Quantifying dialect Dutch verb clusters

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SyHD-workshop

Dialect syntax – the state of the art

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This talk in one slide

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- **traditional dialectometry** measures (dis)similarities between dialect locations based on their linguistic profile
- **reverse dialectometry** measures (dis)similarities between *linguistic constructions* based on their geographical spread and maps these results against formal-theoretical parameters
- **result:** a method that can detect and identify grammatical parameters in a large and highly varied data set

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'that he laughed yesterday during class.'

(2) dat hij gisteren tijdens de les heeft gelachen.
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- this freedom in word order is a source of massive interdialectal variation

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  - for a total of 31 cluster orders
- if we map, for each of the 267 SAND-dialects, which dialect has which combination of cluster orders, we find 137 different combinations of verb cluster orders

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    - if there are, what are they and how can we detect them?
    - more generally, how can we distinguish between the signal and the noise in such large and highly variable datasets?
- **in this talk** I use statistical methods to detect and identify grammatical microparameters regulating (a large part of) the variation found in Dutch verb clusters

A dialectometric analysis

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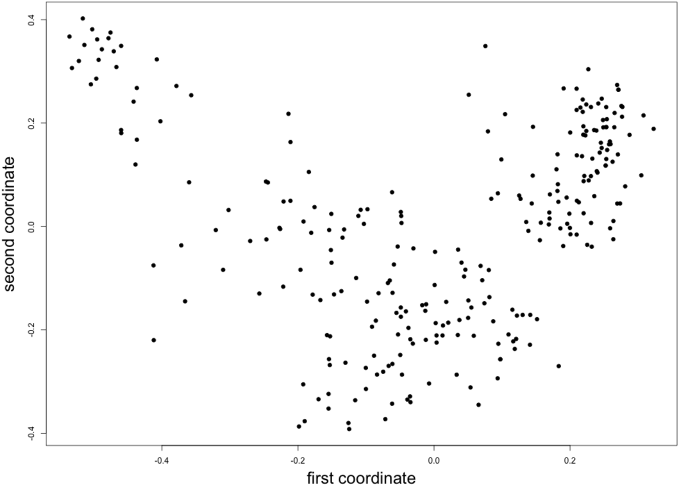
- a typical dialectometric analysis measures similarities and differences between dialect locations based on their linguistic profile
- starting point: data table with dialects in rows and cluster orders in columns

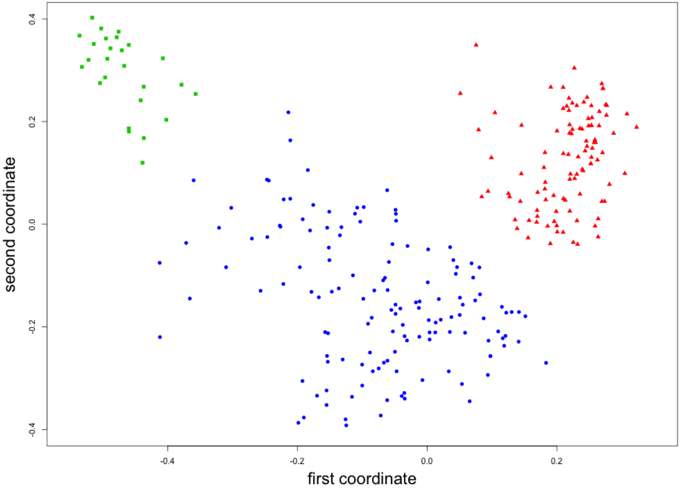
	AUX1(be.sg)-PART2	PART2-AUX1(be.sg)	AUX1(have.sg)-PART2	PART2-AUX1(have.sg)	AUX1(have.pl)-PAF
Midsland / Midslâr	no	yes	no	yes	
Lies	no	yes	no	yes	
West-Terschelling	no	yes	no	yes	
Oosterend	NA	NA	no	yes	
Hollum	no	yes	NA	NA	
Schiermonnikoog	no	yes	no	yes	
Ferwerd / Ferwert	no	yes	no	yes	
Anjum / Eanjum	no	yes	no	yes	
Kollum	no	yes	no	yes	
Visvliet	no	yes	no	yes	
Oosterbierum / Ea	no	yes	no	yes	
Beetgum / Bitgum	no	yes	NA	NA	
Bergum / Burgum	no	yes	no	yes	
Jorwerd / Jorwert	no	yes	NA	NA	
Bakkeveen / Bakk	no	yes	no	yes	
Waskemeer / De \	no	yes	no	yes	
Kloosterburen	no	yes	no	yes	
Warffum	no	yes	no	yes	
Leermens	no	yes	no	yes	
Groningen	no	yes	yes	no	
Nieuw-Scheemda	NA	NA	no	yes	
Langelo	no	yes	no	yes	

- step 1: convert the data table into a 267×267 (symmetric) distance matrix, whereby for each pair of locations a distance between them is calculated based on the linguistic features they share

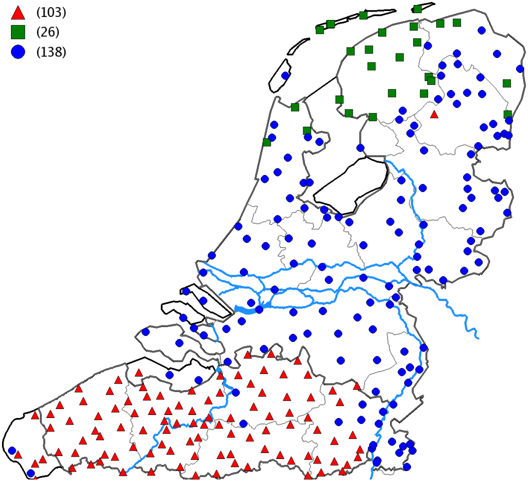
	Midsland	Lies	West-Ter:	Oosteren	Hollum	Schiermo	Ferwerd /	Anjum /	Kollum	Visvliet	Oosterbie	Beetgum	Bergum /	Jorwerd /
Midsland / Mic	0,000	0,500	0,333	0,706	0,250	0,647	0,357	0,250	0,611	0,650	0,533	0,545	0,500	0,692
Lies	0,500	0,000	0,444	0,750	0,588	0,375	0,471	0,563	0,444	0,444	0,632	0,714	0,500	0,667
West-Terschel	0,333	0,444	0,000	0,789	0,429	0,667	0,286	0,429	0,632	0,600	0,500	0,500	0,429	0,583
Oosterend	0,706	0,750	0,789	0,000	0,706	0,765	0,737	0,538	0,563	0,600	0,600	0,727	0,813	0,846
Hollum	0,250	0,588	0,429	0,706	0,000	0,667	0,167	0,000	0,625	0,714	0,462	0,500	0,500	0,545
Schiermonnik	0,647	0,375	0,667	0,765	0,667	0,000	0,625	0,667	0,400	0,556	0,706	0,750	0,571	0,667
Ferwerd / Fer	0,357	0,471	0,286	0,737	0,167	0,625	0,000	0,182	0,588	0,682	0,308	0,333	0,333	0,400
Anjum / Eanju	0,250	0,563	0,429	0,538	0,000	0,667	0,182	0,000	0,571	0,625	0,417	0,556	0,500	0,600
Kollum	0,611	0,444	0,632	0,563	0,625	0,400	0,588	0,571	0,000	0,353	0,625	0,643	0,429	0,571
Visvliet	0,650	0,444	0,600	0,600	0,714	0,556	0,682	0,625	0,353	0,000	0,588	0,500	0,667	0,692
Oosterbierum	0,533	0,632	0,500	0,600	0,462	0,706	0,308	0,417	0,625	0,588	0,000	0,167	0,571	0,500
Beetgum / Bit	0,545	0,714	0,500	0,727	0,500	0,750	0,333	0,556	0,643	0,500	0,167	0,000	0,500	0,455
Bergum / Bur	0,500	0,500	0,429	0,813	0,500	0,571	0,333	0,500	0,429	0,667	0,571	0,500	0,000	0,222
Jorwerd / Jorv	0,692	0,667	0,583	0,846	0,545	0,667	0,400	0,600	0,571	0,692	0,500	0,455	0,222	0,000
Bakkeveen / E	0,400	0,500	0,438	0,706	0,385	0,563	0,357	0,385	0,438	0,579	0,533	0,545	0,385	0,583
Waskemeer /	0,438	0,526	0,556	0,818	0,500	0,588	0,471	0,533	0,471	0,652	0,588	0,667	0,429	0,500
Kloosterburen	0,500	0,412	0,611	0,810	0,563	0,357	0,529	0,600	0,333	0,636	0,706	0,667	0,385	0,583
Warffum	0,563	0,438	0,667	0,737	0,625	0,429	0,588	0,643	0,400	0,652	0,600	0,636	0,571	0,750
Leermens	0,667	0,652	0,739	0,550	0,773	0,650	0,739	0,722	0,389	0,455	0,667	0,571	0,684	0,765
Groningen	0,714	0,682	0,714	0,636	0,783	0,762	0,800	0,778	0,471	0,476	0,684	0,714	0,737	0,786
Nieuw-Scheer	0,650	0,682	0,650	0,652	0,773	0,762	0,739	0,722	0,556	0,368	0,647	0,615	0,667	0,786
Langelo	0,727	0,524	0,739	0,652	0,792	0,650	0,760	0,647	0,550	0,500	0,700	0,824	0,810	0,950

- step 2: reduce this 267-dimensional matrix to a two- or three-dimensional one, so that it can easily be visualized


second coordinate
first coordinate
0.4
0.2
0.0
-0.2
-0.4
-0.4
-0.2
0.0
0.2


second coordinate
first coordinate
0.4
0.2
0.0
-0.2
-0.4
-0.4
-0.2
0.0
0.2

- step 3: project back onto a geographical map


(103)
(26)
(138)

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    1. the linguistic constructions themselves play only an indirect role in the outcome of the analysis: we can see when two dialects differ, but we don't see which cluster orders are responsible for this difference or how they cluster or correlate

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    1. the linguistic constructions themselves play only an indirect role in the outcome of the analysis: we can see when two dialects differ, but we don't see which cluster orders are responsible for this difference or how they cluster or correlate
    2. there is no link between the data that feed into the quantitative analysis and the formal theoretical literature on verb clusters

Reverse dialectometry

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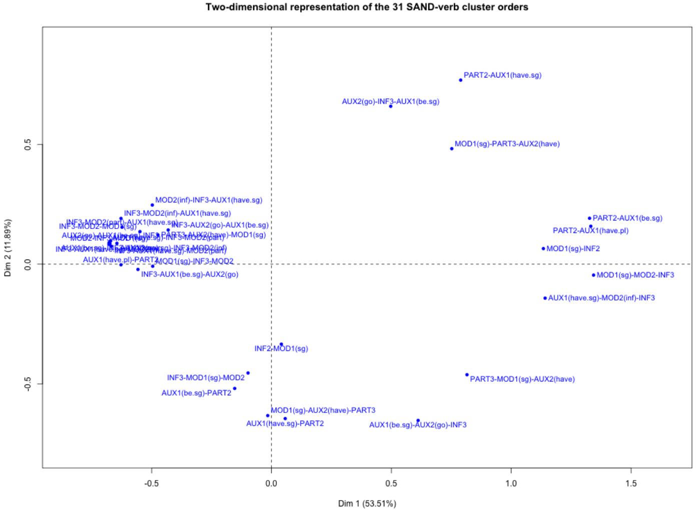
	Midsland	Lies	West.Tersch	Oosterend	Hollum	Schiermonni	Ferwerd	Anjum	Kollum	Visvliet
AUX1(be.sg)-PART2	no	no	no	NA	no	no	no	no	no	no
PART2-AUX1(be.sg)	yes	yes	yes	NA	yes	yes	yes	yes	yes	yes
AUX1(have.sg)-PART2	no	no	no	no	NA	no	no	no	no	no
PART2-AUX1(have.sg)	yes	yes	yes	yes	NA	yes	yes	yes	yes	yes
AUX1(have.pl)-PART2	no	no	no	no	no	no	no	no	no	no
PART2-AUX1(have.pl)	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
MOD1(sg)-INF2	no	no	yes	no	no	no	no	no	no	yes
INF2-MOD1(sg)	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
MOD2-INF3-MOD1(sg)	no	no	no	no	no	no	no	no	no	no
MOD1(sg)-MOD2-INF3	no	no	no	yes	no	no	no	no	yes	yes
MOD1(sg)-INF3-MOD2	yes	no	no	no	no	no	no	no	no	no
INF3-MOD2-MOD1(sg)	yes	yes	yes	no	yes	yes	yes	yes	yes	yes
INF3-MOD1(sg)-MOD2	no	no	no	no	no	no	no	no	no	yes
MOD1(sg)-AUX2(have)-PART3	no	no	no	no	no	no	no	NA	no	no
MOD1(sg)-PART3-AUX2(have)	no	no	no	no	no	no	no	NA	yes	yes
PART3-MOD1(sg)-AUX2(have)	no	yes	no	yes	no	no	no	NA	yes	yes
PART3-AUX2(have)-MOD1(sg)	yes	yes	yes	no	yes	yes	yes	NA	yes	yes
AUX1(be.sg)-AUX2(go)-INF3	no	no	no	yes	no	no	no	no	NA	yes
AUX1(be.sg)-INF3-AUX2(go)	no	no	no	no	no	no	no	no	NA	no
AUX2(go)-AUX1(be.sg)-INF3	no	no	no	no	no	yes	no	no	NA	no
AUX2(go)-INF3-AUX1(be.sg)	no	no	no	no	no	no	no	no	NA	no
INF3-AUX1(be.sg)-AUX2(go)	no	no	no	no	no	no	no	no	NA	no
INF3-AUX2(go)-AUX1(be.sg)	yes	yes	yes	no	yes	no	yes	yes	NA	no
AUX1(have.sg)-MOD2(inf)-INF3	no	no	no	yes	no	no	no	no	no	no
AUX1(have.sg)-INF3-MOD2(part)	no	no	no	no	no	no	no	no	no	yes
AUX1(have.sg)-INF3-MOD2(inf)	no	no	no	no	no	no	no	no	no	no
MOD2(inf)-INF3-AUX1(have.sg)	no	no	no	no	no	no	no	no	no	no
INF3-AUX1(have.sg)-MOD2(inf)	no	no	yes	no	no	no	no	no	no	no
INF3-AUX1(have.sg)-MOD2(part)	no	no	no	no	no	no	no	no	no	yes
INF3-MOD2(part)-AUX1(have.sg)	no	yes	no	no	no	yes	no	no	yes	yes
INF3-MOD2(inf)-AUX1(have.sg)	yes	yes	yes	no	yes	no	yes	yes	no	yes

- transform to a distance matrix and reduce its dimensionality


Two-dimensional representation of the 31 SAND-verb cluster orders
PART2-AUX1(have.sg)
AUX2(go)-INF3-AUX1(be.sg)
MOD1(sg)-PART3-AUX2(have)
MOD2(inf)-INF3-AUX1(have.sg)
INF3-MOD2(inf)-AUX1(have.sg)
INF3-AUX2(go)-AUX1(be.sg)
AUX1(have.pl)-PART3
MOD1(sg)-INF3-MOD2
INF3-AUX1(be.sg)-AUX2(go)
PART2-AUX1(be.sg)
PART2-AUX1(have.pl)
MOD1(sg)-INF2
MOD1(sg)-MOD2-INF3
AUX1(have.sg)-MOD2(inf)-INF3
INF2-MOD1(sg)
INF3-MOD1(sg)-MOD2
AUX1(be.sg)-PART2
PART3-MOD1(sg)-AUX2(have)
MOD1(sg)-AUX2(have)-PART3
AUX1(have.sg)-PART2
AUX1(be.sg)-AUX2(go)-INF3
Dim 2 (11.89%)
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
1.5
Dim 1 (53.51%)

- **note:** each point now represents a particular cluster order and closeness of points indicates how alike two verb cluster orders are based on their geographical spread

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- if this likeness is the result of grammatical microparameters, then verb cluster orders that are 'closeby' should be the result of the same parameter setting, i.e. parameters create **natural classes** of verb cluster orders

- **note:** each point now represents a particular cluster order and closeness of points indicates how alike two verb cluster orders are based on their geographical spread
- if this likeness is the result of grammatical microparameters, then verb cluster orders that are 'closeby' should be the result of the same parameter setting, i.e. parameters create **natural classes** of verb cluster orders
- in order to find those parameters, we can also encode the cluster orders in terms of their theoretical linguistic analyses

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  - [$\pm$movement]: can the order be derived via movement?
  - [$\pm$pied-piping]: does the derivation involve pied-piping?

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  - [$\pm$feature-checking violation]: does the order involve a feature checking violation?

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⇒ this account can be decomposed into the following microparameters:
  - [±base-generation]: can the order be base-generated?
  - [±movement]: can the order be derived via movement?
  - [±pied-piping]: does the derivation involve pied-piping?
  - [±feature-checking violation]: does the order involve a feature checking violation?
- and our 31 cluster orders can be encoded in terms of these microparameters

	Barbiers-base.generation	Barbiers-movement	Barbiers-spec-pied-piping	Barbiers-feature.checking-failure
AUX1(be.sg)-PART2	yesBase	noMvt	noPiedP	noFeatCheckFail
PART2-AUX1(be.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
AUX1(have.sg)-PART2	yesBase	noMvt	noPiedP	noFeatCheckFail
PART2-AUX1(have.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
AUX1(have.pl)-PART2	yesBase	noMvt	noPiedP	noFeatCheckFail
PART2-AUX1(have.pl)	noBase	yesMvt	noPiedP	noFeatCheckFail
MOD1(sg)-INF2	yesBase	noMvt	noPiedP	noFeatCheckFail
INF2-MOD1(sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
MOD2-INF3-MOD1(sg)	noBase	yesMvt	noPiedP	yesFeatCheckFail
MOD1(sg)-MOD2-INF3	yesBase	noMvt	noPiedP	noFeatCheckFail
MOD1(sg)-INF3-MOD2	noBase	yesMvt	noPiedP	noFeatCheckFail
INF3-MOD2-MOD1(sg)	noBase	yesMvt	yesPiedP	noFeatCheckFail
INF3-MOD1(sg)-MOD2	noBase	yesMvt	noPiedP	noFeatCheckFail
MOD1(sg)-AUX2(have)-PART3	yesBase	noMvt	noPiedP	noFeatCheckFail
MOD1(sg)-PART3-AUX2(have)	noBase	yesMvt	noPiedP	noFeatCheckFail
PART3-MOD1(sg)-AUX2(have)	noBase	yesMvt	noPiedP	noFeatCheckFail
PART3-AUX2(have)-MOD1(sg)	noBase	yesMvt	yesPiedP	noFeatCheckFail
AUX1(be.sg)-AUX2(go)-INF3	yesBase	noMvt	noPiedP	noFeatCheckFail
AUX1(be.sg)-INF3-AUX2(go)	noBase	yesMvt	noPiedP	noFeatCheckFail
AUX2(go)-AUX1(be.sg)-INF3	noBase	noMvt	noPiedP	noFeatCheckFail
AUX2(go)-INF3-AUX1(be.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
INF3-AUX1(be.sg)-AUX2(go)	noBase	yesMvt	noPiedP	yesFeatCheckFail
INF3-AUX2(go)-AUX1(be.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
AUX1(have.sg)-MOD2(inf)-INF3	yesBase	noMvt	noPiedP	noFeatCheckFail
AUX1(have.sg)-INF3-MOD2(part)	noBase	yesMvt	noPiedP	noFeatCheckFail
AUX1(have.sg)-INF3-MOD2(inf)	noBase	yesMvt	noPiedP	noFeatCheckFail
MOD2(inf)-INF3-AUX1(have.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
INF3-AUX1(have.sg)-MOD2(inf)	noBase	yesMvt	noPiedP	yesFeatCheckFail
INF3-AUX1(have.sg)-MOD2(part)	noBase	yesMvt	noPiedP	yesFeatCheckFail
INF3-MOD2(part)-AUX1(have.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail
INF3-MOD2(inf)-AUX1(have.sg)	noBase	yesMvt	noPiedP	noFeatCheckFail

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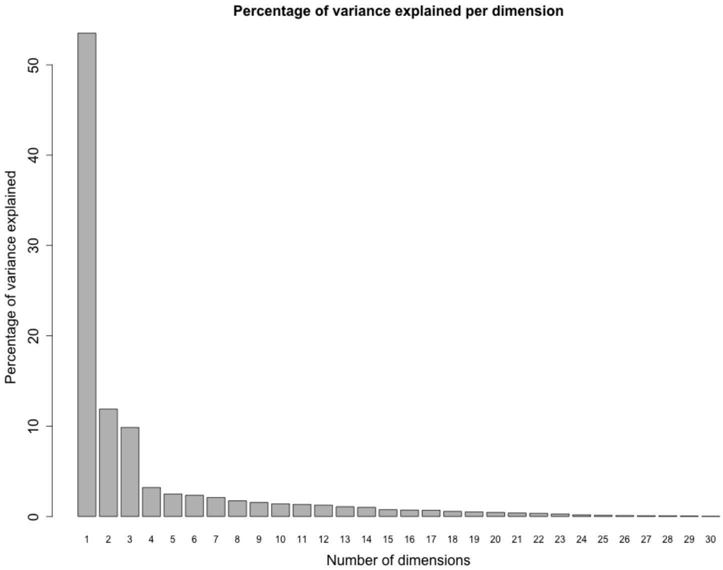
  - 17 additional variables based on the theoretical literature, but not linked to a specific analysis

- **proposal (I):** the number of microparameters responsible for the verb cluster variation = the number of dimensions we reduce our data set to


Percentage of variance explained per dimension
Percentage of variance explained
0
10
20
30
40
50
Number of dimensions
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

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- in order to know what those microparameters are, we need to *interpret* the first three dimensions

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- **proposal (II):** the identity of those microparameters = the interpretation of the dimensions
- the degree of similarity/correlation between a dimension and a linguistic variable can be determined by:
    1. visual inspection of a color-coded map
    2. calculating the squared correlation ratio (η^2): value between 0 and 1 indicating the strength of the link between a dimension and a particular categorical variable; can be interpreted as the percentage of variation on the dimension that can be explained by that categorical variable

Dimension 1

- is related to the position of infinitives and participles *vis-à-vis* their selecting verbs (modals and auxiliaries respectively)

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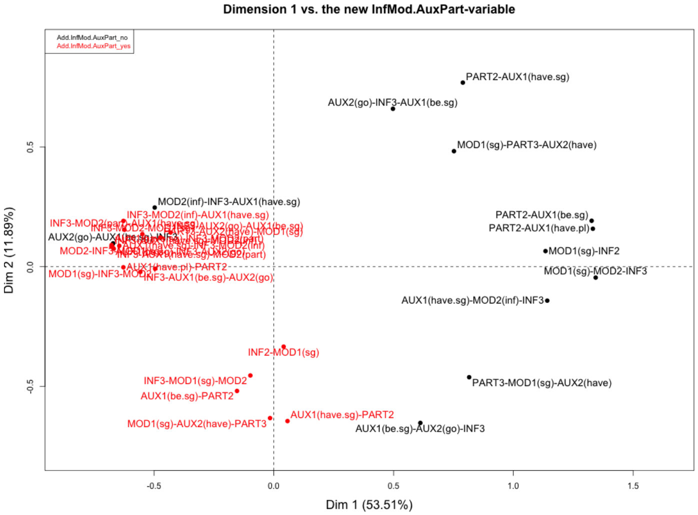
  - set to ‘yes’ when at least one of these conditions is not met
- this variable has a η^2 of 0.6142


Dimension 1 vs. the new InfMod.AuxPart-variable
Add.InfMod.AuxPart_no
Add.InfMod.AuxPart_yes
PART2-AUX1(have.sg)
AUX2(go)-INF3-AUX1(be.sg)
MOD1(sg)-PART3-AUX2(have)
MOD2(inf)-INF3-AUX1(have.sg)
INF3-MOD2(inf)-AUX1(have.sg)
PART2-AUX1(be.sg)
PART2-AUX1(have.pl)
MOD1(sg)-INF2
MOD1(sg)-MOD2-INF3
AUX1(have.sg)-MOD2(inf)-INF3
AUX1(have.pl)-PART2
INF3-AUX1(be.sg)-AUX2(go)
INF2-MOD1(sg)
INF3-MOD1(sg)-MOD2
AUX1(be.sg)-PART2
PART3-MOD1(sg)-AUX2(have)
AUX1(have.sg)-PART2
MOD1(sg)-AUX2(have)-PART3
AUX1(be.sg)-AUX2(go)-INF3
Dim 1 (53.51%)
Dim 2 (11.89%)
-0.5
0.0
0.5
1.0
1.5

Dimension 2

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  - set to 'yes' if the cluster ends in a descending order
  - set to 'no' if it ends in an ascending order

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  - set to 'yes' if the cluster ends in a descending order
  - set to 'no' if it ends in an ascending order

FinalDescent_yes	**FinalDescent_no**
21	12
132	123
321	312
231	213

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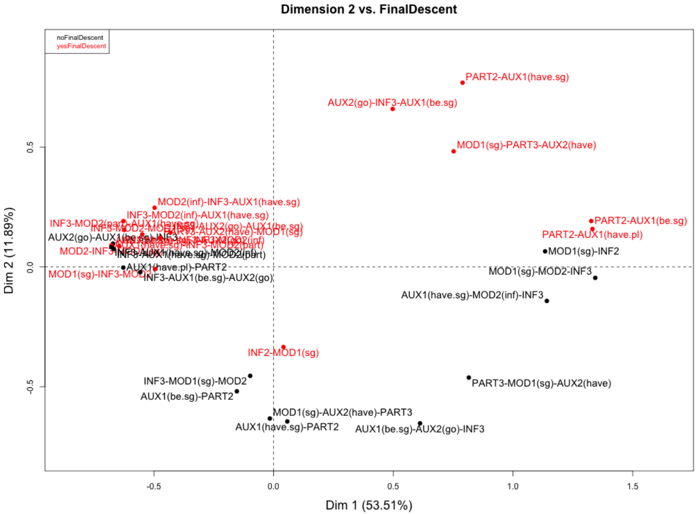
  - set to 'yes' if the cluster ends in a descending order
  - set to 'no' if it ends in an ascending order

FinalDescent_yes	FinalDescent_no
21	12
132	123
321	312
231	213

- this variable has a η^2 of 0.382


Dimension 2 vs. FinalDescent
noFinalDescent
yesFinalDescent
PART2-AUX1(have.sg)
AUX2(go)-INF3-AUX1(be.sg)
MOD1(sg)-PART3-AUX2(have)
MOD2(inf)-INF3-AUX1(have.sg)
INF3-MOD2(inf)-AUX1(have.sg)
PART2-AUX1(be.sg)
PART2-AUX1(have.pl)
MOD1(sg)-INF2
AUX2(go)-AUX1(be.sg)-INF3
AUX1(have.pl)-PART2
MOD1(sg)-MOD2-INF3
INF3-AUX1(be.sg)-AUX2(go)
AUX1(have.sg)-MOD2(inf)-INF3
INF2-MOD1(sg)
INF3-MOD1(sg)-MOD2
PART3-MOD1(sg)-AUX2(have)
AUX1(be.sg)-PART2
MOD1(sg)-AUX2(have)-PART3
AUX1(have.sg)-PART2
AUX1(be.sg)-AUX2(go)-INF3
Dim 2 (11.89%)
Dim 1 (53.51%)
0.5
0.0
-0.5
1.0
1.5

Dimension 3

- is strongly correlated with head-finality

Dimension 3

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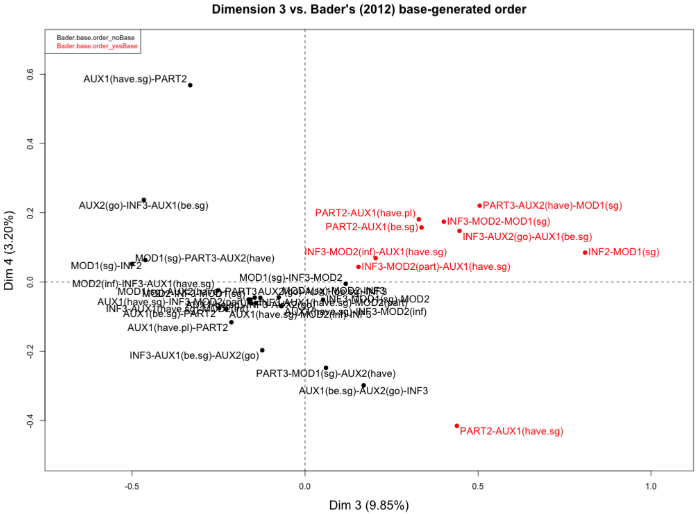
- a variable like HEADFINALBASEORDER that separates strictly head-final orders from all others has a η^2 of 0.686


Dimension 3 vs. Bader's (2012) base-generated order
Bader.base.order_noBase
Bader.base.order_yesBase
AUX1(have.sg)-PART2
AUX2(go)-INF3-AUX1(be.sg)
MOD1(sg)-PART3-AUX2(have)
MOD1(sg)-INF2
MOD2(inf)-INF3-AUX1(have.sg)
MOD1(sg)-INF3-MOD2
AUX1(have.pl)-PART2
INF3-AUX1(be.sg)-AUX2(go)
PART3-MOD1(sg)-AUX2(have)
AUX1(be.sg)-AUX2(go)-INF3
PART3-AUX2(have)-MOD1(sg)
PART2-AUX1(have.pl)
INF3-MOD2-MOD1(sg)
PART2-AUX1(be.sg)
INF3-AUX2(go)-AUX1(be.sg)
INF3-MOD2(inf)-AUX1(have.sg)
INF2-MOD1(sg)
INF3-MOD2(part)-AUX1(have.sg)
PART2-AUX1(have.sg)
Dim 4 (3.20%)
Dim 3 (9.85%)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.5
0.0
0.5
1.0

A possible analysis

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  1. a head-final base order
  2. which dialects can diverge from or not: [±Movement] (dimension 3)
  3. those that diverge can diverge strongly or not: Economy of Movement (dimension 2)
  4. above and beyond all this, a headedness parameter regulates the order of infinitives and participles *vis-à-vis* their selecting verbs: [±ModInf&PartAux] (dimension 1)

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- more generally, there is room for fruitful collaboration between formal-theoretical and quantitative-statistical linguistics:
  - the former can guide the interpretation of results from the latter
  - the latter can help evaluate and test hypotheses of the former

Bonus: headedness

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	dimension 1	**dimension 2**	**dimension 3**
head-initial	0.126	0.309	0.130
head-final	0.006	0.101	0.686
mixed_1 (Barbiers and Bennis (2010))	0.146	0.039	0.193
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- basically, any theoretical proposal that predicts certain data patterns to co-occur can be put to the test with this method

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