The processing of compound words in Italian: evidence for an access to morphological constituents and an headedness effect

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INTRODUCTION

- Compound-word processing has been a long studied theme in psycholinguistic researches, focusing on a few important topics
- Semantic transparency: the meaning of a transparent compound is clearly deducible by the meaning of its constituents (e.g. *car-wash*) while opaque compounds' meaning isn't related to the meaning of their constituents (e.g. *hogwash*)
  - there is evidence for Dutch that transparent compounds are processed through the representation of their constituents, while representations of opaque words are accessed directly (Sandra 1990)
  - more recently, evidences in favour of an automatic (regardless of semantic properties) access to morphological constituents have been found (see Fiorentino and Poeppel 2007)
- Morphological head: in a compound word it is the constituent that transfers its semantic and lexical properties to the whole construction
  - there are evidences in French suggesting that the activation of both the first constituent and the head constituent can be particularly effective in facilitating the access to the representation of the whole compound (Jarema et al. 1999)
  - Libben et al. (2003) suggested that in English the semantic transparence of the head alone makes the whole compound more easily to process. However, in English the head is always the rightmost element. It is therefore impossible to tell apart a simple role of the rightmost constituent from a real headedness effect.

AIM OF THE STUDY

We want to assess how all the variables considered in literature (e.g. semantic transparency, headedness and position of the constituents) influence the processing of compounds, exploiting properties of the Italian language, in which both head-final and head-initial compounds are present.

MATERIALS AND METHODS

Task

- Constituent priming paradigm with a lexical decision task

Subjects

- 32 Italian undergraduated students (5 male and 27 female; mean age=23)

Materials

- 48 target compounds (7 noun-adjective, 7 adjective-noun and 34 noun-noun compounds)
  - 12 opaque head-initial compounds: *porcospino*, hedgehog
  - 12 opaque head-final compounds: *banconota*, banknote
  - 12 transparent head-initial compounds: *capobanda*, ringleader
  - 12 transparent head-final compounds: *fotocopia*, photocopy

  The four groups as well as (1) transparent and opaque compounds and (2) head-final and head-initial compounds were balanced for length, lemma frequency and form frequency.
- 4 possible prime words paired to each target compound
  - the first constituent: *foto/FOTOCOPIA – photo/PHOTOCOPY*
  - the second constituent: *copia/FOTOCOPIA – copy/PHOTOCOPY*
  - a control word for the 1st constituent: *foro/FOTOCOPIA – hole/PHOTOCOPY*
  - a control word for the 2nd constituent: *coppa/FOTOCOPIA – cup/PHOTOCOPY*

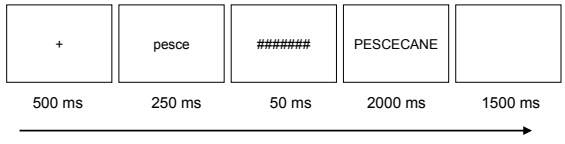
  Each control words was very orthographically similar to the paired constituent prime (mean orthographic overlap = 0,7). Constituent primes and control words were matched for lemma frequency, form frequency, length and neighbourhood size.
- Four different experimental lists were constructed, each containing the 48 target words paired with one of the four primes. As for the target words, no prime was repeated within any experimental list.
- 96 filler trials
  - 24 non-words: *tarestola*
  - 24 monomorphemic real words: *gorgonzola*
  - 48 false compounds: *baciosala*

  Filler words were preceded by real words as primes, matched with experimental primes for frequency and length.

Experimental design

- A 2x2x2x2 design with the following variables:
  - Prime Type (PT): constituent vs control (orthographically similar) word
  - Constituent Primed (CP): first vs second constituent
  - Compound Headedness (CH): head-initial vs head-final target compound
  - Semantic Transparency (ST): transparent vs opaque target compound

Timeline

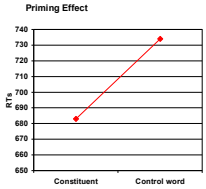


RESULTS

- Response times (RTs) analyzed in four-way ANOVAs. In the participant analysis all factors were within-subjects; in item analysis PT and CP were repeated measures, while ST and CH were between items factors.

Priming Effect

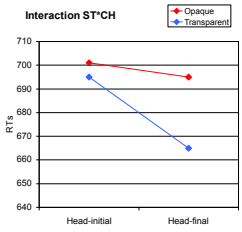
- Main effect of PT is significant both in subject and item analysis
- PT interacts significantly with no other factors.



	Subj Analisys		Item Analisys	
	F	sign	F	sign
PT	38.3	<.001	48.9	<.001
PT*ST	0.5	.8	0.5	.5
PT*CP	0.9	.4	2.3	.1
PT*CP*CH	1.8	.4	0.5	.5

Lexical Decision Latencies

- Main effects of CH and ST are significant in subject analysis.
- Interaction between CH and ST is significant in subject analysis.



	Subj Analisys		Item Analisys	
	F	sign	F	sign
ST	9.1	.005	1.3	.3
CH	8.4	.007	0.2	.7
ST*CH	5.2	.03	1.2	.3

DISCUSSION

Priming Effect

- Our findings suggest an automatic access to constituent representations during compound processing, not explainable by orthographic similarity
- This access takes place regardless of all the other factor considered: it is not influenced by the semantic transparency of target compounds (PT*ST is not significant) and it is modulated by the priming of neither head or non-head constituent (PT*CP*CH not significant) nor first or second constituent (PT*CP not significant)
- In summary, our results are in favor of a purely morphological, parallel and automatic access to both constituents during the processing of compound words.

Lexical Decision Latencies

- Overall lexical decision latencies are modulated by semantic properties of the compound: even if not at a morphological level semantic features of a compound can influence the processing.
- The facilitation for head-final compounds is less expected. Williams (1981) claims that all morphologically complex words are right-headed. This assumption (called RHR: righthand head rule) could have a psychological counterpart, as our results seems to suggest. We can assume that a parsing processing-route takes as default position for the morphological head the rightmost constituent, even in a language that is not right-headed.

REFERENCES

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INTRODUCTION

- Compound-word processing has been a long studied theme in psycholinguistic researches, focusing on a few important topics
- It has been claimed that a main role in determining how compound words are mentally represented (e.g. if they're represented as a whole or constructed online via a parsing process) is played by its semantic features, particularly by semantic transparency (Sandra 1990). This property is based on how much the meaning of a morphologically complex word is predictable by the meaning of its morphemes. There is evidence for Dutch that transparent compounds are processed through the representation of their constituents, while representations of opaque words are accessed directly. However, more recently, evidences in favor of an automatic access to morphological constituents has been found (see Fiorentino and Poeppel 2007)
- The other important question regards the role played by the constituents during word processing, particularly whether certain properties of the constituents can facilitate the access to the whole compound. There are evidences in French (Jarema et al. 1999) suggesting that the activation of both the first constituent and the head constituent (e.g. the constituent that share the lexical and semantic properties with the whole compound) can be particularly effective in facilitating the access to the representation of the whole compound, thus pointing to the presence of an interaction of factors (the salient position of the first constituent because of a left-to-right parsing device and the importance of the morphological head). Moreover, Libben et al. (2003) suggested that in English the semantic transparence of the head alone makes the whole compound more easily to process. However, English (as well as Dutch, the two languages most studied in psycholinguistics) is a right-headed language: in its morphologically complex words the head is always the rightmost element. It is therefore impossible to tell apart a simple role of the rightmost constituent from a real headedness effect.

AIM OF THE STUDY

Although there is a relatively wide amount of studies about the processing of compound words, the results favor different possible interpretations of how the representation of a compound word is achieved. We want to assess how all the variables considered in literature (e.g. semantic transparency, headedness and position of the constituents) influence the processing of compounds, exploiting properties of the Italian language, in which both head-final and head-initial compounds are present.

A constituent priming paradigm can be employed to understand the processing of compounds, especially concerning the parsing/listing problem: the possible interaction between the priming effect and the various factors considered so far in literature can provide information regarding the crucial aspects involved in the access to constituent representations.

MATERIALS AND METHODS

Subjects

- 32 Italian undergraduated students (5 male and 27 female; mean age=23)

Materials

- 48 target compounds (7 noun-adjective, 7 adjective-noun and 34 noun-noun compounds)
  - 12 opaque head-initial compounds: ***porco****spino*, hedge**hog**
  - 12 opaque head-final compounds: *banco****nota***, bank**note**
  - 12 transparent head-initial compounds: ***capo****banda*, ring**leader**
  - 12 transparent head-final compounds: *foto****copia***, photo**copy**

  The four groups as well as (1) transparent and opaque compounds and (2) head-final and head-initial compounds were balanced for length, lemma frequency and form frequency.
- 4 possible prime words were paired to each target compound
  - the first constituent: *foto/FOTOCOPIA – photo/PHOTOCOPY*
  - the second constituent: *copia/FOTOCOPIA – copy/PHOTOCOPY*
  - a control word for the 1st constituent: *foro/FOTOCOPIA – hole/PHOTOCOPY*
  - a control word for the 2nd constituent: *coppa/FOTOCOPIA – cup/PHOTOCOPY*

  Control words were semantically unrelated to the whole compound and to either of the two constituents and each of them was very orthographically similar to the paired constituent prime (mean orthographic overlap = 0,7). Constituent primes and control words were matched for lemma frequency, form frequency, length and neighbourhood size.
- Four different experimental lists were constructed, each containing the 48 target words paired with one of the four primes; no target was then repeated in any experimental list. Each list was internally counterbalanced. As for the target words, no prime was repeated within any experimental list.
- We used 96 filler trials
  - 24 non-words: *tarestola*
  - 24 monomorphemic real words: *gorgonzola*
  - 48 false compounds: *baciosala*

  Filler words were preceded by real words as primes, that were matched with experimental primes for frequency and length.

Task

- Lexical decision

Experimental design

- A 2x2x2x2 design with the following variables:
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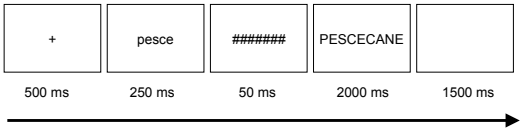

RESULTS

- Response times (RTs) were analyzed in item and subject ANOVAs. In the participant analysis a four-way ANOVA with repeated measures on all factors was applied. In item analysis PT and CP were repeated measures, while ST and CH were between items factors.

Priming Effect

- A significant main effect of PT was found both in subject and item analysis: target compounds primed by one constituent of theirs presented faster RTs (51 ms faster) than compounds primed by control words, only orthographically related to them.
- PT interacts significantly with no other factors.

TABELLA + GRAFICO (?)

Lexical Decision Latencies

- In subject analysis a significant main effect (thus not influenced by prime presentation) of CH and ST was found. Moreover, the interaction between these two factors resulted significant too: first-level effects are therefore better explainable as statistical artifacts due to the second-level interaction.
  - RTs for opaque compounds are no distinct from RTs for head-initial transparent compounds.
  - RTs for head-final transparent compounds are about 30ms shorter than RTs for other target compound groups

TABELLA + GRAFICO

DISCUSSION

Priming Effect

- The presence of a priming effect can be interpreted as signalling the existence of associative relations between representations within the mental lexicon. Our findings suggest an automatic access to constituent representations during compound processing, not explainable by orthographic similarity (control primes are orthographically similar too)
- This access takes place regardless of all the other factor considered: it is not influenced by the semantic transparency or the headedness of target compounds (PT*ST and PT*CH are not significant) and it is modulated by the priming of neither head or non-head constituent (PT*CP*CH not significant) nor first or second constituent (PT*CP not significant)
- In summary, our results are in favor of a purely morphological, parallel and automatic access to both constituents during the processing of compound words.

Lexical Decision Latencies

- Overall lexical decision latencies are modulated by semantic properties of the compound and the position of morphological head: even if not at a morphological level, therefore, semantic features of a compound can influence the processing.
- Our results can be accounted for assuming the existence, at a conceptual level, of two possible processing routes: 1) a lexical route that accesses directly to the whole compound, efficient for all compounds, and 2) a parsing route that activates constituent representations and the associative link between them, efficient for transparent compounds only. These two routes could work according to a "horse race" model.
- The facilitation for head-final compounds, however, is less expected. Williams (1981) claims that all morphologically complex words are right-headed. This assumption (called RHR: righthand head rule), even if immediately verified in languages as English and Dutch, is debated in linguistics because there are a lot of example of languages with head-initial words. This rule, however, could have a psychological counterpart, as our results seems to suggest. They could indeed be accounted for by assuming that the parsing route takes as default the right position for the morphological head, thus interpreting the word as "a type of X", where X is the rightmost constituent. But this is possible only for head-final transparent compounds, thus explaining the facilitation that we have found for this class of stimuli

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