

## Pragmatic drivers of word order changes: Game-theoretic simulations

This project probes into the relation between two grammatical changes in the history of French, namely, the spread of definite determiners on the one hand and of SVO order on the other, on the assumption that determiners and word order both play a role in information packaging and that their evolution was mediated by speakers’ pragmatic inferences about their use. We build these assumptions into a Rational Speech Act model (RSA, [Frank and Goodman 2012](#)), which, we show, generates word order distributions very similar to what is observed in the history of French. This work contributes to a better understanding of the drivers of syntactic change.

**Word order and determiners: A pragmatic tradeoff.** As table 1 illustrates, historical French was characterized by a relatively free word order which eventually converged to SVO. Along with non-SVO orders in declarative clauses, French also witnessed a rise in determiner frequencies ([Carlier and Goyens 1998](#)). It is uncontroversial that both word and determiners are one of the main means (along with prosody) of structuring propositional information in pragmatic terms (i.e. as related to the discourse goals). It is thus reasonable to hypothesize that changes in word order and determiner systems could have been related. Our goal is to propose a model of such relation and test it on the historical French material.

Our starting point for modelling the relation in question is the information flow principle \*New  $\succ$  Presupposed of [Kučerová \(2012\)](#), presented in (1) in an amended form where “presupposed” replaces the original notion of “given” (for the discussion of why the former concept is more suitable see [Šimík and Wierzba \(2015\)](#)). (1) allows [Kučerová \(2012\)](#) to capture (4) in Czech.

- (1) Generalisation \*New  $\succ$  Presupposed (with an obviation condition)

Within a domain [ $_{Dom}$  Y ... X], if X is presupposed, so is Y unless X involves a lexical trigger of existential presupposition (determiner/proper name/pronoun). Based on [Kučerová \(2012, 14\)](#)

On this proposal, the role of object scrambling is to align the syntactic structure with Presupposed  $\succ$  New, as in (5). Because of the obviation effect, the presence of a lexical presupposition marker, such as the demonstrative determiner in (6), can replace scrambling. In terms of how they convey information, syntactic and lexical means are not equivalent: word order “NP<sub>1</sub> NP<sub>2</sub>”, incompatible with New  $\succ$  Presupposed interpretation, is compatible with Presupposed  $\succ$  New, Presupposed  $\succ$  Presupposed, and New  $\succ$  New interpretations, whereas a sequence NP<sub>1</sub> det NP<sub>2</sub> is compatible with all four information configurations. This principle thus embodies an intuition about a “competition” between word order and determiners in information structuring. Historical French is a ideal test case because of the empirical parallelism in the spread of determiners and the disappearance of non-SVO. Our model incorporates the long-standing hypothesis that convergence to SVO in French was related to a prosodic restructuring of the clause which resulted in scrambling being dispreferred and eventually lost ([Kroch 1989, Rainsford 2011](#)).

**RSA for historical French.** Our goal is to see if a model which assumes that speech act participants are aware of interpretative possibilities associated with word order and determiners can generate the change in word order and determiner distributions attested in historical French. RSA assumes Bayesian reasoning on the part of the speech act participants. Given an utterances, a Literal Listener ( $L_0$ ) generates a probability distribution over states of affairs based on a) prior probabilities of these states and b) literal meaning of an utterance (a pre-set relation between an utterance and states of affairs, 2<sup>1</sup>), (2). A Pragmatic Speaker, given a state of affairs, generates a probability distribution over utterances based on a) prior probabilities of these utterances and b) the properties of  $L_0$ , while trying to minimize the surprisal and utterance costs, (3).

$$(2) P_{L_0}(s | u) \propto \llbracket u \rrbracket(s) \times P(s) \quad \text{Scontras et al. (2017)}$$

$$(3) P_S(u | s) \propto \exp(\alpha(\log L_0(s | u) - C(u))),$$

where  $\alpha$  is speaker’s optimality parameter and  $C$  is a cost function. Scontras et al. (2017)

To estimate priors of information states, we classified 430 Russian transitive sentences (both “S O” and “O S”) from the Russian National Corpus, [RNC \(2019\)](#) according to their information state and obtained the following distribution: {Presupposed-New: 0.46, New-Presupposed: 0.02, Presupposed-Presupposed: 0.35, New-New: 0.16}. We also assumed (uniform) penalties for scrambling (i.e. for all orders involving OS) and factored in probabilities of (subject and object) determiners into the prior probabilities of utterances involving determiners (determiner probabilities were estimated directly from the historical French data). Figure 1 shows the probabilities of various word orders per century as predicted by our Pragmatic Speaker (we ran the Speaker model on each information state separately and summed up resulting probabilities for each word order after having multiplied them by the priors of the relevant informations state), as well as the estimates obtained from the historical French corpus. Our RSA model, which is based on the assumption that determiners are less ambiguous than bare nouns in conveying information states, 2, and which involves a) uniform priors for utterances b) independently estimated priors for information states, and c) (uniform and rising

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<sup>1</sup>*Det* stands for a determiner either triggering existential presupposition (definite, demonstrative or possessive) or indicating its absence (indefinite). We assume that bare arguments in clauses where another argument has a determiner are interpreted as indefinite.

with time) costs for scrambling generates a historical profile that is strikingly similar to the actual profile of language change in French. In our talk, we will discuss parallel models for historical Portuguese and English.

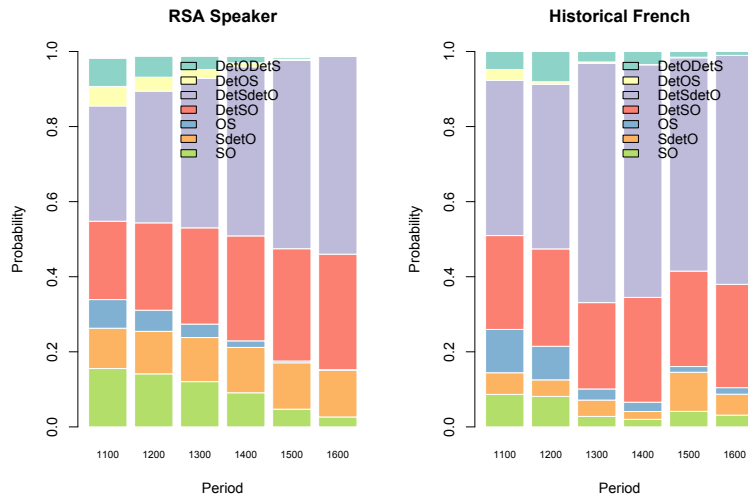
	OSV	OVS	SOV	SVO	VOS	VSO
1100	0.02 (2)	0.13 (17)	0.14 (18)	0.64 (83)	0.02 (3)	0.05 (6)
1200	0.01 (27)	0.11 (203)	0.12 (219)	0.61 (1120)	0.05 (95)	0.09 (173)
1300	0.00 (3)	0.04 (23)	0.02 (13)	0.77 (493)	0.02 (15)	0.15 (97)
1400	0.00 (3)	0.03 (37)	0.03 (37)	0.73 (1043)	0.03 (47)	0.18 (255)
1500	0.00 (0)	0.02 (11)	0.01 (8)	0.88 (615)	0.02 (13)	0.07 (52)
1600	0.00 (0)	0.02 (5)	0.00 (0)	0.91 (286)	0.02 (6)	0.06 (18)

**Table 1:** Constituent order in transitive clauses with nominal arguments (counts based on Kroch and Santorini (2010) and Martineau et al. (2010))

- (4) Chlapec našel lízátko.  
 boy.Nom found lollipop.Acc  
 “The/a boy found a lollipop.” # “A boy found this lollipop.”
- (5) Lízátko našel chlapec.  
 lollipop.Acc found boy.Nom  
 “A boy found this lollipop.”
- (6) Chlapec našel **ten** lízátko.  
 boy.Nom found this lollipop.Acc  
 “A boy found this lollipop.”

UTTERANCE	INFORMATION STATE
“Det Obj Det Sbj”	Given $\succ$ Given, Given $\succ$ New, New $\succ$ Given, New $\succ$ New
“Det Obj Sbj”	Given $\succ$ New, New $\succ$ New
“Det Sbj Det Obj”	Given $\succ$ Given, Given $\succ$ New, New $\succ$ Given, New $\succ$ New
“Det Sbj Obj”	Given $\succ$ New, New $\succ$ New
“Obj Sbj”	Given $\succ$ Given, Given $\succ$ New, New $\succ$ New
“Sbj Det Obj”	New $\succ$ Given, New $\succ$ New
“Sbj Obj”	Given $\succ$ Given, Given $\succ$ New, New $\succ$ New

**Table 2:** Literal meaning: utterances and corresponding information states (“Obj Det Sbj” does not occur in our data)



**Figure 1:** RSA Speaker vs. historical French data

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