

# Grammatical class effects in production of Italian inflected verbs

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## Abstract

**English.** We report a picture-word interference (PWI) experiment conducted in Italian where target verbs were used to name pictures in presence of semantically related and unrelated distracters. The congruency of grammatical class between targets and distracters was manipulated and nouns and verbs were used as distracters. Consistently with previous studies, an expected semantic interference effect was observed but, interestingly, such an effect does not equally apply to target-distracter pairs sharing or not grammatical class information. This outcome seems to corroborate the hypothesis of the intervention of grammatical constraints in word production as explored in the PWI task.

**Italiano.** *Questo lavoro descrive un esperimento di interferenza figura-parola sull'italiano in cui le figure dovevano essere denominate usando verbi in presenza di distrattori semanticamente collegati o non collegati alla figura. È stata manipolata anche la congruenza di classe grammaticale tra target e distrattori; questi ultimi nella metà dei casi erano nomi e nell'altra verbi. In linea con studi precedenti, abbiamo ottenuto un effetto di interferenza semantica; il dato interessante è che quest'ultimo effetto interessa in modo differente le coppie target-distrattore congruenti o non congruenti per classe grammaticale. Questo risultato sembra corroborare l'ipotesi che nella di produzione di parole esplorata attraverso il compito di interferenza figura-parola giochino un ruolo le proprietà grammaticali delle parole.*

## 1. Introduction

Models of lexical access share the assumption that different kinds of linguistic information (semantic, orthographic-phonological, syntactic-grammatical, and so on) have different levels of lexical representation (Caramazza, 1997; Levelt, Roelofs and Meyer, 1999; Dell, 1986). The picture-word interference (PWI) paradigm has been widely exploited to test the dynamics of activation of different properties of words during lexical production. Such a task allows the observation of specific lexical effects by manipulating the linguistic relation between words to be used in a picture naming task and written distracter-words super-imposed to pictures. The basic assumption is that linguistic information of a distracter influences the time needed to select the appropriate word-form to name a picture. For instance, two well-known effects observed in PWI, the semantic interference and the phonological facilitation effects, are thought to reflect respectively the competition at the lexical level between the lexical representations of the target and the distracter and the co-activation of the phonemes shared by the target and the distracter during the phonetic encoding stage.

Scholars have also tried to investigate the activation of grammatical information in speech production through the PWI paradigm but conflicting evidence has been collected. For instance, Pechmann and Zerbst (2002), Pechmann and coll. (2004), Vigliocco and coll. (2005), Rodriguez-Ferreiro and coll. (2014), De Simone and Collina (2016) obtained grammatical class effects, while Mahon and coll. (2007), Iwasaki and coll. (2008) and Janssen and coll. (2010) did not. Arguably, the variability in the experimental evidence can be ascribed to heterogeneous methodologies across studies: for instance, results obtained by Vigliocco and coll. (2005) could be biased by their methodological choice to administer noun-distracters with determiners, while in the study of Rodriguez-Ferreiro and coll. (2014)

semantic categories (actions/objects/instruments) partially overlapped grammatical classes and a confound due to an imageability bias (Exp. 3) was present.

As a consequence, the intervention of grammatical constraints during production processes, as explored in PWI tasks, is still debated.

In this study on Italian we aimed at exploring the problem by trying to avoid possible confounds existing in previous studies.

## 2. Method

**Participants:** Thirty-six undergraduate students (28 females) from University of Salerno voluntarily took part in the experiment. They were all native speakers of Italian and they all had normal or corrected-to-normal vision. Their age ranged from 20 to 30 years (mean=22; sd=2.5). They served for a session lasting about 45 minutes.

**Materials:** Thirty-five black-and-white line drawings depicting actions were used as experimental items. Participants were instructed to name these pictures by using inflected verb forms (either present indicative, or 3<sup>rd</sup> singular person). These verbs constituted the target items. For each target-verb a semantically related distracter-verb and a semantically related distracter-noun were selected, so that a list of 35 distracter-verbs and a list of 35 distracter-nouns were built. The selected nouns and verbs were not affected by the semantic bias due to the object/action dichotomy. The semantic relatedness between targets and distracters was calculated on the basis of 2 measures: corpus-based automatic semantic metrics (WEISS, Word-embeddings Italian semantic spaces; Marelli, 2017) and subjective ratings on a 5 point Likert scale<sup>1</sup>.

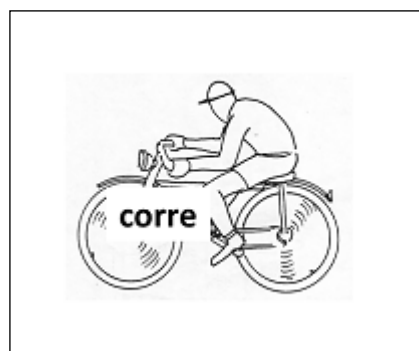
The same distracters were differently paired with the target verbs so that two lists of unrelated nominal (related-noun and unrelated-noun experimental conditions) and verbal (related-verb and unrelated-verb experimental conditions) distracters were created. Distracters in the four experimental conditions were matched for the main psycholinguistics variables: imageability, writ-

ten form frequency (CoLFIS; Bertinetto et al., 2005) length, semantic relatedness. Formal orthographic or phonological overlap between targets and distracters was avoided. The mean values and standard deviations for each of these variables are reported in Table 1.

The experimental list was composed of 140 trials where the 35 target-verbs were accompanied by 70 verb-distracters (35 semantically related and 35 unrelated) and by 70 noun-distracters (35 semantically related and 35 unrelated). Two additional distracters were used as filler trials: for each target a related and an unrelated word were provided; these filler distracters differed from experimental distracters since they were word-class ambiguous items. Instances of all experimental conditions are reported in Table 2 and an example of experimental item is reported in Figure 1.

	Semantically related pairs		Semantically unrelated pairs	
	noun	verb	noun	verb
length	7.1 (1.6)	6.3 (1.4)	7.1 (1.6)	6.3 (1.4)
written form frequency	79.3 (92.3)	75.3 (97.7)	79.3 (92.3)	75.3 (97.7)
imageability	3.5 (0.6)	3.7 (0.6)	3.5 (0.6)	3.7 (0.6)
shared letters between targets and distracters	2 (1.1)	2 (1.1)	2 (1.1)	1.6 (1.0)
subjective semantic relatedness ratings	3.3 (0.9)	3.5 (1.03)	1.4 (0.4)	1.4 (0.4)
WEISS metrics	0.7 (0.1)	0.6 (0.2)	0.9 (0.1)	0.9 (0.1)

**Table 1:** Mean values and standard deviations (in parenthesis) of distracters' characteristics



**Figure 1.** An example of a related distracter-picture pair

<sup>1</sup> The first measure provided objective values, based on distributional estimates, for the semantic distance between each target-word and its distracter. The second measure allowed us to ascertain to what extent the specific word sense evoked by the picture was related to the distracter-word.

<i>Distracters</i>	Related noun: <i>frittura</i> (frying)
	Related verb: <i>frigge</i> (he/she fries)
	Unrelated noun: <i>rumore</i> (noise)
	Unrelated verb: <i>sente</i> (he/she listens to)
<i>Target</i>	<i>cuoce</i> (he/she cooks)

**Table 2.** Distracter-target pairs

In order to prevent any strategic bias due to semantic and/or grammatical relationships among targets and distracters, 15 additional pictures were used as filler targets and were presented with 6 different distracters. The whole list of both experimental and filler target-distracter pairs was composed of 300 trials: 33% were semantically related trials and 67% were unrelated trials.

**Procedure:** The participants were tested individually; an experimental session consisted of three parts: a familiarization, a practice and an experimental phase. The E-Prime software 2.0 (Psychology Software Tools, Inc., Pittsburgh, PA) was used.

At the beginning of the experiment, each participant was familiarized with the whole set of experimental and filler pictures in an untimed picture naming session. In this phase, the pictures were presented on the computer screen with a superimposed row of Xs to simulate the distracter word. Participants learned to produce the targets upon presentation of the corresponding pictures. If participants named a picture with a verb that differed from the one designed as the target by experimenters, a feedback was given: the expected verb was provided to participants and they were invited to use it in the experimental session.

Following the familiarization phase, a practice block was administered where participants were asked to name each picture as inflected verb forms (present indicative 3<sup>rd</sup> singular person, e.g. *beve*, he/she drinks) and were instructed to respond as quickly and accurately as possible, while ignoring the distracter word. The experimenter was seated behind the participant and recorded errors and equipment failures. The stimuli presented in the training phase were part of the filler set.

The stimuli appeared on a video display unit controlled by a personal computer. Reaction

times from the appearance of the stimuli to the onset of articulation were collected by a voice key connected to the computer and participant responses were recorded. Upon a response, the picture and the distracter disappeared from the screen. Both the presentation of the stimuli and the recording of the responses were managed by the E-Prime software 2.0. The responses of the participants were checked for accuracy by an experimenter.

Each single trial consisted of the following events: a fixation cross presented at the center of the screen for 300 ms; the stimulus until the response or for a maximum of 2.5 seconds; a feedback mask signaling the activation of the voice key of 500ms, a blank interval of 500 ms. The SOA between pictures and distracter-words was 0 ms.

Words pronounced incorrectly, non-expected picture names, hesitations in giving the responses, word fragments, omissions, verbal dysfluencies and responses given after the deadline were scored as errors. Invalid responses (e.g., trials in which the voice key was triggered by external noise) and responses shorter than 400 ms were considered as missing data.

At the end of the practice phase, the experiment started and 6 experimental blocks of 50 trials (35 experimental items and 15 filler items) were presented, for a total of 300 trials. An equal number of items from each experimental condition was included in every block. Blocks were counterbalanced across participants. In each block, stimuli underwent a randomization governed by the E-Prime software 2.0.

### 3. Results

An analysis of variance (ANOVA) was performed on naming latencies and accuracy rates by subjects (F1) and by items (F2) with the distractor type (four levels) as a variable. For the sake of conciseness only the statistically significant analyses will be reported and discussed.

A main effect of semantic relatedness has been observed both in the ANOVA by participants ( $F(1, 35) = 4.56, p < .05$ ) and by items ( $F(1, 30) = 4.46, p < .05$ ) on response latencies. Responses to target verbs were slower when they were accompanied by semantically related distracters (+17 ms).

Neither effects of grammatical class nor interaction between grammatical class and semantic relation were found.

Two-tailed t tests comparing the semantic interference effect within the grammatical class congruent and non-congruent target/distracter pairs revealed that the semantic interference effect reaches the statistical significance with noun-distracters (+24 ms,  $p = .02$ ) but not with verb-distracters (+9 ms,  $p = .43$ ). The results are graphically shown in Table 3.

	Noun distracters	Verb distracters
Related	1020 ms (125)	1011 ms (121)
Unrelated	996 ms (107)	1002 ms (111)

Table 3. Mean response latencies and standard deviations (in parenthesis) for all conditions

#### 4. Conclusions

One of the aim of the present experiment was to overcome some limitations of previous investigations. The following constraints were adopted:

1. We contrasted the production of verbs when presented with semantically related and unrelated distracters: the expected semantic interference effect guaranteed for the reliability of the paradigm.
2. We selected experimental materials where the differences between grammatical classes in terms of their semantic domain (objects (nouns) vs. actions (verbs)) was kept under control.
3. Word-class ambiguous items were excluded by experimental materials.
4. Inflected finite verbal-forms were used both as targets and distracters: these verbal forms allow to maximize the difference between nouns and verbs<sup>2</sup>. Actual-

<sup>2</sup> The distinction between finite and non-finite moods is motivated on morphological and syntactic grounds: finite-forms are inflected for person and in syntactic context they are used as verbal predicates. Conversely, non-finite forms lack for person inflection and are used in periphrastic construction or in combination with auxiliary verbs to assemble the “composed tenses” of the paradigm. Under certain circumstances, non-finite forms undergo syntactic trans-categorization and behave as nouns or adjectives: “*mi piace ballare* [infinitive]”, (I love dancing). “*I partecipanti* [present participle], *sono pronti*” (participants are ready); “*tre gare vinte* [past participle, from “*vincere*”] e *cinque perse* [past participle, from “*perdere*”], (three competitions won and five lost).

ly, the Italian inflected form “*amavo*” (indicative, imperfect, 1<sup>st</sup> singular person, I used to love), is composed of a stem, “*am-*”, which conveys the core meaning of the verb, the vowel “*-a-*”, which specifies the inflectional pattern compatible with the verbal stem, the segment “*-v-*”, which encodes mood and tense information, and the segment “*-o*” which encodes person and number information. None of these features, with the exception of meaning and number features, can be part of the lexical representation of noun-forms. This latter manipulation has relevant consequences on the detection of grammatical class effect in PWI, since it has been demonstrated that, when finite verbs have to be produced, the naming context sets the response-relevant criterion on the grammatical class of verbs and then noun-distracters tend to interfere significantly more than verb-distracters (De Martino & Laudanna, 2017)<sup>3</sup>.

Consistently with previous PWI evidence, our experiment replicated a reliable semantic interference effect. This finding confirms that the selection of an oral target response is slowed-down by the activation of a semantically-related distracter because the lexical system has to manage the level of activation of target lexical competitors, including the highly activated semantically related distracter word. Interestingly, we observed that, at least when pictures have to be named by using inflected verb forms, such an effect does not equally affect all semantically related target-distracter pairs: related pairs sharing grammatical class information do not exhibit significant semantic interference but grammatical-class incongruent pairs do.

In conclusion, our data suggest that the PWI task is sensitive to the manipulation of grammatical class information. In other words, such a pattern of results is compatible with the intervention of grammatical constraints during production processes, as explored in the PWI task.

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<sup>3</sup> This result was obtained regardless of semantic relation between targets and distracters.

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