Intervention effects in object relatives in English and Italian: a study in quantitative computational syntax

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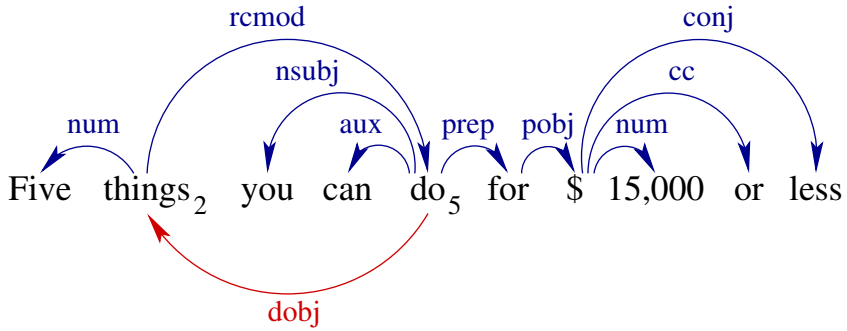
Intervention effects and quantitative computational syntax

- **Aim** investigate locality issues adopting a quantitative computational syntax point of view (Merlo, 2016): *differentials in counts are the expression of underlying grammatical properties.*
- Quantitative aspect of long-distance dependencies according to a theory of intervention.
- Comparison of the theoretically expected and the observed counts of features in grammatical structures indicate which set of features plays a role in the syntax of object relative clauses.

Object Relative clauses



- This is the *apple*$_i$ that William *hit*$_i$ with his arrow.

Relative clauses

Not all relative clauses are equally easy to process or learn.

(1a) Show me the tiger that **the lion** is washing <the tiger>.

(1b) Show me the tiger that <the tiger> is washing the lion.

- Object relatives (1a) are harder than subject relatives (1b), in various respects both in children and adult grammar.
- Experimental studies and results on both production and comprehension of relatives clauses, in acquisition (Friedmann and Novogrodsky, 2004), adult processing (Frauenfelder et al., 1980), and pathology (Grillo, 2008).

Intervention theory (Rizzi 1990, 2004)

- Core to the explanation of these facts is the notion of **intervener**.
- Intervener: an element that is **similar** to the two elements that are in a long-distance relation, and **structurally intervenes** between the two, blocking the relation.
- Intervention: the head of the relative clause and the intervener share some **computationally relevant features**.

Relevant features

head of relative		subject	
the debate XP, singular, inanimate	**which**	**we** head, plural, animate	**held**
these lovely little chocolates XP, plural, inanimate	**that**	**we** head, plural, animate	**get**
Il terreno *the ground* XP, singular, inanimate	**che** *that*	**l' acqua** *the water* XP, singular, inanimate	**copre** *covers*

- **Type**: lexical or maximal projection.
- Agreement features: **number** creates intervention effects (so decreases acceptability) but person doesn't;
- **Animacy**: children don't seem to mind in relative clauses but intervention effects have been found in weak-islands (Franck et al., 2015).

Research Questions and Definitions

1. Do the features *type*, *number* and *animacy* play a role in intervention effects?
2. If the features play a role in intervention effects, are these effects stronger in a given language?

- *Feature match* A feature match, $match_f(C, I)$, is true iff, for a given feature f, the head of the relative C and the intervener I have the same value.
- *Linking hypothesis* If a feature is a stronger intervener, we expect it to create greater inacceptability and hence surface less often in a corpus in a match configuration.

Hypotheses

H_1 Both in Italian and English, if the features *type*, *number* or *animacy* trigger intervention effects, we expect match configurations to be less frequent than expected. (Possibly, non-match configurations are more frequent than expected.)

H'_1 If the features *number* triggers intervention effects, the effect (the difference between expected and observed matches) should be larger in Italian than in English.

Observed counts: the counts in the corpus.
Expected counts: the counts of the features that we would expect based on their distribution in a setting where intervention is not at play and, therefore, they do not interact with each other.

Materials

Treebank	objs	left objs	OR	%OR
English ParTut (Bosco and Sanguinetti 2014)	3186	51	44	86
English LinEs (Ahrenberg et al, 2015)	5985	139	16	11
English UD (Bies et al., 2012)	15259	403	191	47
Italian ParTut (Bosco and Sanguinetti 2014)	3142	56	49	71
Italian UD (Bosco et al., 2013)	14639	549	216	39

Examples of coding in English

Relative head			Intervener			Sentence
type	num	an	type	num	an	
XP	sg	in	head	pl	an	*the foreign investment* that **they** need to help their economies grow
XP	pl	in	head	pl	an	*the fees* that **they** charge
XP	sg	in	XP	pl	an	*a luxury* that only **rich countries** can afford
XP	sg	an	XP	pl	an	*a better person* that **people** are wanting to hire
XP	sg	in	XP	sg	an	*a realist technique* which **French novelist Marcel Proust** later named *retrospective illumination*
XP	sg	in	XP	sg	in	a format that Access recognizes

Examples of coding in Italian

Relative head			Intervener			Sentence
type	num	an	type	num	an	
XP	pl	in	null	sg	an	*i luoghi* che **[0]** aveva visitato (the places that (s/he) had visited)
XP	pl	in	head	sg	in	*i seri problemi* che **ciò** genera (the serious problems that this engenders)
XP	sg	an	null	sg	an	*l'associazione* che **[0]** aveva fondato (the association that (s/he) had founded)
XP	pl	in	XP	sg	an	*i sonetti* che **Shakespeare** intendeva pubblicare (the sonets that Shakespeare meant to publish)
XP	pl	in	XP	sg	in	*le limitazioni* che **la legge** stabilisce (the limitations that the law dictates)
XP	sg	in	XP	sg	in	Il terreno che l' acqua copre (the ground that the water covers)

Prior Probabilities of Expected Counts

	English		Adjusted En		Italian		Adjusted It	
	Sbj	Obj	Sbj	Obj	Sbj	Obj	Sbj	Obj
XP	.49	.91	.49	1.0	.62	.86	.62	1.0
head	.48	.09	.48	.00	.05	.14	.05	.00
null	.03	-	.03	.00	.33	-	.33	.00
singular	.70	.73	.70	.73	.74	.67	.74	.67
plural	.30	.27	.30	.27	.26	.33	.26	.33
animate	.93	.22	.93	.22	.78	.20	.78	.20
inanimate	.07	.78	.07	.78	.22	.80	.22	.80

- Adjusted counts: relatives with a pronoun head or a null head are extremely rare or impossible.
- So the counts in a relative clause are different from their distribution in a simple transitive sentence.
- We will use the adjusted expected counts for our comparisons.

Results: match condition

English

HRel	Intervener	Exp	Obs	*p*	Bin *p*	*z*-*p*
XP	XP	123.0	**108**	0.490	0.033	0.033
sing	sing	128.7	132	0.511	0.341	0.341
plur	plur	20.3	22	0.081	0.382	0.393
anim	anim	51.4	**20**	0.205	0.000	< .000001
inan	inan	13.7	12	0.055	0.399	0.384

Italian

HRel	Intervener	Exp	Obs	*p*	Bin *p*	*z*-*p*
XP	XP	164.3	**149**	0.62	0.0313	0.03053
sing	sing	131.4	138	0.496	0.218	0.218543
plur	plur	22.7	34	0.86	0.011	0.007814
anim	anim	41.3	**23**	0.156	0.0006	0.001263
inan	inan	46.6	**27**	0.176	0.0006	0.001009

Results: mismatch condition

English

HRel	Intervener	Exp	Obs	*p*	Bin *p*	*z*-*p*
XP	head	120.5	**135**	0.480	0.383	0.038
XP	null	7.5	0	0.030	0.0005	*n.v.*
sing	plur	47.4	49	0.219	0.203	0.202
plur	sing	53.2	40	0.189	0.131	0.132
anim	inan	3.9	0	0.015	0.022	*n.v.*
inan	anim	182.1	**211**	0.725	0.00001	0.00003

Italian

HRel	Intervener	Exp	Obs	*p*	Bin *p*	*z*-*p*
XP	head	13.3	**29**	0.050	0.000075	0.000009
XP	null	87.5	**101**	0.330	0.0453	0.044109
sing	plur	46.2	**59**	0.174	0.0249	0.022341
plur	sing	64.7	48	0.244	0.0088	0.010407
anim	inan	11.7	0	0.044	0.000007	0.000415
inan	anim	165.4	**229**	0.624	0.00000001	0.000001

Discussion

- **Type and animacy**: H_1 confirmed in most match cases, for both English and Italian. Only the (inanimate, inanimate) pair in English is numerically smaller than expected, but not significantly.
- Increase of observed non-match configurations: possibly compatible with an intervention effect.
- The hypothesis is not confirmed only in the smaller or zero observed counts. We reserve to investigate further if this result is due to a too small sample size.
- **Number:** neither H_1 nor H_1' are convincingly confirmed. All aspects of the hypotheses need further investigation.

Discussion – Finer-grained distinctions among intervention theories

- Narrow intervention (grammar-based, explains ungrammaticality, weak islands): only morpho-syntactic features are relevant to define intervention.
- Cue-based memory based models (processing-based, explain difficulty, object relatives): similarity can take any feature type into account (as demonstrated in experiment on weak islands above, which also manipulate semantic reversibility) and intervention is a kind of interference at retrieval in memory.

Discussion

- Narrow intervention: predicts effects of morpho-syntactic features but needs to be extended to explain effects of animacy.
- Cue-based memory based models: a broad notion of intervention features expect animacy effects.

Conclusions

- Human languages exhibit the ability to interpret elements distant from each other in the string as if they were adjacent, such as relative clauses.
- The structural intervention of an element similar to those involved in the object relative can disrupt the relation.
- Results show that object relative clauses matching in animacy exhibit lower than expected counts, but not clauses matching in number.

The end

- Thank you.