Seminar in statistics and methodology

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Talk` s structure

- The study
- Results
- Stating the problem
- Odds ratio measurement
- Results reviewed

THE STUDY
Aim

Give some insight for the operation ‘movement’ in agrammatism. We used two types of movement that are to be found in the Italian grammar:

- Verb movement (which occurs in order to check features, i.e. agreement and tense)
- Movement of the clitic particle ‘non’ in negative sentences.

THE STUDY
The linguistic background

- Clause typology and verb movement in Italian

Clause typology and verb movement in Italian

- Three types of clauses:
- *Small Clauses*
  - Vedo [il gatto mordere$_{inf}$ il topo]
    I see the cat biting the mouse
- *Matrix Clauses*
  - Il gatto morde il topo
    The cat bites the mouse
- *Subject relative Clauses*
  - Vedo il gatto che [morde$_{fin}$. il topo]
    I see the cat that bites the mouse

Clause typology and verb movement in Italian

- In matrix clauses and subject relative clauses the verb is *finite* whereas in small clauses the verb is *infinite*. In matrix clauses and subject relative clauses, the verb moves in order to check its features, i.e. Agreement and Tense.
- In small clauses the verb, which is infinitival stays in its base position.

THE STUDY
The linguistic background

- Italian negative clauses

Italian negative clauses

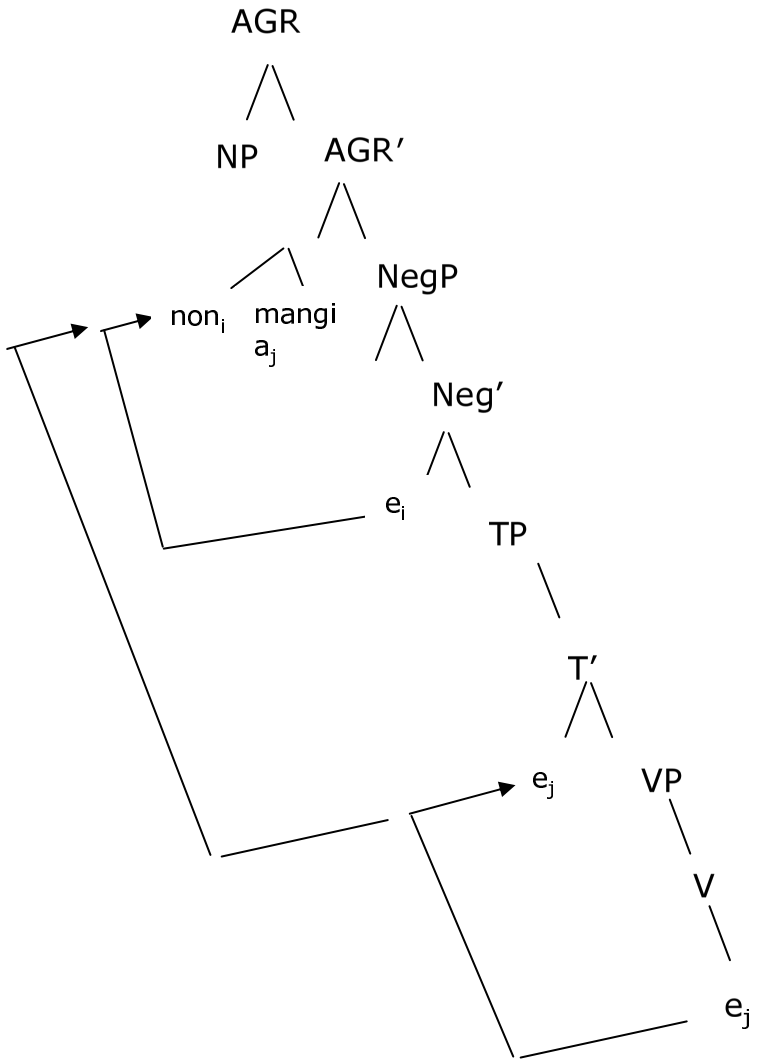
- Maria *non* mangia la mela

  Maria does not eat the apple

  Maria not eats the apple

According to Belletti (1990) the negative particle 'non' (not) is considered to be a *clitic* therefore undergoing movement from NegP° to AgrP° to give as a result the constituent order: Subj. *non* V_{fin} :

The derivation



Verb movement vs. Movement of *non*

- The verb is moving from its based position in order to get Tense and Agreement to land in AgrP°.
  - This movement is *independent* from the movement of
- The negative particle *non* which moves with a head to head movement from NegP° to AgrP°.
  - The V and the negative particle *non* have the property to share the same landing site.

THE STUDY
Hypotheses

- Hp1: SC>[SRC;MC]
  - Italian agrammatics will better produce SC than SRC and MC, where the verb doesn't move to check features.
- Hp2:
  - An association should be found between *finite structures* i.e. MCs and SRCs and *non finite structures*, i.e. SCs (the first ones requiring a finite verb and the second ones a non finite verb).
- Hp3: aff. clauses>neg. clauses
  - The Negative particle *non* has to undergo a head to head (clitic) movement to reach its landing site i.e. SpecAgr

The study

- *Subjects:*
  - One Italian agrammatic patient R.B. was tested (!!This is part of the problem)
- *Experiment design:*
  - Sentence completion task.
  - Affirmative and negative sentences prompted by pictures crossing within the three clause typologies were presented (tot. 108 sentences).

Results

- We clustered together the answers for the structures which require a finite verb (MC and SRC), and the ones which need a non finite verb (SC).

Observed Values and % correct	Finite structures (MC;SRC)	Non finite structures (SC)
+Finiteness	21 (29%)	5 (13%)
-Finiteness	51 (71%)	31 (86%)

Stating the problem

- In aphasiology the number of patients is often insufficient to run statistical analyses like t-Test or Anova (it is rarely possible to compare between groups)
- The number of responses to analyse is often to small to analyse, as well.
- Normally an association analysis is performed using Chi^2 test.

Stating the problem

- Recall that Chi^2 gives us a measure of association: if there is or there is not an association between two categorical variables.

$$\chi^2 = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

But it doesn't give as much information about the direction of the association.

Some basic terminology

- Contingency table
- *Joint distributions*
- Marginal distributions
- *Conditional distributions*
- Odd Ratios

Joint distribution

- In a contingency table with two variables let π_{ji} be the probability that (X,Y) occurs in row *i* and column *j*.

$$\Sigma_i \Sigma_j \pi_{ji} = 1$$

π_{ij}	Finite structures (MC;SRC)	Non finite structures (SC)
+Finiteness	0.19	0.046
-Finiteness	0.47	0.29

Some basic terminology

- Marginal distributions
- *Conditional distributions*
- Odd Ratios

Conditional distribution

- Given one independent(X) and one dependent variable (Y), the *conditional distribution* $\pi_{j/i}$, is the probability of X to fall into one column j of Y

$$\Sigma_j \pi_{j/i} = 1$$

π	Finite structures (MC;SRC)	Non finite structures (SC)
+Finiteness	$\pi_1 0.29$	$\pi_1 0.14$
-Finiteness	$\pi_2 0.71$	$\pi_2 0.86$

Odds ratio

- Usually used in 2x2 tables.
- Also applied in JxI tables.
- Presenting probabilities.
- The odds of an event happening is the probability that the event will happen divided by the probability that the event will not happen.

Odds Ratio for conditional distribution

- For simplification we assign π to the former notation $\pi_{j/i}$
- Odds are defined as:

$$\Omega = \pi / (1- \pi)$$

- The odds ratio Θ is therefore assigned the formula:

$$\Theta = \frac{\Omega_1}{\Omega_2} = \frac{\pi_1 / (1- \pi_1)}{\pi_2 / (1- \pi_2)}$$

Odds Ratio for joint distributions

- For joint distributions the formula (called cross-product ratio as well) will be:

$$\Theta = \frac{\pi_{11}\pi_{22}}{\pi_{21}\pi_{12}}$$

Properties of the Odds Ratio

$\Theta = 1$

There is independence for X and Y

$1 < \Theta < \infty$

$\pi_1 > \pi_2$

There is association: the proportion of events in row/column 1 is bigger than the proportion of events in row/column 2

$0 < \Theta < 1$

$\pi_1 < \pi_2$

The proportion of events in row/column 2 is bigger than the proportion of events in row/column 1

Columns and rows can be reversed. The Odds ratio formula is symmetric.

X^2: Results

- Running a X^2 test we did not find any significant association (X^2=0.08; Fisher's exact test=0.098 both n.s.)
- Our hypothesis that we should have found an association between *structure* of the clause and *typology* of verb is not supported.
  - This tells us that our patient is impaired
  - However….

Results: applying the Odds Ratio

- Applying to the data an Odds Ratio analysis we will be able to have more information about the "direction" of the association.
  - In probability terms we will assess which is the structure that has the bigger chance to be produced.

Applying Odds Ratio

- We applied the Odds ratio to our data using conditional distributions:

π	Finite structures (MC;SRC)	Non finite structures (SC)
+Finiteness	$\pi_1$0.29	$\pi_1$0.14
-Finiteness	$\pi_2$0.71	$\pi_2$0.86

- Looking at the independent variable Finite Structures the odds ratio value is *0.16*.
- Recall that $0<\Theta<1 = \pi_1<\pi_2$

  This equals to say that within finite structures R.B. has more chances to produce non finite verbs, showing an impairment.
- For non finite structures an odds ratio value of *0.02* confirms our expectations, i.e. R.B. has difficulty in producing finite verbs. This tells us that again R.B. is biased toward the use of non finite verbs. In this case however this turns out to be correct.

Conclusions and discussion

- X^2 is a measure of association between categorical variables.
- No real ‘direction’ of the association can be defined.
- Odds Ratio is presenting probabilities, and the direction a probability takes between to variables.
- Good way of analyzing results in studies where only association measures are possible.