Corpus-Based Acquisition of Support Verb Constructions for Portuguese

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What are Support Verb Constructions (SVCs)?

- Subgroup of multiword expressions
  ⇒ SVCs form a syntactic and semantic unit
- Complex predicates (CPs) consisting of verb and noun; prepositional and non-prepositional
  Estou na dúvida. – I am in doubt.
  Vamos dar um passeio! – Let‘s take a walk!
  ⇒ Verbs in SVCs are often semantically impoverished (light verbs)
  ⇒ Hard to distinguish from other CPs and arbitrary constructions
  ⇒ Our focus: non-prepositional SVCs
- Often replaceable by an individual full verb
  Maria deu a resposta correcta. – Maria respondeu correctamente.
  Maria gave the correct answer. – Maria answered correctly.
  ⇒ Syntactic modifications

Motivation

SVCs have effect on the performance of many NLP tasks, e.g. for:

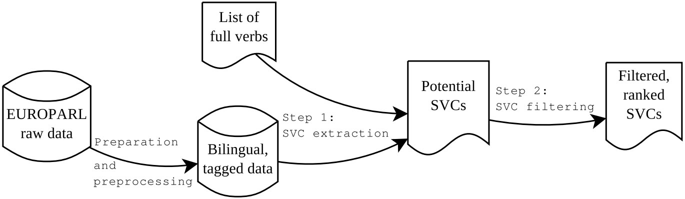
- Language generation (syntax):
  ∗ *Ela levou o amigo a casa e ao desespero.* [Athayde, 2001]
  ∗ *She drove her friend home and to despair.*
- Recognition of selectional preferences (semantics):
  $X_{\theta AGT}$ *decidiu* $Y_{\theta THM} \leftrightarrow X_{\theta AGT}$ *tomou a decisão de* $X_{\theta THM}$
  $X_{\theta AGT}$ *decided* $Y_{\theta THM} \leftrightarrow X_{\theta AGT}$ *made the decision to* $Y_{\theta THM}$

  $X_{\theta AGT}$ *decidiu* $Y_{\theta THM} \not\leftrightarrow X_{\theta AGT/CAUSE}$ *atrasou a decisão de* $Y_{\theta THM}$
  $X_{\theta AGT}$ *decided* $Y_{\theta THM} \not\leftrightarrow X_{\theta AGT/CAUSE}$ *delays the decision to* $Y_{\theta THM}$

⇒ Recognition of SVCs is desirable

Our idea: Acquisition of Portuguese SVCs by combining cross- and monolingual methods with shallow preprocessing

Overall structure of the SVC acquisition procedure



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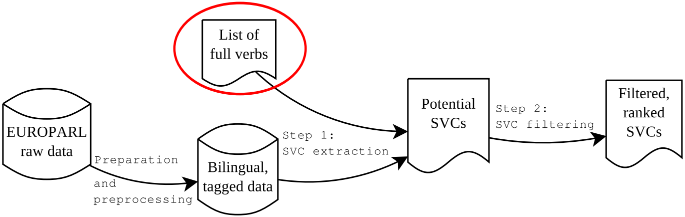

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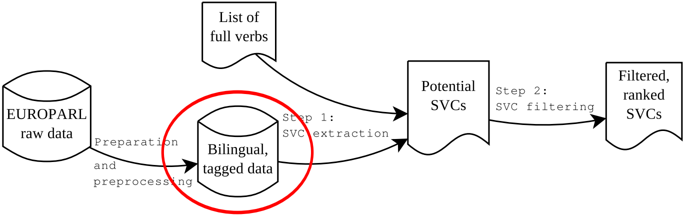

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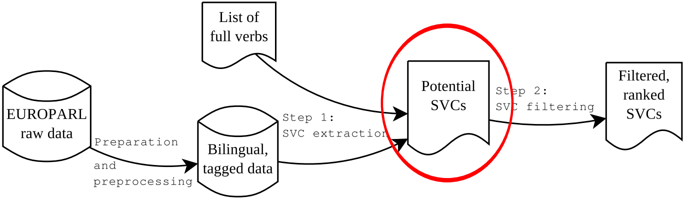

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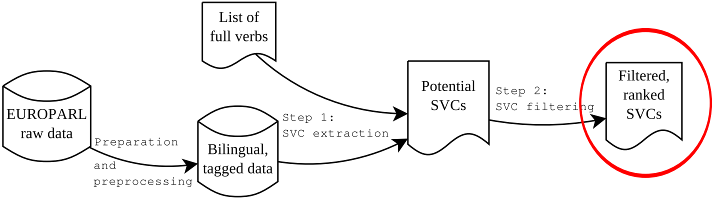
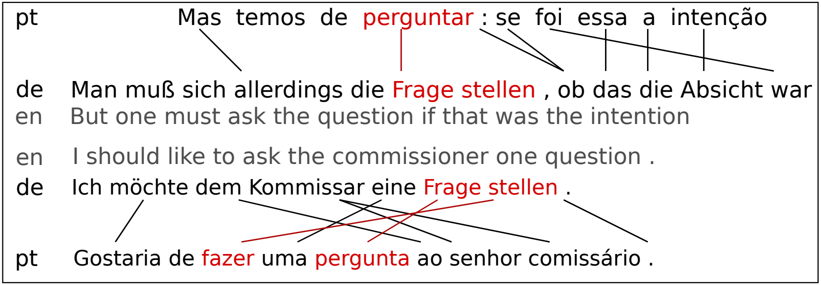


- Goal: acquiring Portuguese SVCs with little preprocessing (POS tagging [Schmid, 1994, Carreras et al., 2004, Padró et al., 2010])
- Parallel corpus: PT-DE portion of EUROPARL, v.3 [Koehn, 2005]
- Starting point: full verbs which semantically correspond to at least one SVC
- Cross-lingual extraction: foreign language as pivot [Bannard and Callison-Burch, 2005]
  ⇒ semantic equivalence and syntactic status
- Monolingual filtering: association measures [Krenn and Evert, 2001, Evert and Krenn, 2001]
  ⇒ strength of correlation

Setting of the cross-lingual step



pt Mas temos de perguntar : se foi essa a intenção

de Man muß sich allerdings die Frage stellen , ob das die Absicht war

en But one must ask the question if that was the intention

en I should like to ask the commissioner one question .

de Ich möchte dem Kommissar eine Frage stellen .

pt Gostaria de fazer uma pergunta ao senhor comissário .

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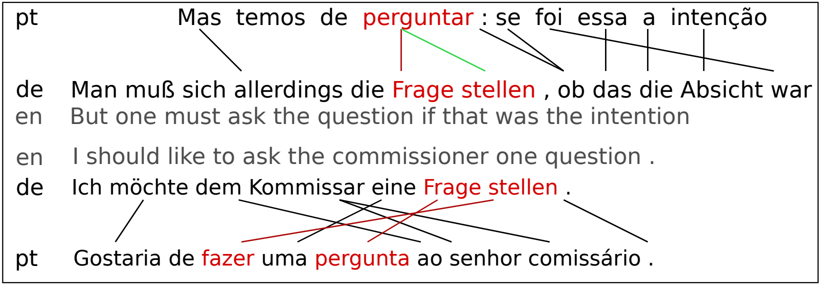

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- Heuristic extension of word alignments

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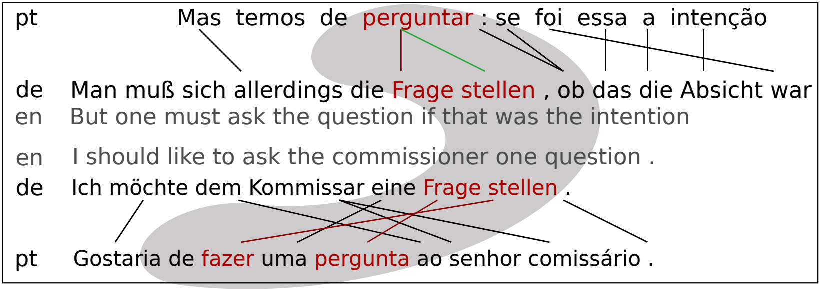

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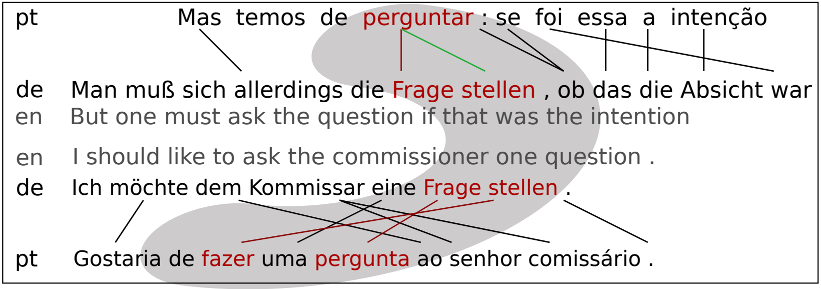

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- Heuristic extension of word alignments
- Occurrence thresholds for alignment pairs, restriction to verb-noun (V-N) pairs

Benefits and shortcomings of the cross-lingual step

- Extraction of Portuguese V-N pairs
- Detection of semantically correct SVCs:
  apoiar → *dar apoio*, *dar assistência*
  to support → *to provide support*
- Remaining false positive, compositional V-N pairs:
  apoiar → *exigir apoio*
  to support → *to ask for support*

⇒ Necessary: distinction between compositional and fixed V-N combinations, removal of compositional ones

⇒ Identify correlations between V and N with association measures

Setting and benefits of the monolingual step

PMI ranking of cross-lingual results for *apoiar* ($\times 10^{-7}$):

01.	prestar assistência	160
02.	prestar ajuda	45
03.	conceder ajuda	28
04.	granjear apoio	19
05.	prestar apoio	18
06.	receber ajuda	13
07.	receber apoio	9.8
08.	providenciar apoio	7.5
09.	conceder apoio	7.5
10.	fornecer apoio	6.9
11.	disponibilizar apoio	5.6
12.	dar assistência	4.4
13.	proporcionar apoio	4.3
...		
40.	garantir apoio	0.18
41.	retirar apoio	0.17
42.	prever apoio	0.15
43.	demonstrar apoio	0.11
44.	esperar apoio	0.10
45.	ter apoio	0.041

- Association measures reveal correlations between words

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- Association measures reveal correlations between words
- Filtering to increase precision:

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  → minimum V-N co-occurrence threshold

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  → remove entries if verb is unlikely to occur in SVCs (diversity)

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⇒ Rejection of arbitrary constructions

⇒ Different settings: restrictive thresholds for high precision (hiPrec), loose thresholds for high recall (hiRec)

Evaluation setting

Gold standard:

- 6 initial full verbs:
  ameaçar, *apoiar*, *faltar*, *perguntar*, *prometer*, *responder*
- V-N pairs resulting from cross-lingual step as reference set
- Judged by two native speakers on semantic similarity to full verb (IAA $\kappa = 0.74$ [Cohen, 1960])
- 22 V-N pairs judged as true positive SVCs

Evaluation:

- Computation of precision, (relative) recall and f_1
- Evaluation of results of cross-lingual step (relative recall = 100%)
- Evaluation of final results including monolingual step

Results for the cross-lingual step

	6 full verbs
Precision	**0.26**
Recall	**1.00**
F_1	**0.42**

- Variable precision for individual verbs: $\text{prec}_{faltar} = 1.00$, $\text{prec}_{apoiar} = 0.16$
- Reason: *apoiar* occurs frequently and in many contexts

⇒ 22 SVCs retrieved for 6 full verbs
⇒ Success depends on initial full verb
⇒ Goal: Increase precision while not overly lowering recall

Final results

	Cross-lingual only	PMI hiPrec	PMI hiRec
Precision	0.26	**0.91**	0.61
Recall	1.00	0.45	**0.86**
F_1	0.42	0.61	**0.72**

- Restrictive filtering increases precision, loose filtering hardly lowers recall while improving precision
- Most responsible for improvement: V-N co-occurrence threshold on PMI-ranked list

⇒ Considerable improvement over cross-lingual results: f_1 0.42 → f_1 0.72

⇒ Reliable scores for both precision and recall in different settings

Conclusions:

- Synergy effects by combining cross- and monolingual techniques:
  1. extraction of syntactically and semantically correct expressions
  2. filtering to keep only SVCs
- No complex preprocessing necessary: parallel corpus and POS tags
- Applicable to the need for both solid precision and recall, e.g. language generation and lexicon expansion

Related studies about CP extraction:

- Monolingual: with POS information [Grefenstette and Teufel, 1995, Duran et al., 2011] or association measures [Krenn and Evert, 2001, Evert and Krenn, 2001]
- Cross-lingual: paraphrase detection with pivot idea [Bannard and Callison-Burch, 2005], with deep linguistic analysis [Zarrieß and Kuhn, 2009]

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Addendum: Specification of the second monolingual filter – context diversity

- Two categories of SVCs:
  - SVCs with light verbs. Verb has very high context diversity, e.g. dar apoio, dar um passo, dar uma resposta, . . .
  - SVCs with nearly idiomatic meaning. Verb has very low context diversity given the mininimum V-N co-occurrence threshold, e.g. correr um risco
- Remove V-N pairs with verbs which have a medium amount of co-occurring nouns

⇒ Filter 1: Consider only V-N pairs with a specific minimum frequency
⇒ Filter 2: Consider only V-N pairs with very high / low context diversity