Reverse dialectometry

Geography as a probe into linguistic theory

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Maps and Grammar

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Introduction: verbs, word order, and linguistic theory

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(3) **Ferwerd Dutch**

a. dasto it ook net zien meist.
that.you it also not see may
'that you're also not allowed to see it.' (✓21)

b. *dasto it ook net meist zien.
that.you it also not may see
'that you're also not allowed to see it.' (*12)

- this word order freedom is typically a source of interdialectal variation:

(4) **Gendringen Dutch**

a. dat ee et ook nie zien mag.
that you it also not see may
'that you're also not allowed to see it.' (✓21)

b. dat ee et ook nie mag zien.
that you it also not may see
'that you're also not allowed to see it.' (✓12)

- this word order freedom is typically a source of interdialectal variation:

(5) **Poelkapelle Dutch**

a. *dajtgie ook nie zien meug.
that.it.you also not see may
'that you're also not allowed to see it.' (*21)

b. dajtgie ook nie meug zien.
that.it.you also not may see
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- and the more complex the verbal cluster, the more variation there is: in verbal clusters consisting of two modal auxiliaries and one main verb, out of the six orders that are theoretically possible, four are attested in Dutch dialects:

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I find that everyone must can swim
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(7) a. Ik vind dat iedereen moet zwemmen kunnen. (132)
b. Ik vind dat iedereen zwemmen moet kunnen. (312)
c. Ik vind dat iedereen zwemmen kunnen moet. (321)
d. *Ik vind dat iedereen kunnen zwemmen moet. (231)
e. *Ik vind dat iedereen kunnen moet zwemmen. (213)

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(8) *Midsland Dutch*

a. *dat elkeen mot kanne zwemme.
that everyone must can swim
'that everyone should be able to swim.' (*123)

b. dat elkeen mot zwemme kanne. (✓132)

c. *dat elkeen zwemme mot kanne. (*312)

d. dat elkeen zwemme kanne mot. (✓321)

e. *dat elkeen kanne zwemme mot. (*231)

f. *dat elkeen kanne mot zwemme. (*213)

- but once again, it is not the case that each of the four allowed orders is attested in all dialects:

(9) *Langelo Dutch*

a. dat iedereen moet kunnen zwemmen.
that everyone must can swim
'that everyone should be able to swim.' (✓123)

b. *dat iedereen mot zwemmen kunnen. (*132)

c. dat iedereen zwemmen mot kunnen. (✓312)

d. *dat iedereen zwemmen kunnen mot. (*321)

e. *dat iedereen kunnen zwemmen mot. (*231)

f. *dat iedereen kunnen mot zwemmen. (*213)

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example dialect	**123**	**132**	**321**	**312**
Beetgum	✓	✓	✓	✓
Hippolytushoef	✓	✓	✓	*
Warffum	✓	✓	*	*
Oosterend	✓	*	*	*
Schermerhorn	✓	✓	*	✓
Visvliet	✓	*	✓	✓
Kollum	✓	*	✓	*
Langelo	✓	*	*	✓
Midsland	*	✓	✓	*
Lies	*	*	✓	*
Bakkeveen	*	*	✓	✓
Waskemeer	*	✓	*	*

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- 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
- in other words, there are 137 different types of dialects when it comes to word order in verbal clusters

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  - related methodological question: how do we go about finding those parameters?

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- **in this talk** I argue that a quantitative-statistical analysis of the data enriched with insights from formal-theoretical linguistics can separate the wheat from the chaff
- more specifically, I will argue that roughly 80% of the variation found in Dutch verb cluster orders can be reduced to three grammatical parameters

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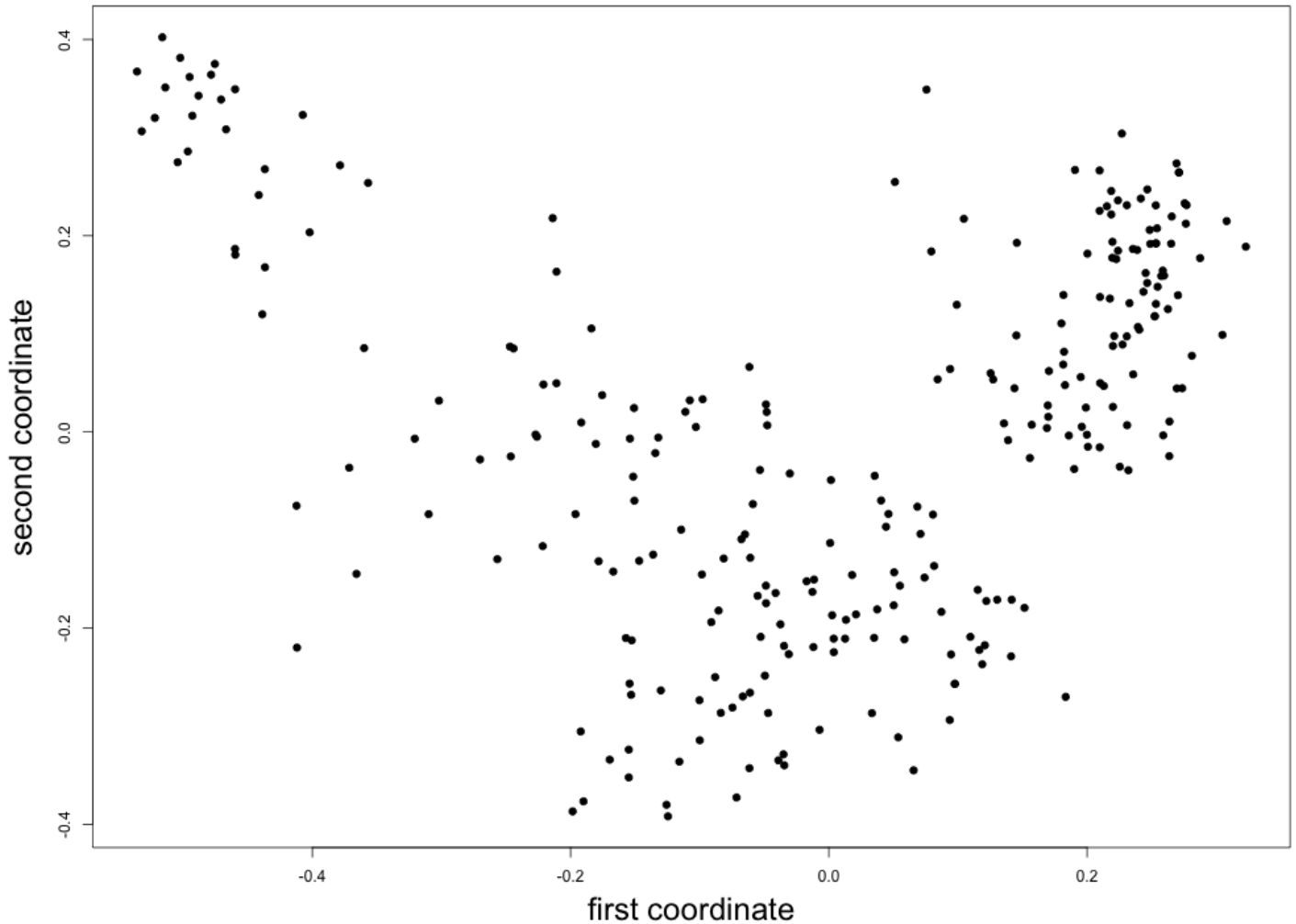
- often used method: Multidimensional Scaling (MDS)
- starting point: data table with dialects in rows and cluster orders in columns

	AUX1(be.sg)-PART2	PART2-AUX1(be.sg)	AUX1(have.sg)-PART2	PART2-AUX1(have.sg)	AUX1(have.pl)-PAR
Midsland / Midslân	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 V	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-Ters	Oosteren	Hollum	Schiermo	Ferwerd /	Anjum /	Kollum	Visvliet	Oosterbie	Beetgum	Bergum /	Jorwerd /
Midsland / Mi	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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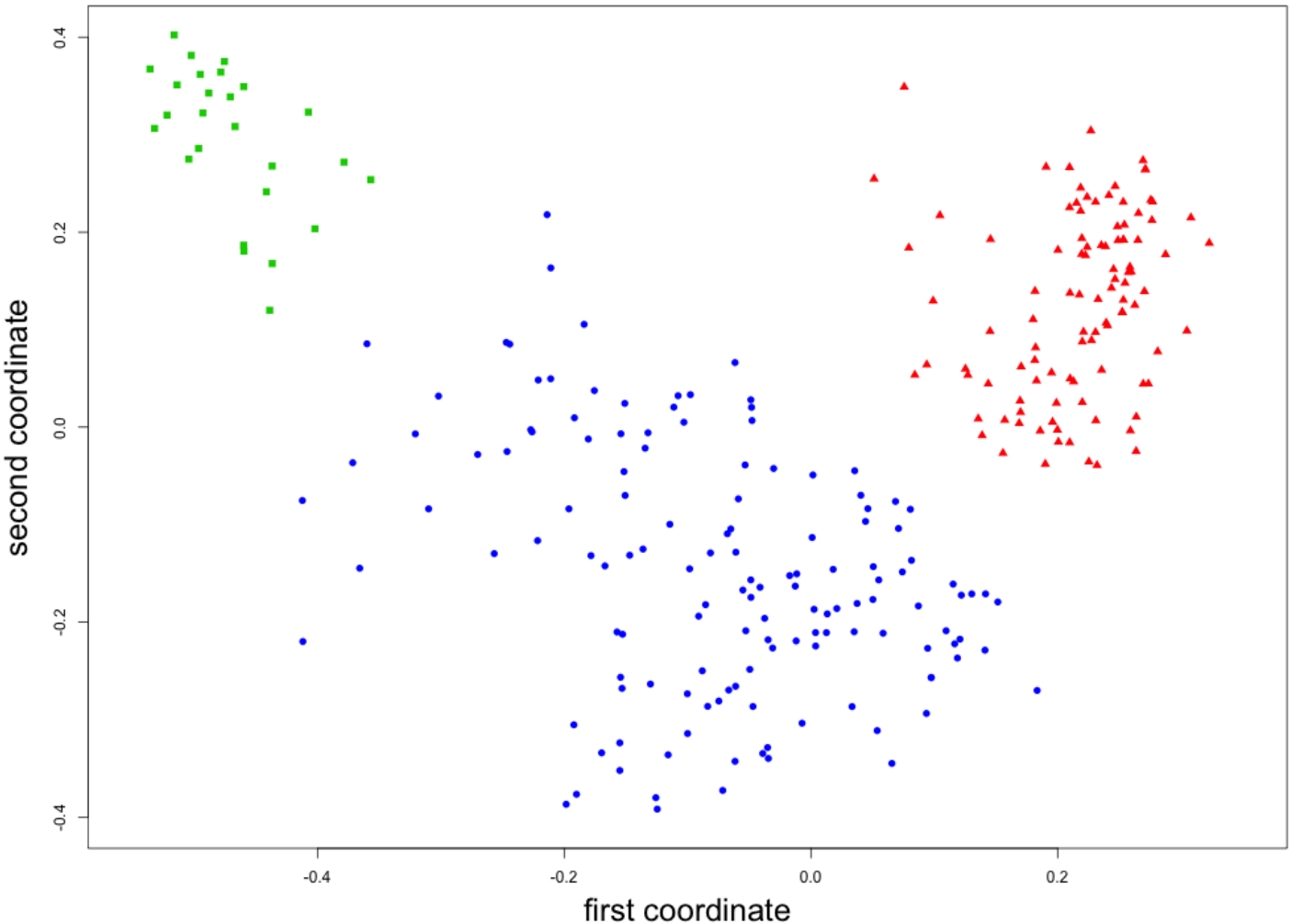
second coordinate
first coordinate
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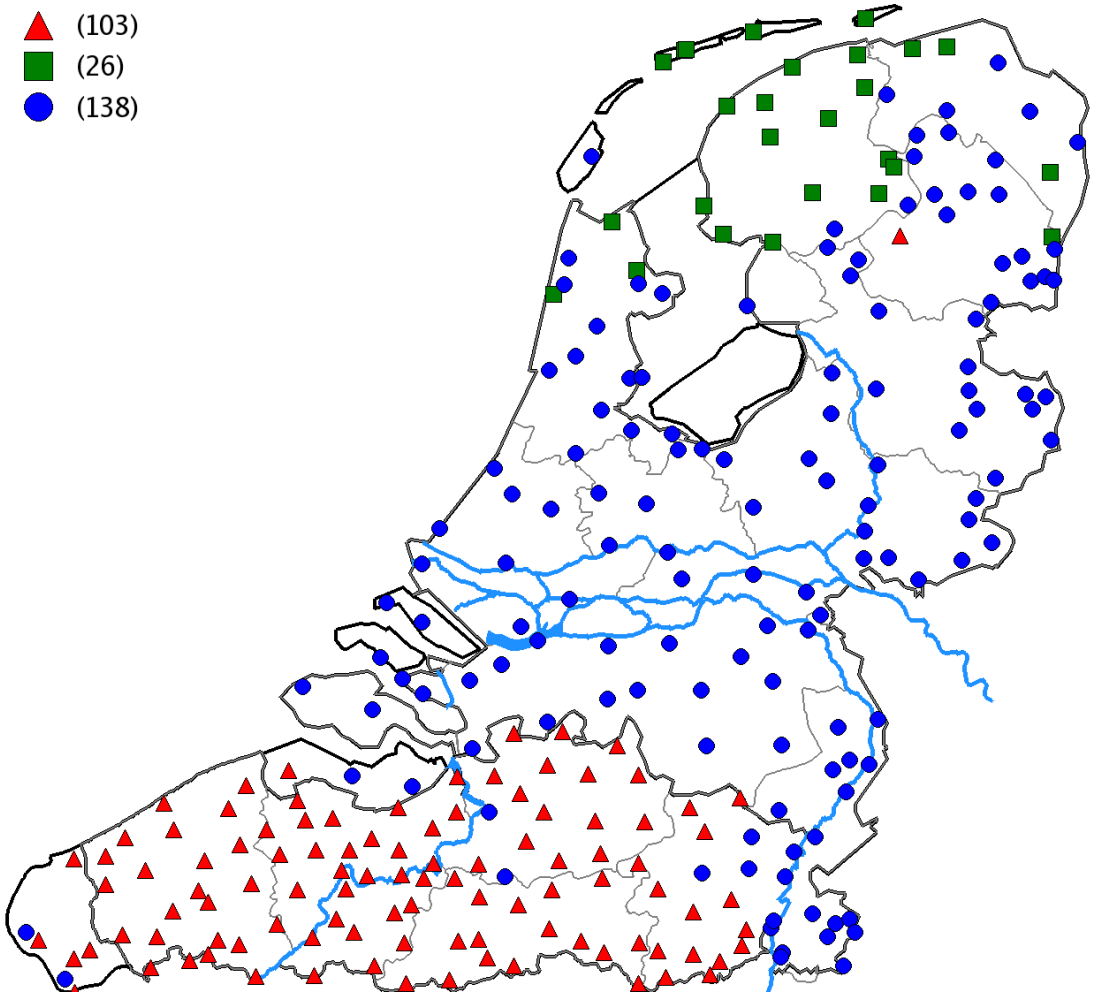
- step 3: project back onto a geographical map


(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

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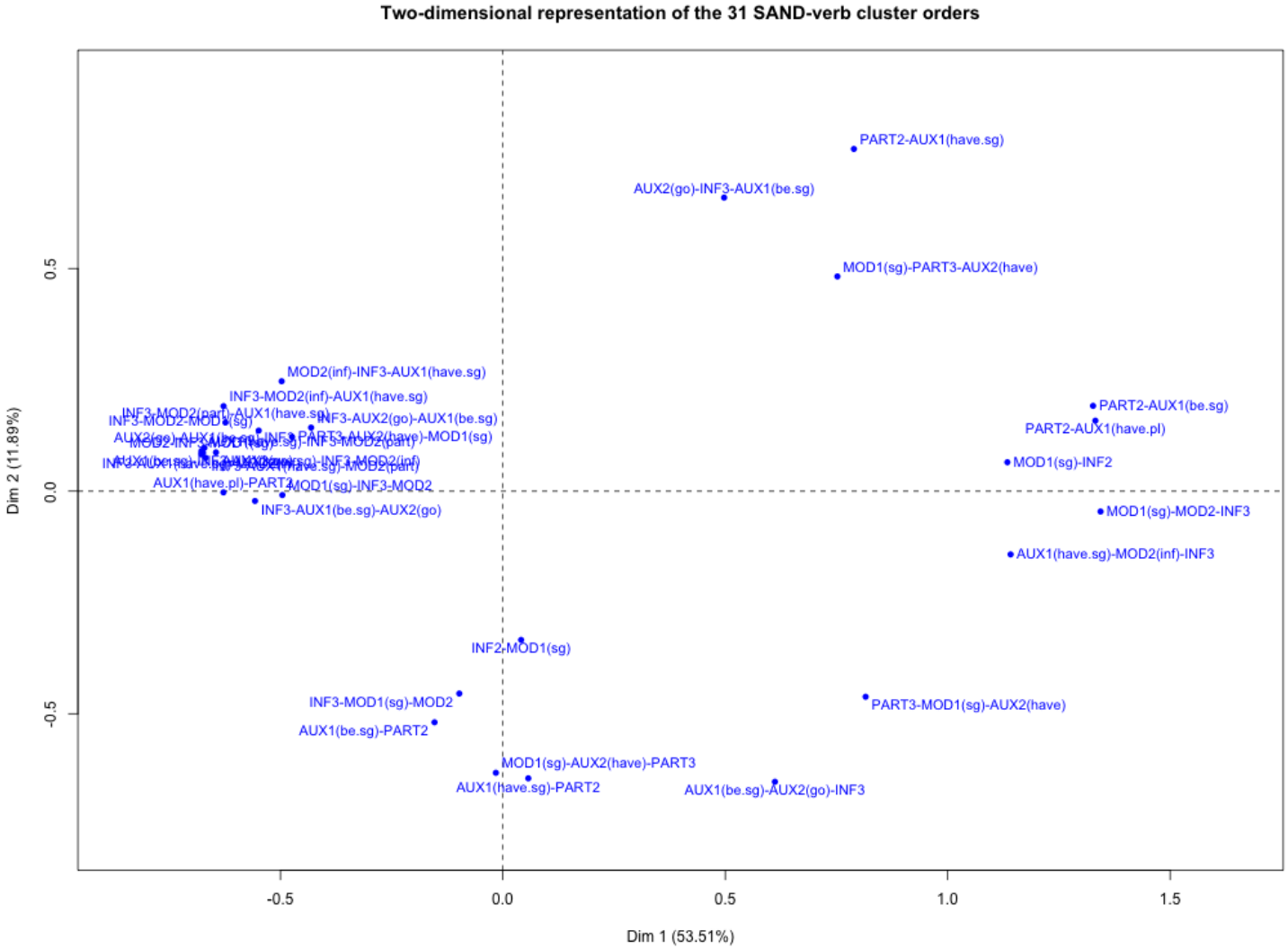
- starting point: a data table with cluster orders as rows and dialect locations as columns

	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)
PART2-AUX1(be.sg)
PART2-AUX1(have.pl)
MOD1(sg)-INF2
AUX1(have.pl)-PART2
MOD1(sg)-INF3-MOD2
INF3-AUX1(be.sg)-AUX2(go)
MOD1(sg)-MOD2-INF3
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%)
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
1.5
Dim 1 (53.51%)

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- in order to find those parameters, we can also encode the cluster orders in terms of their theoretical linguistic analyses

- theoretical accounts differ in which analysis they assign to which cluster order ⇒ cluster orders have their own specific 'fingerprint' in each analysis, some of them very similar to one another and others very different

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  - [±pied-piping]: does the derivation involve pied-piping?
  - [±feature-checking violation]: does the order involve a feature checking violation?

	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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- in the analysis, these 70 variables are used as **supplementary variables**: they do not contribute to the dimension reduction, but they are mapped against its output, in order to interpret the results

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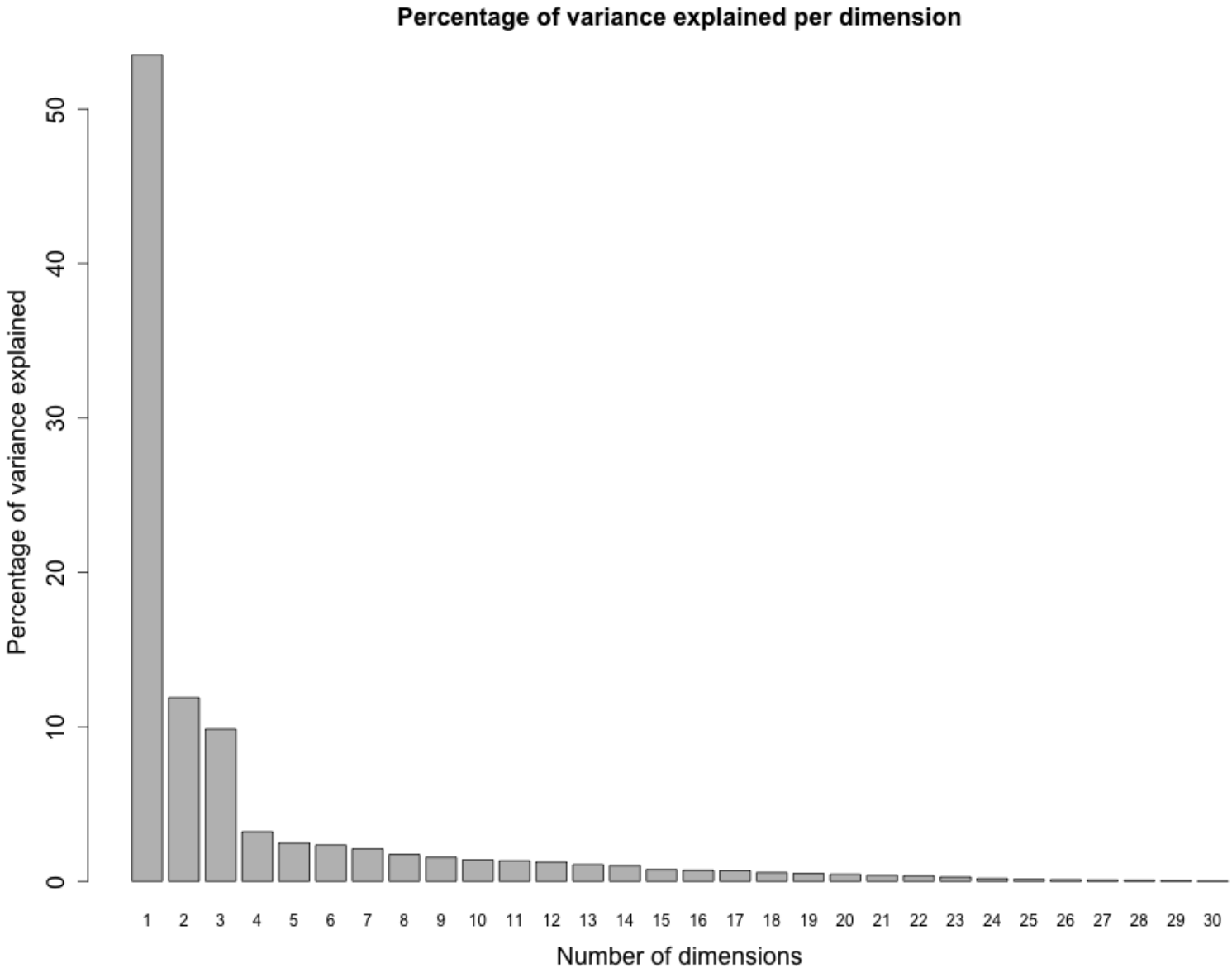
- **proposal (I):** the number of parameters responsible for the verb cluster variation = the number of dimensions we reduce our data set to


Percentage of variance explained per dimension
Percentage of variance explained
0
10
20
30
40
50
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
Number of dimensions

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  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

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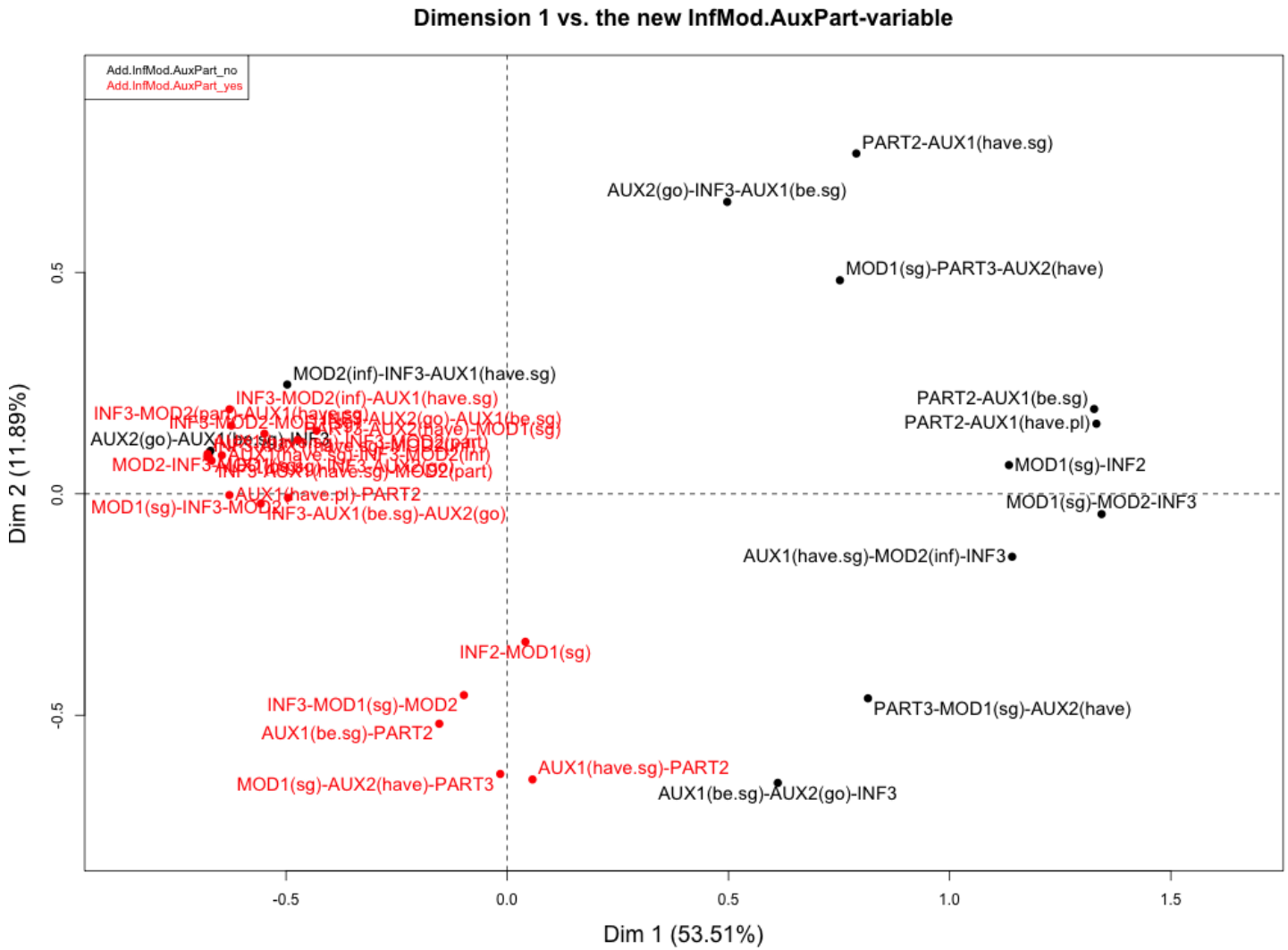
- this variable has a η^2 of 0.6142


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
INF2-MOD1(sg)
PART3-MOD1(sg)-AUX2(have)
INF3-MOD1(sg)-MOD2
AUX1(be.sg)-PART2
AUX1(have.sg)-PART2
MOD1(sg)-AUX2(have)-PART3
AUX1(be.sg)-AUX2(go)-INF3
Dim 2 (11.89%)
Dim 1 (53.51%)
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
1.5

Dimension 2

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

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132	123
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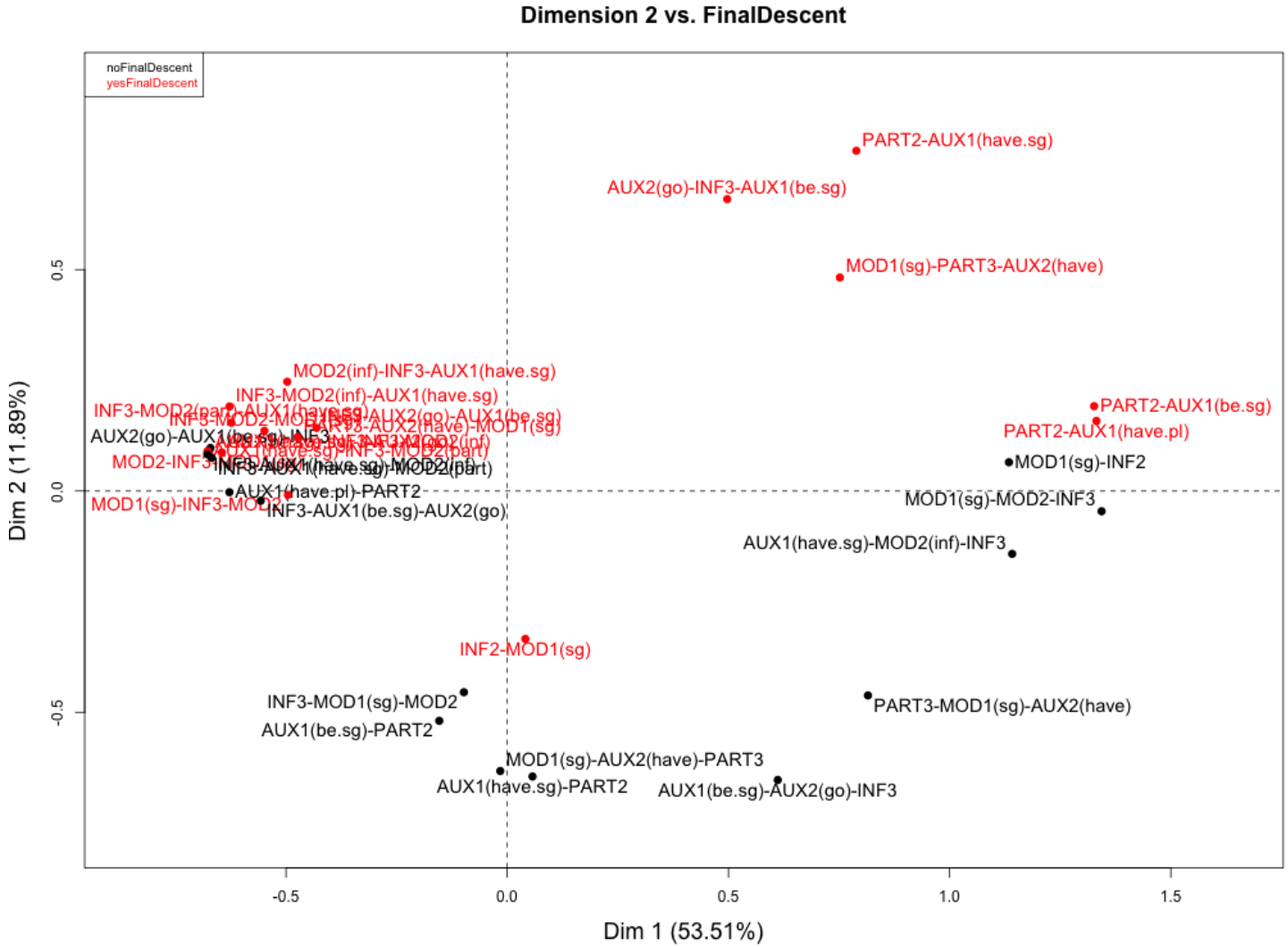
- this variable has a η^2 of 0.382


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
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)
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
-0.5
0.0
0.5
1.0
1.5

Dimension 3

- is again related to the slope of the cluster (and strongly so)

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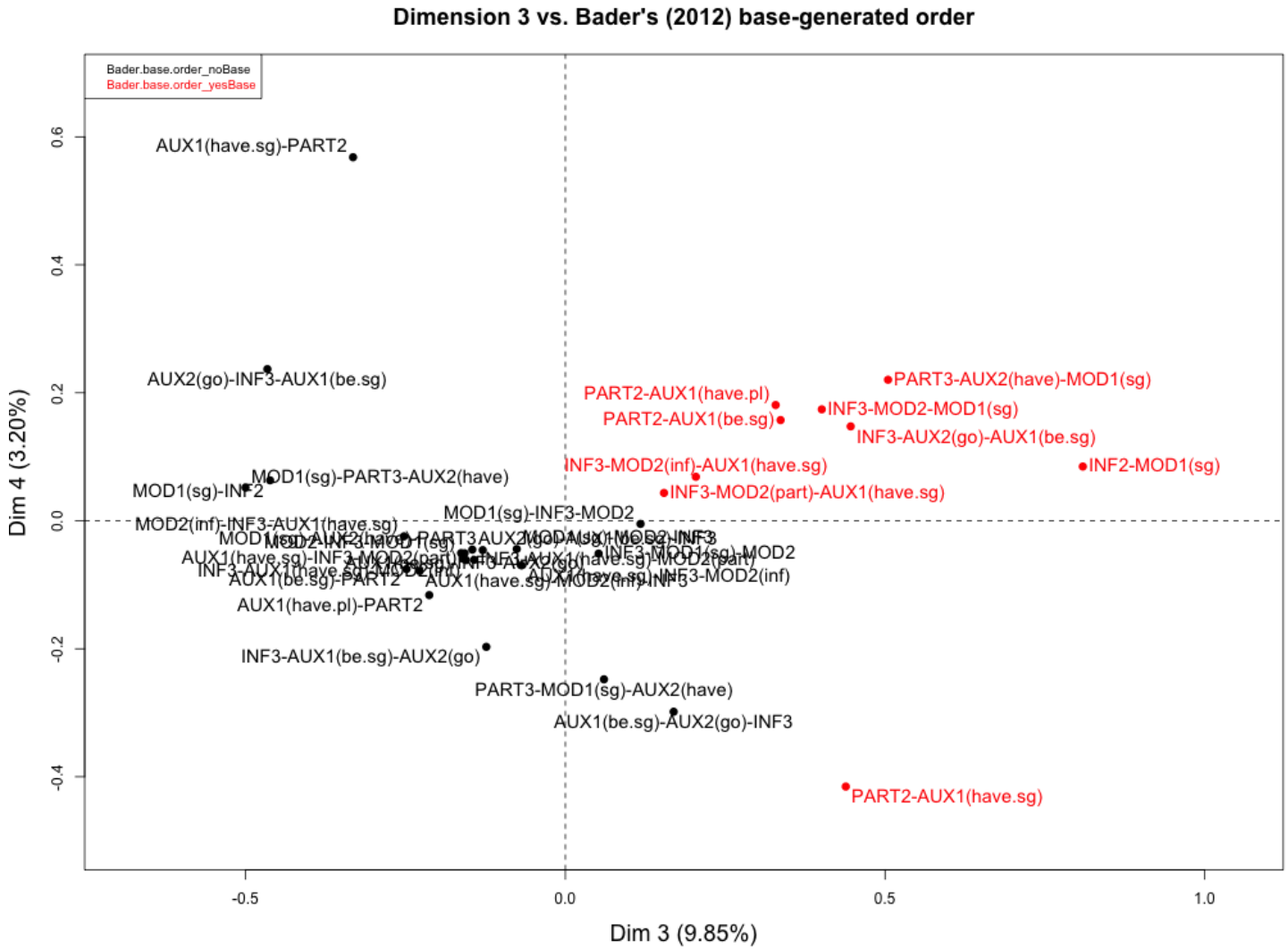
- is again related to the slope of the cluster (and strongly so)
- it separates the strictly descending orders (i.e. 21 and 321) from all the others (12, 123, 132, 312, 213, 231): $\eta^2 = 0.686$


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.sg)-INF3-MOD2(part)
INF3-AUX1(have.sg)-MOD2(inf)
AUX1(be.sg)-PART2
AUX1(have.pl)-PART2
INF3-AUX1(be.sg)-AUX2(go)
PART3-MOD1(sg)-AUX2(have)
AUX1(be.sg)-AUX2(go)-INF3
PART2-AUX1(have.pl)
PART2-AUX1(be.sg)
PART3-AUX2(have)-MOD1(sg)
INF3-MOD2-MOD1(sg)
INF3-AUX2(go)-AUX1(be.sg)
INF3-MOD2(inf)-AUX1(have.sg)
INF2-MOD1(sg)
INF3-MOD2(part)-AUX1(have.sg)
INF3-MOD2(inf)
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

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- for example, a possible parametrized analysis of verb clusters:
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  3. those that diverge can diverge strongly or not: Economy of Movement (dimension 2)

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- for example, a possible parametrized analysis of verb clusters:
  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

References I

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