset asynchrony'). Shorter SOA was used in Spanish because the stimuli were more frequent than the Italian ones, and hence could be processed faster.

(7) Structure of trials

	Italian	Spanish

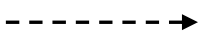
	structure of trials	example	structure of trials	example
Fixation point	750ms	+	600ms	+
Blank screen	750ms		-	
Prime (SOA)	300 ms	*discutere* (opposite) *scomparire* (similar) *XXXXX* (neutral)	250 ms	*salvarse* (opposite) *batallar* (similar) *XXXXX* (neutral)
Target	5000 ms, or until the participant's answer	*sbarcare*	5000 ms, or until the participant's answer	*navegar*

During the instruction phase, the subjects were shown illustrative examples of activities and achievements, although no specific linguistic criteria were provided (see (8) and (9)). In addition, two drawings graphically representing each aspectual group were included. The ones given below are those used in the Spanish instructions; the ones used in the French and Italian experiments were very similar. The participants' attention was drawn to the differences between the pictures: the length of the line symbolizes duration and the presence of a vertical bar at the end of the arrow denotes result or culmination.

(8) Spanish (examples):

a. [+resultative,-durative]: *venir* 'come', *aparecer* 'appear', *encenderse* 'come on, light', *mancharse* 'get dirty, get stained'

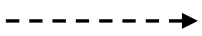
b. [-resultative,+durative]: *andar* 'walk', *patrullar* 'patrol', *vaguear* 'laze around'



(9) Italian (examples):

a. [+resultative,-durative]: *inciampare* 'stumble', *pungersi* 'prick oneself'

b. [-resultative,+durative]: *pattinare* 'skate', *scarabocchiare* 'scribble'



The participants were instructed to read and identify the first word or letter string, and to decide as quickly and accurately as possible whether the second word 'referred to an event with a clear outcome' (in the resultativity task) or whether it 'denoted a durative event' (in the durativity task). The left and right keys of the button box were used to respond in the Italian experiment, the upper and lower keys in the Spanish experiment. The positive answer was associated with the preferred hand of the individual subject.

The instruction was completed with a training session, made up of nine trials for Italian and seven trials for Spanish. Each subject was assigned a single list; the trial order was fixed for Italian and automatically randomized every time a list was displayed for Spanish.

3.4. Design

In the statistical analyses, the dependent measures were decision latency and accuracy. The decision task (durativity or resultativity) and the list assigned were between-subjects factors; within-subject factors were the event type value of the target (activity or achievement) and the type of priming context (neutral, opposite or similar).

3.5. Results

In the decision latency analysis, trials with wrong responses (e.g., a [+durative] verb judged as [-durative]) and outliers were excluded. Data points with z-scores beyond ±2 after a z-transformation by participant and by item were considered outliers and answers given past the 5000 ms limit were considered wrong. In Italian, wrong responses were 18% of the total observations in the resultativity task and 11% in the durativity task; outliers were 8% of the correct responses in the resultativity task and 5% in the durativity task. In Spanish, wrong responses were 14% of the total observations in the resultativity task and 12% in the durativity task; outliers were 7% of the correct responses in the resultativity task and 8% in the durativity task.

A logistic regression analysis of errors revealed no effect of priming context, featural value or any other factor. As the data in table (10) show, accuracy rates are quite high (82-89%) and similar in both languages. The fact that accuracy in the durativity task is higher than in the resultativity task suggests that the latter was more difficult.

(10) Accuracy rates

	Italian			Spanish		
	ACT	ACH	Mean	ACT	ACH	Mean
RES	0.86	0.79	0.82	0.91	0.82	0.86
DUR	0.88	0.89	0.89	0.93	0.82	0.88

As far as processing speed is concerned, faster decision latencies were registered in Italian (see the data in (11)). Across event types (MEAN1), activities yielded shorter reaction times than achievements, with the only exception of the resultativity task in Spanish, where achievements were processed a little faster (1827 ms vs. 1836 ms). The decision latencies in the durativity task are shorter than in the resultativity task (MEAN2), confirming that the latter task was more difficult.

(11) Decision latencies in ms.

a. Italian

	RES		DUR	
Priming context	ACH	ACT	ACH	ACT
Neutral	1558	1309	1370	1291
Opposite	1335	1227	1242	1186
Similar	1472	1296	1312	1100
MEAN1	1455	1277	1308	1192
MEAN2	1366		1250	

b. Spanish

	RES		DUR	
Priming context	ACH	ACT	ACH	ACT
Neutral	1867	1866	1992	1711
Opposite	1762	1798	1860	1640
Similar	1851	1845	1827	1686

MEAN1	1827	1836	1893	1679
MEAN2	1831		1786	

In both languages, reaction times corresponding to targets in similar and opposite prime contexts were faster than in the neutral prime condition (see Appendix A for separate analyses). A mixed-effect model on decision latencies showed that the facilitating effect, with activities as primes, reached significance for Italian achievements in both tasks and for activities in the durativity task. Spanish achievements also yielded significant priming effect in both tasks; they were indeed the only event type significantly affected by priming. This occurred with both types of primes in the durativity task and with activities only in the resultativity task. The fundamental parallelism between the two languages is that achievements were consistently primed by activities in both tasks.

The following table sums up the findings, with one star (*) standing for 'significant effect' ($p<0.05$) and two stars (**) for 'highly significant effect' ($p<0.01$).

(12) Priming effects in Italian and Spanish

	Italian				Spanish			
	DUR		RES		DUR		RES	
	ACH	ACT	ACH	ACT	ACH	ACT	ACH	ACT
opp	*		**		*		*	
sim		**			**			

4. ROMANCE VS. RUSSIAN

The actional-aspectual system of Slavic languages (among which Russian) differs from Romance in two crucial respects: it is highly grammaticalized and overtly encoded by means of morphological markers. Every verbal form (including the non-finite ones) refers to either the 'perfective' or the 'imperfective' grammatical aspect. For clarity's sake, we use these terms between quotes in order to remind the reader of the peculiar character of the Russian verbal system (as well as that of most northern Slavic languages), whereby the categories of aspect and actionality, in their neutral, i.e. typologically general meaning, appear to be strictly intertwined. Considering this fundamental property, the idea of testing isolated infinitives (both transitive and intransitive) was entirely justified.

A detailed description of the Russian experiment is beyond the scope of this paper (see Batiukova *et al*. 2012 for specifics). However, a brief summary sets the scene for cross-linguistic comparison.

In the Russian experiments, a single semantic decision task was performed, whereby the subjects had to answer whether the target yielded a clear result or not (the question was the same as for French, Italian and Spanish). Three groups of Russian verbs were tested[11]: non-prefixed imperfectives (e.g., *xrapet'* 'snore', *pomogat'* 'help', *šutit'* 'joke'), non-prefixed perfectives (e.g., *ucelet'* 'survive', *najti* 'find', *isčeznut'* 'disappear') and prefixed perfectives (e.g., *porvat'* 'tear', *vylečit'* 'cure, heal', *upast'*

[11] There was a fourth group, namely the 'delimitatives', tested in a separate experiment. We do not discuss them here for coherence's sake. See however Batiukova *et al*. (2012).

'fall'). In actional terms, the first group includes activities (atelic), while the second and third include telic predicates. These groups were combined as primes and targets in three experiments:

(13) Combinations of primes and targets in the Russian experiments
(PRO – 'processual' (i.e., 'non-resultative'), RES – 'resultative')[12]

	Primes	Targets
Experiment 1	Non-prefixed RES Imperfective PRO	Non-prefixed RES Imperfective PRO
Experiment 2	Prefixed RES Imperfective PRO	Prefixed RES Imperfective PRO
Experiment 3	Prefixed RES Imperfective PRO	Non-prefixed RES Imperfective PRO

The goals were two-fold: to check whether Russian speakers identify a one-to-one correspondence between resultativity and 'perfectivity'; to assess the impact of morphological cues on decision latencies and accuracy.

The analysis of the results showed that the given task was easy for the native speakers: accuracy rates were 93%-94% in all experiments, well above the levels obtained in Italian and Spanish (cf. table (10)). The highly grammaticalized nature of the Russian aspect certainly played an important role here (possibly activating the metalinguistic awareness of the speakers), because the correlation between resultativity and 'perfectivity' was quite strong. An additional facilitating factor was aspectual morphology: lowest decision latencies were obtained in experiment 2, where prefixed perfectives were used[13] (see table 14). Note, however, that with respect to reaction times Russian only outscored Spanish: the decision latencies reported for French in Bonnotte (2008: 209) are faster, and so are the Italian ones (cf. (11a)).

(14) Summary of decision latencies in Russian

	Experiment 1		Experiment 2		Experiment 3	
Priming context	RES	PRO	RES	PRO	RES	PRO
Neutral	1788	1794	1630	1521	1670	1627
Opposite	1674	1692	1591	1545	1638	1472
Similar	1736	1710	1570	1564	1575	1504
MEAN1	1733	1732	1597	1543	1628	1535
MEAN2	1733		1570		1582	

As for the priming effects, the only group the processing of which was significantly sped up after both types of primes were the processuals in experiment 1 and 3, as shown in table (15). Absence of priming on resultative targets can be accounted for by the reasons put forth above: the identification of 'perfective' forms as resultatives was an intrinsically easy task, which may have hindered any priming effect. In experiment 2, the presence vs. absence of morphological markers exacerbated the

[12] The use of these labels ('processuals' and 'resultatives') is justified by the fact that Russian verbs do not fit in well with the canonical Vendlerian classes. As a matter of fact, some 'imperfectives' can be interpreted as accomplishments in the appropriate context (*gasit'* 'extinguish, put out', *žarit'* 'fry', etc.). As for 'perfectives', although they usually carry a telic meaning (even when they correspond to potentially ambiguous verbs in other languages, such as: *pomyt'* 'wash', *vyrostit'* 'grow, raise', etc.), they may also involve 'bounded', rather than *stricto sensu* telic, events (cf. the so-called delimitatives and the punctual-semelfactives).

[13] Given that non-prefixed 'perfectives' are significantly more frequent and hence have an *a priori* processing advantage over the prefixed ones, this finding appears to be revealing.

contrast between both groups tested, facilitating their recognition and ultimately levelling out any tendency to priming. This pattern clearly contrasts with that of French, Italian and Spanish, where facilitation was only detected on achievements in the resultativity task (recall the summary in (12)).

(15) Priming effects in Russian

	Exp1		Exp2		Exp3	
	RES	PRO	RES	PRO	RES	PRO
opp		*				***
sim		*				**

5. GENERAL DISCUSSION AND CONCLUSIONS

One of the goals of this study was to show that a feature-based approach to event types is empirically justified and, more specifically, that the durativity and resultativity features are a salient component of verbal semantics, involved in the on-line processing of verb meaning. We believe that the evidence collected helps us shed light on both points. It is quite likely that these features are consistently exploited in semantic priming, which confirms that they belong to the mental representation of verb meaning.

In a cross-linguistic perspective, there seem to be obvious similarities among the three Romance languages (where only achievements were primed in the resultativity task), alongside some differences. Russian, on the other hand, yielded a completely divergent pattern, in that only processual targets were primed. For convenience's sake, the data summary of all four languages is repeated below.

(16) Priming effects across languages

	FRENCH				ITALIAN				SPANISH				RUSSIAN	
	DUR		RES		DUR		RES		DUR		RES		RES	
	ACH	ACT	ACH	ACT	ACH	ACT	ACH	ACT	ACH	ACT	ACH	ACT	RES	PRO
opp		*			*		**		*		*			*
sim		*	*			**			**					*

These results call for a principled explanation. As mentioned in section 2.1, one of Bonnotte's claims is that only targets positively marked with a given feature are primed in the task focusing on this feature (i.e., activities are primed in the durativity task, achievements in the resultativity task). However, this generalization is not borne out by the other languages (Russian provides a particularly striking counterexample), which suggests that the explanation must reside somewhere else.

An alternative line of reasoning is based on the nature of the event type categories and their features. All previous studies (Bonnotte 2008, Zarcone and Lenci 2010, and Batiukova *et al*. 2012) converge in pointing out that sensitivity to priming could be related to the degree of contextual adaptability of the event type. The word "context" should be interpreted, here, as referring to the specific experimental setting, whereby each prime builds up the target's context. This approach certainly accounts for the Russian data. According to Bonnotte, activities are highly dependent on context and are thus supposed to yield priming. This, however, is based on the debatable assumption that the durativity feature, as opposed to the resultativity one, is intrinsically 'adjustable'.

A further, conceivable claim is that a verb is more sensitive to context when it can have more than one actional interpretation. One might call it the "ambiguity" hypothesis. Two factors are especially relevant here: transitivity (as a major factor in actional interpretation) and the internal structure of events in terms of phases, or subevents. Consider, in this respect, that although activities are homogeneous (and hence are unambiguous) durative events with just one identifiable phase (see [17a-a"]), they can easily turn into accomplishments and be interpreted as telic events when used transitively (as in [17b-b"]).

(17) a. Juan escribió {durante horas / de tres a cinco / *en tres meses}
a'. Giovanni scrisse {per ore / dalle tre fino alle cinque / *in tre mesi}
a". Jean a écrit {pendant des heures / de trois à cinq heures / * en trois mois}
'John wrote {for hours / from three to five/ *in three months}'
b. Juan escribió un libro {durante horas / ?de tres a cinco / en tres meses}
b'. Giovanni scrisse il libro {per ore / ?dalle tre fino alle cinque / in tre mesi}
b". Jean a écrit un livre {pendant des heures / ?de trois à cinq heures / en trois mois}
'John wrote a book {for hours / ?from three to five/ in three months}'

Achievements, on the other hand, are less affected by direct objects (unless pluralized, which turns them into activities: *John found a shell* vs. *John found shells*). However, their internal structure is complex and feeds two possible interpretations: they can either refer to the moment at which the change of state occurs (as in [18a-a"]) or to the resultant state (as in [18b-b"]). The former interpretation is instantaneous and the latter durative, as the adverbial tests suggest.

(18) a. Juan salió de su apartamento a las cinco.
a'. Giovanni è uscito dal suo appartamento alle cinque.
a". Jean est sorti de son appartement à cinq heures.
'John left his apartment at five'.
b. Juan salió de su apartamento durante media hora.
b'. Giovanni è uscito dal suo appartamento per mezz'ora.
b". Jean est sorti de son appartement pendant une demi-heure.
'John left his apartment for half an hour'.

Let us now see how the combination of these two factors can account for the priming patterns.

In the French experiment, activities were favoured by both similar and opposite primes. This is to be expected given that both transitive and intransitive verbs were tested, and that transitive activities are actionally ambiguous as specified above (they can behave as accomplishments when combined with a direct object).

The pattern presented by Spanish is consistent, for only intransitive verbs were used and the achievements were selected so as to exclude punctuals. Thus, the only source of ambiguity was the achievements, which enjoyed the priming effect as predicted. This conclusion is possibly supported by the distribution of the errors. In the Spanish experiment, the achievements yielded the wrong response ('non-resultative' in the resultativity task, 'durative' in the durativity task) in 13% of the cases; with the activities, this only occurred in 8% of the cases. The corresponding figures of the Italian experiment are 16% and 13%, respectively. This invites the speculation that (apart from

the physiological share of errors, to be observed in any such experimental task), with achievement verbs the attention of the participants was attracted, in quite a number of cases, by the (ostensibly durative and non-resultative) resultant state denoted by such verbs. The following table indicates the most problematic verbs, i.e. those achievements which yielded a sizeable number of errors.

(19) Proportion of answers per selected verbs

Italian					
Resultativity task			Durativity task		
ACH	+RES	-RES	ACH	+DUR	-DUR
balzare	16	8	sbarcare	10	14
rinunciare	17	7			

Spanish					
Resultativity task			Durativity task		
ACH	+RES	-RES	ACH	+DUR	-DUR
agobiarse	5	13	agobiarse	7	11
distraerse	11	7	distraerse	7	11
atrasarse	8	10	atrasarse	10	8
evadirse	7	11	emigrar	8	10
aturdirse	11	7	marearse	9	9
			dormirse	7	11

The Italian case is more intricate. In the original experiment, both transitive and intransitive verbs were tested. The analyses reported in Zarcone and Lenci (2010), however, only considered the intransitive verbs. This is welcome for the sake of comparison with Spanish, but may have introduced some experimental bias. Although syntactic ambiguity was not at stake with the activities used in the experiment, the whole picture was not perfectly identical with respect to the Spanish experiment. The Italian and Spanish achievements were primed by opposite primes in both tasks (durativity and resultativity). In contrast to Spanish, however, Italian achievements did not benefit from priming when preceded by similar primes in the durativity task; the priming effect was rather yielded, in the same task, by activities. One possible cause of the first dissimilarity is that Italian achievements had not been checked for the presence of punctuals and hence were less coherent as a class. As for activities, the presence of transitive verbs in the actual experimental set might have had a role. It is interesting to observe, at any rate, that whenever activities were primed in the Romance languages, this only happened in the durativity task. This confirms Bonnotte's claim (limited to activities) about the connection between the feature activated in the given task and the featural value of the target.

This account of the priming effects in Romance is further supported by the decision latency times. When only intransitive verbs were included (as in Italian and Spanish), so that achievements were the only ambiguous group, activities yielded faster decision latencies than achievements (with the one marginal exception of the Spanish resultativity task, where achievements were processed 9 ms faster, cf. the tables in (11)). Apparently, it took longer for the speakers to commit to an aspectual interpretation when faced with actionally ambiguous verbs.[14]

[14] The findings in Gennari and Poeppel (2003) and Coll-Florit *et al.* (2009) about the relation between the complexity of different event types and the decision latencies registered in experimental tasks point to the same direction. They found that eventive verbs (activities, accomplishments and achievements) are processed slower than states (the same seems to be valid for the eventive and stative senses of

It should be mentioned that the source of ambiguity may also reside in the type of question the participants were asked. The questions "does the verb refer to an event with a clear outcome" (in the resultativity task) and "does the verb refer to a durative event" (in the durativity task) might have focused the speakers' attention on the resultant subevent, which is stative and by definition enduring (once a result is achieved, it will last forever as an ontologically permanent state).

As far as Russian is concerned, resultative forms are unambiguously marked by 'perfective' aspect (and prefixes in the relevant cases), which makes them easily identifiable as telic. Processuals, on the other hand, are double-faced, since Russian 'imperfectives' can, under certain circumstances, refer to culminating events, hence their sensitivity to priming. As an example, in the following sentence the 'imperfective' *kormit'* 'feed' (used in the experiment) can only be interpreted as telic[15]:

(20)	a.	Ty	poel?	Da, menja	uže	kormili.
		You	eat-PST.PERF.RES	Yes I-GEN.	already	feed-PST.IMP
		Lit.: 'Did you eat? Yes, they already fed me'				

The findings reported here are promising and encourage pursuit of this line of research, although some important methodological issues have to be sorted out to improve the qualitative analysis of the data and the cross-linguistic comparison. At least some of the differences that emerged could be due to the fact that the various experiments discussed and presented in this paper are not identical on every methodological detail. One such issue is data selection: it is crucial that all verbal groups are homogeneous, so that the results obtained can only be attributed to the parameters at stake. In our case, it should be verified whether the results obtained with the French and Italian items might persist when testing intransitive verbs only and when punctual verbs are carefully excluded from the achievement data set. This will in the end provide robust evidence to single out the contribution of the featural values (durative and resultative in the present case) from that of the actional classes as such (to be intended as clusters of non-disaggregated features).

One further aspect worth considering is the use of more ecological experimental techniques, so as to avoid the kind of conscious metalinguistic task exploited in the above reported experiments.

The present authors intend to pursue this line of research.

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aspectually polysemous verbs). The proposed explanation is the following: "eventive verbs entail one or several changes from an initial situation to a resulting one […], while stative verbs entail a single stable situation […]", suggesting that more semantic structure needs to be accessed and processed in the former case. The same reasoning can be applied to our study: achievements contain more subevents than activities and therefore yield longer decision latencies.

It is worth mentioning, as an aside, that the decision latencies obtained in our durativity tasks contradict the ones in Coll-Florit and Gennari (2011), who found that durative events take longer to process than non-durative events. Note, however, that the durative events in their study were all stative, and therefore differed from non-durative events in yet another way.

[15] As a matter of fact, this property of Russian 'imperfectives' is the main evidence to the effect that they represent the 'neutral' or 'unmarked' aspect, although this is a rather controversial issue (see Smith 1991, Dickey 2000, Grønn 2003, etc.). In classical Russian aspectology, this is treated as an instance of the so-called 'aspectual competition' (cf. Maslov 2004: 96-110, Padučeva 1993, etc.).

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APPENDIX A: SEPARATE ANALYSES OF DECISION LATENCIES

Mixed-effect models are used for the analysis of repeated measurement data with subjects and items as crossed random effects. Stars indicate how statistically significant the difference with the baseline (i.e., the neutral prime) is for the opposite prime (opp) and the similar prime (sim).
The tables contain the estimated coefficients (Estimate), their Markov Chain Monte Carlo (MCMC) mean, the highest posterior density (HPD) confidence interval, a *p*-value based on MCMC (pMCMC), another *p*-value Pr(>|t|) based on the t-statistics, and the significance levels: * = $p<0.05$ (significant effect); ** = $p<0.01$ (highly significant effect); *** = $p<0.001$ (highly significant effect).

a) Italian

	Estimate	MCMCmean	HPD95lower	HPD95upper	pMCMC	Pr(>|t|)	Significance
Durativity task, ACH targets							
(Intercept)	9.48	9.48	9.34	9.62	0	0	
opp	-0.1	-0.1	-0.18	-0.02	0.02	0.02	*
sim	-0.03	-0.03	-0.11	0.05	0.47	0.45	
Durativity task, ACT targets							
(Intercept)	9.4	9.4	9.23	9.56	0	0	
opp	-0.06	-0.06	-0.15	0.02	0.13	0.12	
sim	-0.11	-0.11	-0.20	-0.03	0.01	0.01	**
Resultativity task, ACH targets							
(Intercept)	9.61	9.6	9.45	9.77	0	0	
opp	-0.15	-0.15	-0.26	-0.04	0.01	0.01	**
sim	-0.06	-0.06	-0.16	0.06	0.32	0.29	
Resultativity task, ACT targets							
(Intercept)	9.45	9.45	9.32	9.58	0	0	
opp	-0.07	-0.07	-0.17	0.03	0.16	0.14	
sim	-0.02	-0.02	-0.12	0.08	0.71	0.66	
Mixed-effect model: log(dl)~ prime + (1|subj) + (1|verb) + (1|sem_cl)							

b) Spanish

	Estimate	MCMCmean	HPD95lower	HPD95upper	pMCMC	Pr(>|t|)	Significance
Durativity task, ACH targets							
(Intercept)	9.86	9.86	9.76	9.95	0	0	
opp	-0.07	-0.07	-0.13	-0.01	0.03	0.02	*
sim	-0.08	-0.08	-0.15	-0.02	0.01	0.01	**
Durativity task, ACT targets							
(Intercept)	9.72	9.72	9.61	9.83	0	0	
opp	-0.05	-0.05	-0.11	0.01	0.09	0.06	
sim	-0.03	-0.03	-0.09	0.02	0.28	0.24	
Resultativity task, ACH targets							
(Intercept)	9.78	9.78	9.69	9.86	0	0	
opp	-0.07	-0.07	-0.13	0	0.05	0.04	*
sim	-0.02	-0.02	-0.09	0.04	0.52	0.5	
Resultativity task, ACT targets							
(Intercept)	9.77	9.77	9.62	9.91	0	0	
opp	-0.04	-0.04	-0.09	0.02	0.25	0.21	
sim	-0.01	-0.01	-0.07	0.05	0.84	0.83	
Mixed-effect model: log(dl)~ prime + (1|subj) + (1|verb) + (1|sem_cl)							

APPENDIX B: STIMULI

a) Italian

Activity targets

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
discutere 'discuss, argue'	communication	9	1.9	*protestare* 'protest'	social	10	1.56
oscillare 'swing'	motion	9	0.98	*ragionare* 'reason'	cognition	9	1.19
parlare 'speak / talk'	communication	7	2.47	*soffiare* 'blow'	body process	8	1.14
passeggiare 'walk / stroll'	motion	11	1.04	*volare* 'fly'	motion	6	1.75
piangere 'cry'	body process	8	1.76				

Achievement targets

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
balzare 'bounce / jump'	motion	7	0.95	*sbarcare* 'disembark'	motion	8	1.07
cadere 'fall'	motion	6	2.13	*scoppiare* 'burst, explode'	change	9	1.61
entrare 'go in'	motion	7	2.47	*sparare* 'shoot'	competition	7	1.8
morire 'die'	change	6	2.32	*sparire* 'vanish'	change	7	1.65
rinunciare 'give up'	possession	10	1.93				

Activity primes

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
ballare 'dance'	motion	7	1.57	*giocare* 'play (game)'	competition	7	2.33
dormire 'sleep'	body process	7	1.91	*insegnare* 'teach'	communication	9	1.82
fumare 'smoke'	consumption	6	1.29	*ridere* 'laugh'	body process	6	1.89

Achievement primes

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
approdare 'land / shore'	motion	9	1.3	*esplodere* 'burst, explode'	change	9	1.59
arrivare 'arrive / reach'	motion	8	2.83	*scomparire* 'vanish'	change	10	1.88
crollare 'collapse'	motion	8	1.37	*uscire* 'go out'	motion	6	2.5

b) Spanish

Activity targets in lists A, B, C
Activity primes in lists D, E, F

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF

galopar 'gallop'	motion	7	2.12	*comerciar* 'trade'	social	9	2.45
cotillear 'gossip'	communication	9	1.98	*disertar* 'speak, discourse'	cognition	8	2.22
cooperar 'cooperate'	social	8	2.99	*merodear* 'prowl'	motion	8	2.15
peregrinar 'go on a pilgrimage'	motion	10	2.3	*dialogar* 'discuss, talk'	social	8	3
filosofar 'philosophize'	cognition	9	2.37	*forcejear* 'wrestle, struggle'	social	9	1.81
navegar 'navigate'	motion	7	3.31	*concursar* 'compete'	social	9	2.37
transpirar 'perspire'	body process	10	2	*bullir* 'swarm, bubble'	body process	6	2.16
alardear 'boast'	social	8	2.26				

Activity primes in lists A, B, C
Activity targets in lists D, E, F

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
chorrear 'drip'	body process	8	2.14	*traficar* 'deal, traffic in'	social	8	2.01
fantasear 'fantasize'	cognition	9	2.17	*deliberar* 'deliberate'	cognition	9	2.84
divagar 'digress'	cognition	7	2.18	*circular* 'circulate'	motion	8	3.29
batallar 'battle'	social	8	2.68	*charlar* 'chat'	communication	7	2.97
esquiar 'ski'	motion	7	2.09	*coquetear* 'flirt'	social	9	1.88
deambular 'wander'	motion	9	2.15	*conversar* 'talk'	communication	9	3.16
desfilar 'parade'	motion	8	2.59	*roncar* 'snore'	body process	6	2.08
rivalizar 'rival, compete'	social	9	2.2				

Achievement targets in lists A, B, C
Achievement primes in lists D, E, F

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
soltarse 'get loose'	contact	8	2.56	*callarse* 'shut up'	communication	8	2.65
marearse 'feel dizzy, get sick'	body process	8	1.96	*enloquecer* 'go crazy'	emotion	10	1.72
enfadarse 'get angry'	emotion	9	2.49	*irritarse* 'become irritated'	body process	9	2.3
cerrarse 'close'	change	8	3.23	*asustarse* 'get scared'	emotion	9	2.9
emigrar 'emigrate'	social	7	2.95	*apagarse* 'go out (the light)'	change	8	2.81
clavarse 'get stuck (smth sharp)'	contact	8	2.24	*distraerse* 'get distracted'	cognition	10	2.22
evadirse 'escape'	emotion	8	2.29	*escapar* 'escape'	motion	8	3.5
atascarse 'get stuck, get blocked'	change	9	2.02				

Achievement primes in lists A, B, C
Achievement targets in lists D, E, F

Verbs	Semantic class	Length	LF	Verbs	Semantic class	Length	LF
aturdirse 'get	cognition	9	2.05	*dormirse* 'fall	body process	8	2.91

confused’				asleep’			
averiarse ‘break down’	change	9	1.98	*partirse* ‘break, split’	change	8	2.73
exiliarse ‘go into exile’	social	9	2.26	*enmudecer* ‘fall silent’	body process	9	1.6
pararse ‘stop’	stop	7	2.91	*postrarse* ‘kneel’	motion	9	2.2
enfermar ‘get sick’	body process	8	2.55	*desmayarse* ‘faint’	body process	10	2.24
emerger ‘emerge’	change	7	3.12	*agobiarse* ‘get overwhelmed’	emotion	9	2.3
salvarse ‘get saved, survive’	change	8	3.12	*atrasarse* ‘fall behind, be late’	change	9	1.88
calmarse ‘calm down’	emotion	8	2.46				