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The signal and the noise in Dutch verb clusters

A quantitative search for microparameters

Jeroen van Craenenbroeck (KU Leuven)

What happened to Principles & Parameters?

July 4, 2014, Arezzo, Italy

0 – Outline

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1 – Outline

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1 – Introduction: verb clusters & microparameters

- "micro-parameters (..) relate to morpho-syntax and phonology and account for fine-grained differences in the syntax and morphology of closely related languages and dialects (Kayne 2005, Manzini & Savoia 2007). (..) Word order variation in sentence-final Verb Clusters in Germanic (Evers 1975, Wurmbrand 2001) is [a] locus of variation involving microparameters." (Huijbregts and Riemsdijk, 2014)

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- **central questions in this talk:**
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  2. if there are, what are they and how can we detect them?
- **in a nutshell**: I will argue that the bulk of the variation found in Dutch verb clusters can be reduced to three microparameters, and that we can use quantitative-statistical means to detect and identify them

1 – Introduction: verb clusters & microparameters

- highly simplified view of parameters & verb clusters: a difference in cluster order corresponds to a different parameter setting

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dialect A

(1) dat hij **gelachen heeft**
that he laughed has
'that he has laughed.'

dialect B

(2) dat hij **heeft gelachen**
that he has laughed
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- this ideal scenario gets more complicated when we consider bigger verb clusters

1 – Introduction: verb clusters & microparameters

- in Dutch MODAL-MODAL-MAINV-clusters, out of the six orders that are theoretically possible, four are attested:

(3) Ik vind dat iedereen moet kunnen zwemmen.
I find that everyone must can swim
'I think everyone should be able to swim.'

(4) a. Ik vind dat iedereen moet zwemmen kunnen.
b. Ik vind dat iedereen zwemmen moet kunnen.
c. Ik vind dat iedereen zwemmen kunnen moet.
d. *Ik vind dat iedereen kunnen zwemmen moet.
e. *Ik vind dat iedereen kunnen moet zwemmen.

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- in Dutch MODAL-MODAL-MAINV-clusters, out of the six orders that are theoretically possible, four are attested:

(3) Ik vind dat iedereen moet kunnen zwemmen. (123)
I find that everyone must can swim
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(4)
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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- **however:** it is not the case that each of the four allowed orders are attested in all dialects:

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(5) *Midsland Dutch*

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

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)

1 – Introduction: verb clusters & microparameters

- **however:** it is not the case that each of the four allowed orders are attested in all dialects:

(6) *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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    - AUXILIARY-AUXILIARY-INFINITIVE
    - AUXILIARY-MODAL-INFINITIVE
  - 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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  - more generally, how can we distinguish between the signal and the noise in such large and highly variable datasets?
- one extreme position: Barbiers (2005b): the grammar rules out 231 and 213 in MOD-MOD-V-cluster, but all other orders are freely available to all speakers; the choice between them is determined by sociolinguistic factors (geographical and social norms, register, context, . . .)

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- **in this talk** I try to show that there *are* grammatical microparameters at work in regulating the distribution of verb cluster orders in Dutch

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  - to what extent can a quantitative analysis of large datasets lead to new theoretical insights?
  - to what extent can theoretical analyses guide and inform quantitative analyses of language data?

2 – Outline

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2 – A typical dialectometric analysis

- **dialectometry** is a subdiscipline of linguistics that uses computational and quantitative techniques in dialectology (Nerbonne and Kretzschmar Jr., 2013)

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- **in this section:** a typical dialectometric analysis → will serve as a stepping stone for the actual analysis in section 3
- **starting point:** a data matrix with one row per location and one column per linguistic variable, i.e. locations = individuals and linguistic phenomena = variables

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

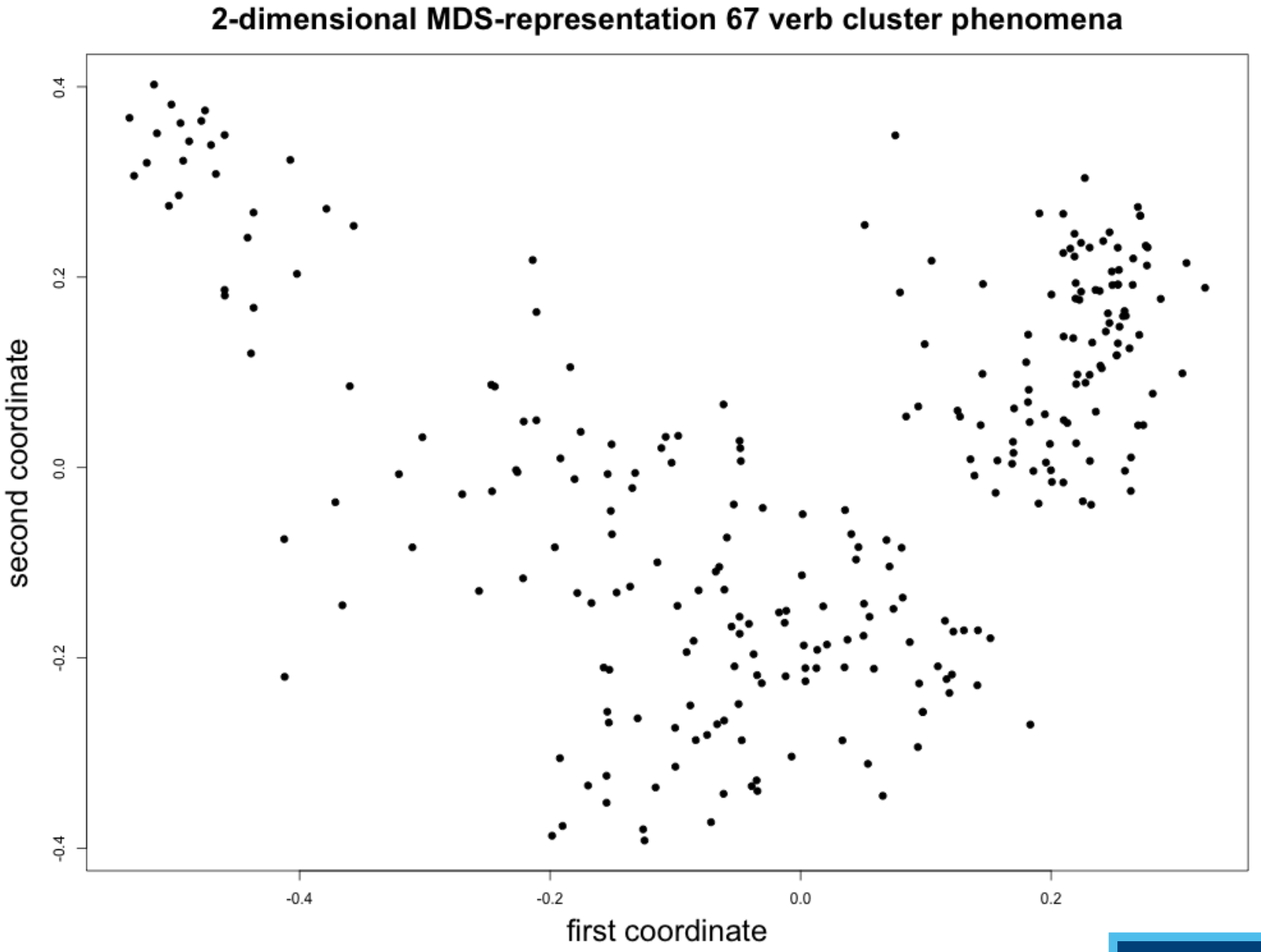
2 – A typical dialectometric analysis

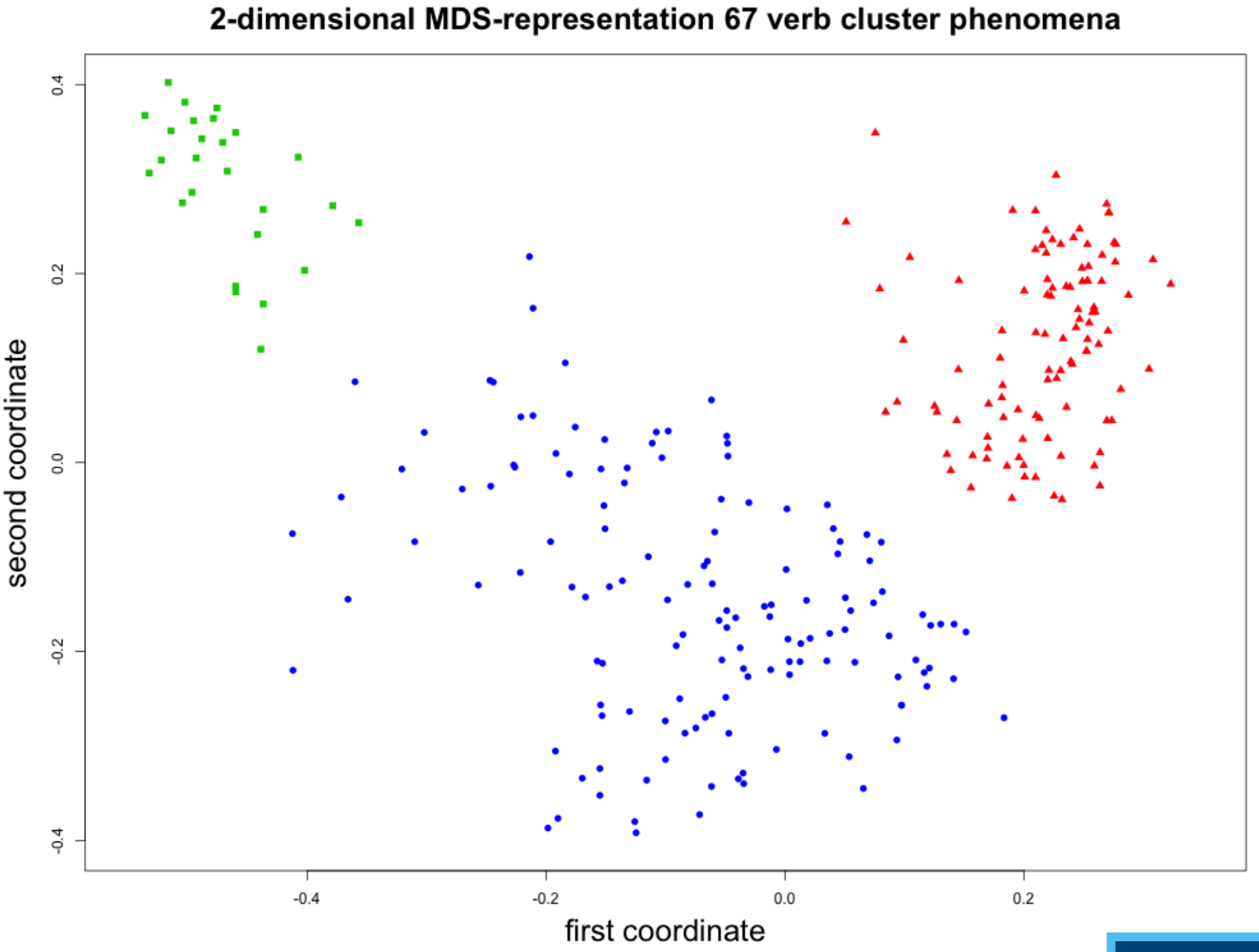
- step 1: convert the table into a 267×267 (symmetric) distance matrix, whereby for each pair of locations a distance between them is calculated based on the linguistic features they share

	Midsland	Lies	West-Ter	Oosteren	Hollum	Schiermo	Ferwerd /	Anjum /	Kollum	Visvliet	Oosterbie	Beetgum	Bergum /	Jorwerd /	Bakkevee
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	0,400
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	0,500
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	0,438
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	0,706
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	0,385
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	0,563
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	0,357
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	0,385
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	0,438
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	0,579
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	0,533
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	0,545
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	0,385
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	0,583
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	0,000
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	0,438
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	0,400
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	0,563
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	0,526
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	0,650
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	0,579
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	0,600

2 – A typical dialectometric analysis

- step 1: convert the 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
- step 2: reduce this 267-dimensional matrix to a two- or three-dimensional one, so that it can easily be visualized


2-dimensional MDS-representation 67 verb cluster phenomena
second coordinate
first coordinate
0.4
0.2
0.0
-0.2
-0.4
-0.4
-0.2
0.0
0.2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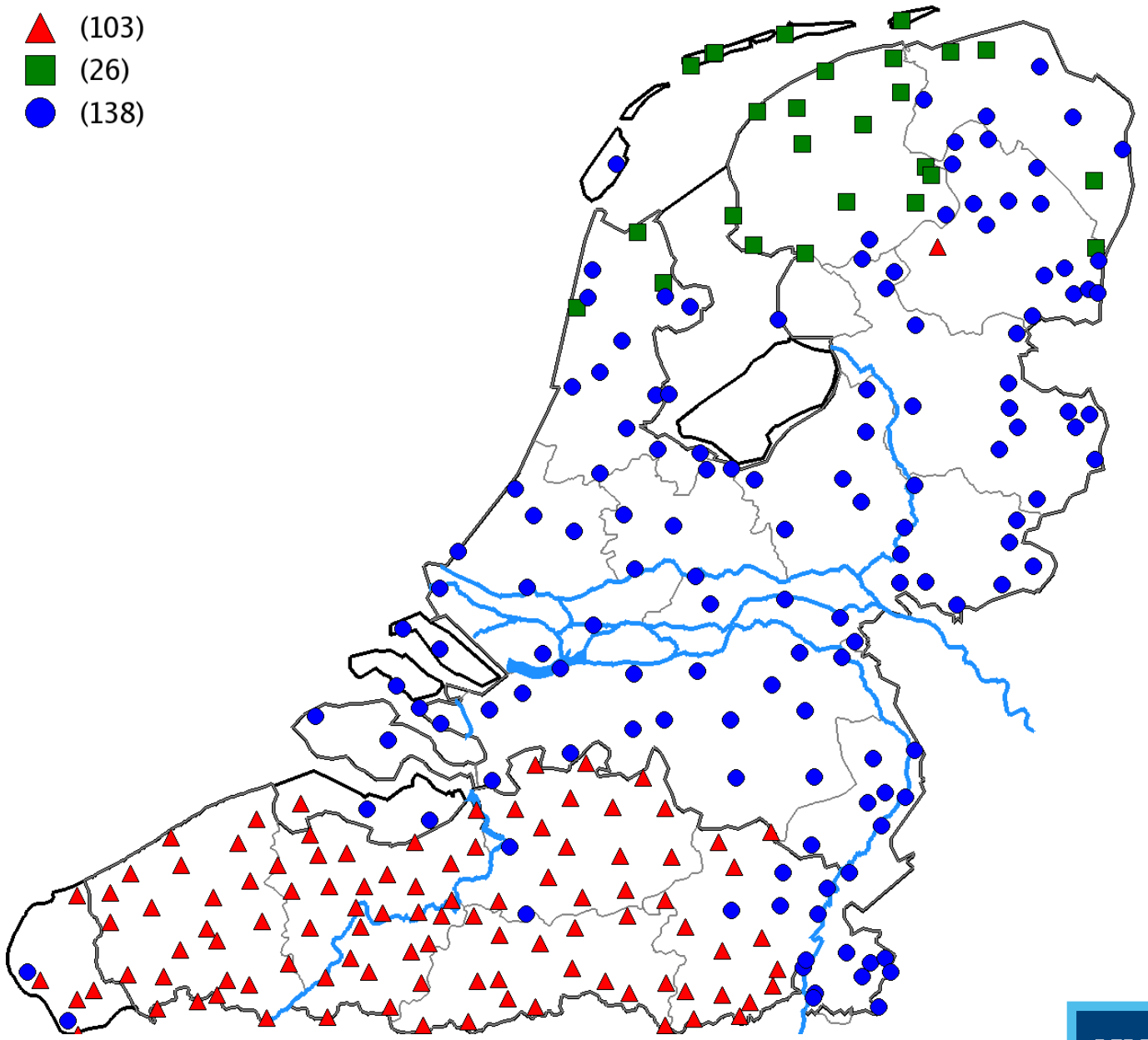

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  1. the linguistic constructions themselves play only an indirect role in the outcome of the analysis: we can see when two dialects differ, but we don't see which cluster orders are responsible for this difference and to what extent

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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 and to what extent
  2. there is no link between the data that feed into the quantitative analysis and the formal theoretical literature on verb clusters

3 – Outline

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3 – Reverse dialectometry: Methodology

- starting point: a data table whereby each cluster order represents a row and each dialect location a column

	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

3 – Reverse dialectometry: Methodology

- starting point: a data table whereby each cluster order represents a row and each dialect location a column
- the dialect locations are now used to determine the degree of difference/similarity between the various cluster orders → each cluster order is compared to each other cluster order on 267 variables (i.e. as many as there are dialect locations)

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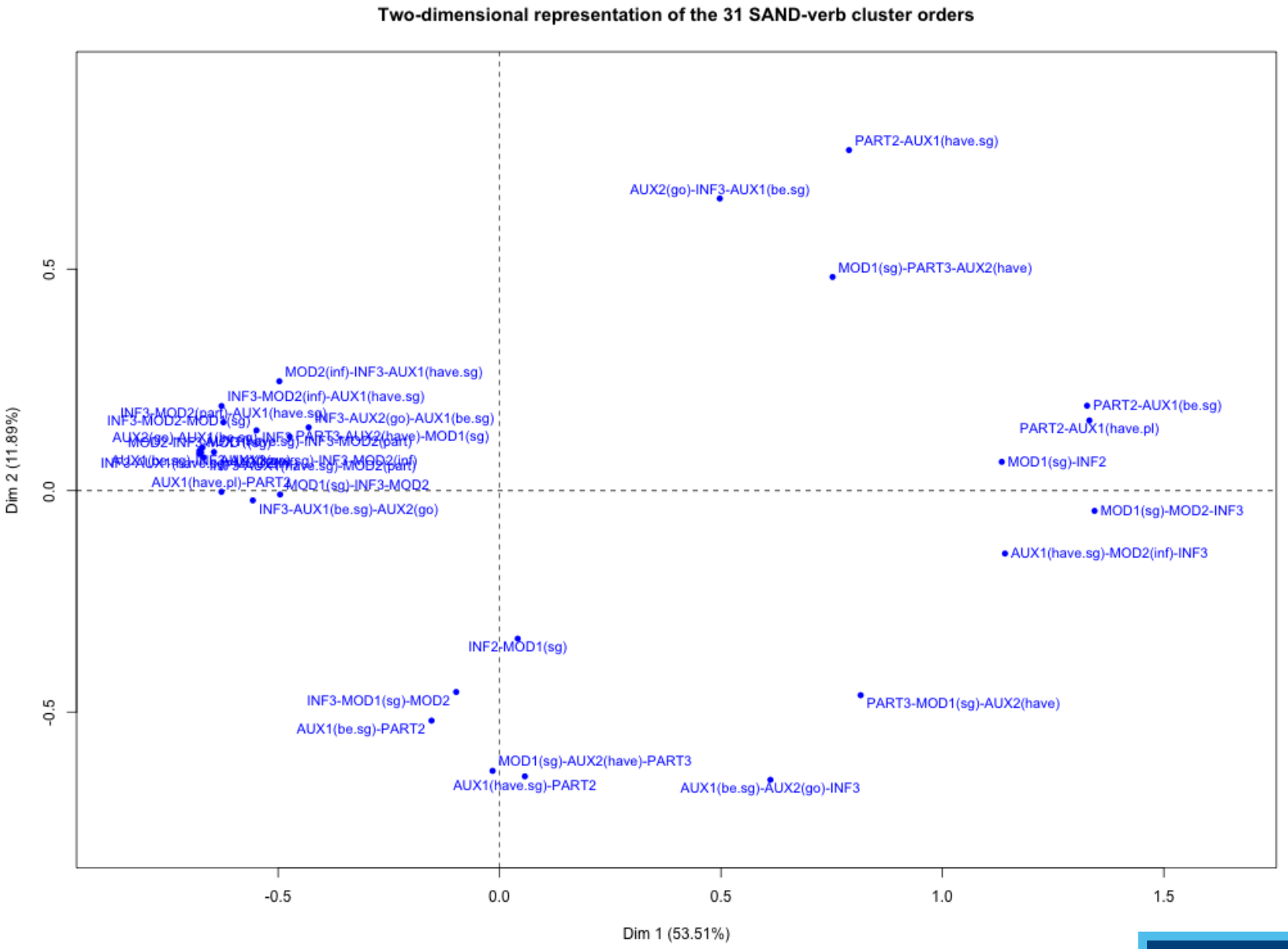
- the dialect locations are now used to determine the degree of difference/similarity between the various cluster orders → each cluster order is compared to each other cluster order on 267 variables (i.e. as many as there are dialect locations)
- when we reduce this 31-dimensional variational space to a two-dimensional one, we can plot the differences and similarities between the 31 cluster orders from the SAND in a simple scatterplot


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-MOD2(part)-AUX1(have.sg)
INF3-MOD2-MOD1(sg)
INF3-AUX2(go)-AUX1(be.sg)
PART3-AUX2(have)-MOD1(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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- example: Barbiers (2005b)

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  - movement is VP-intraposition → derives 21 and 231 (movement of VP2), 312 and 132 (movement of VP3) and fails to derive 213 (because VP2 contains VP3)
  - VP-intraposition can pied-pipe other material → derives 321 (movement of VP3 to specVP1 via specVP2 and with pied-piping of VP2)

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  - VP-intraposition can pied-pipe other material → derives 321 (movement of VP3 to specVP1 via specVP2 and with pied-piping of VP2)
  - VP intraposition is triggered by feature checking → rules out 231 in the case of MOD-MOD-V-clusters and 312 in the case of AUX-MOD-V-clusters (due to feature checking violation)

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- and the 31 SAND 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
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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

3 – Reverse dialectometry: Methodology

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

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  - 17 additional variables based on the theoretical literature, but not linked to a specific analysis
- **important note:** all these variables are encoded as ***supplementary*** variables, i.e. they do not contribute to the construction of the verb cluster plot, but they can be mapped/matched against it (see next subsection)

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3 – The results: The number of relevant dimensions

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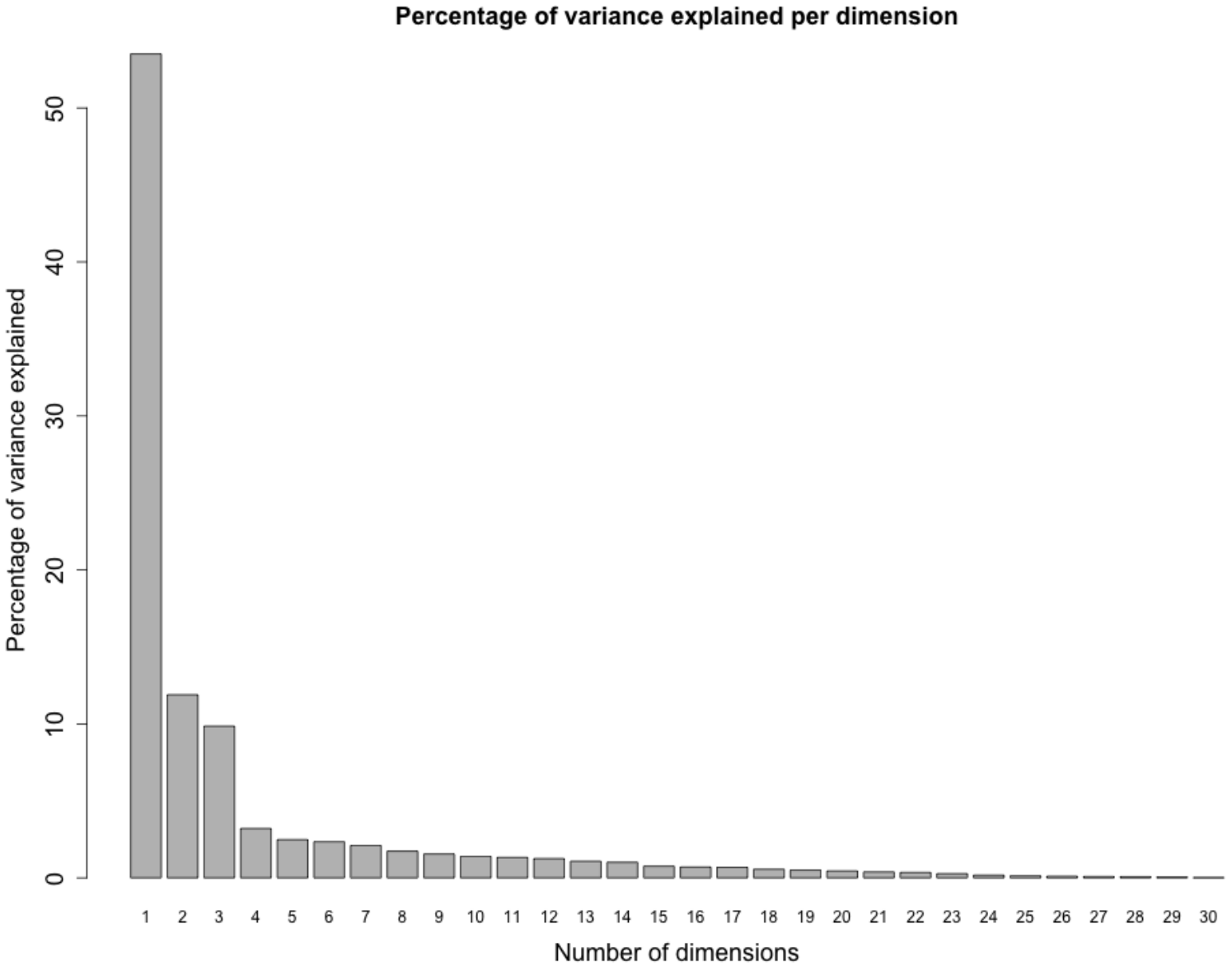
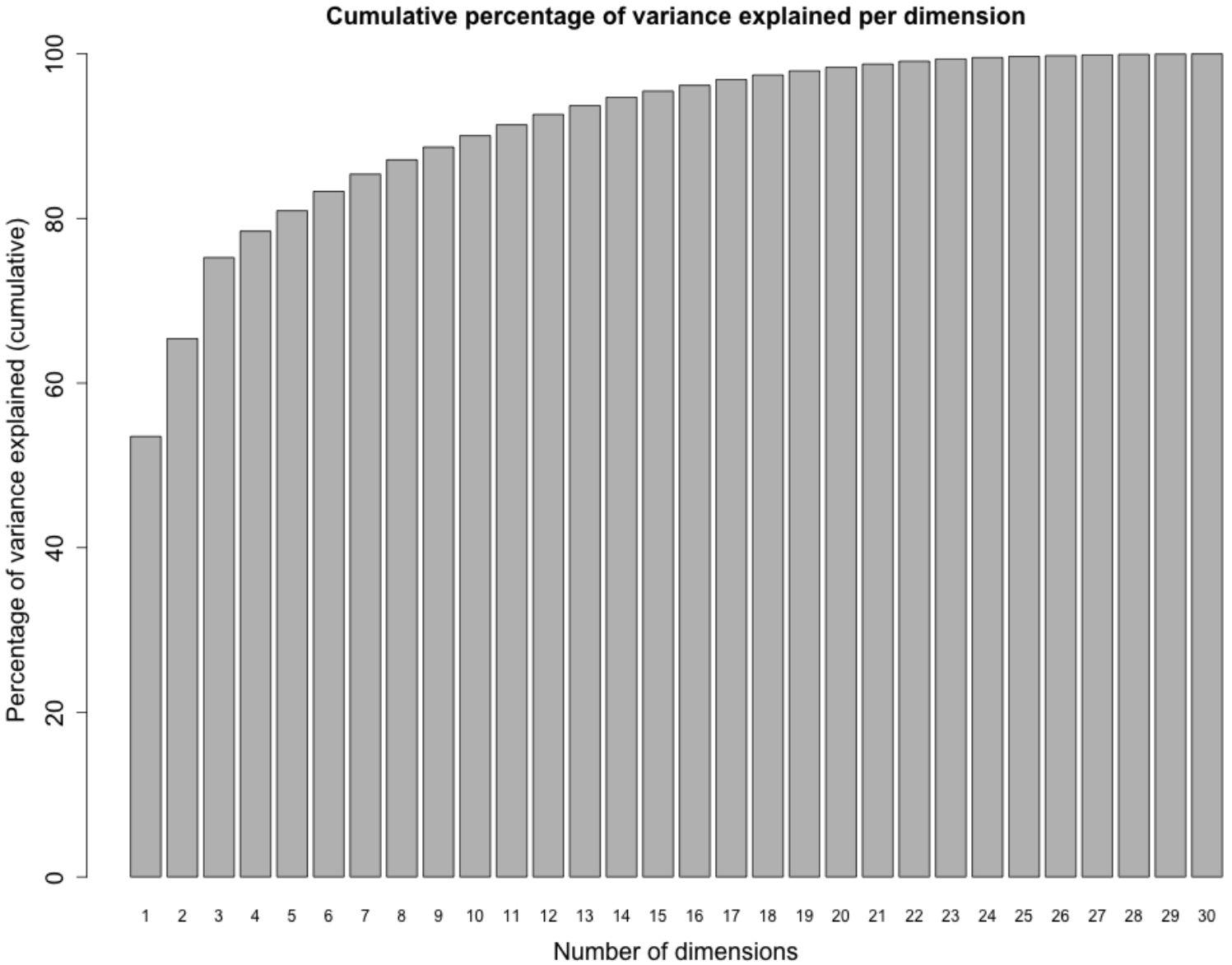
  $\rightarrow$ we have to strike a balance between having as few dimensions as possible and not losing any vital information


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


Cumulative percentage of variance explained per dimension
Percentage of variance explained (cumulative)
0
20
40
60
80
100
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

3 – The results: The number of relevant dimensions

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- together, the first three dimensions account for 78.46% of the variation in the SAND verb cluster data
- this means that roughly 80% of the variation in verb cluster ordering in SAND can be reduced to three microparameters
- in order to know what those microparameters are, we need to *interpret* the first three dimensions

3 – The results: Interpreting dimensions

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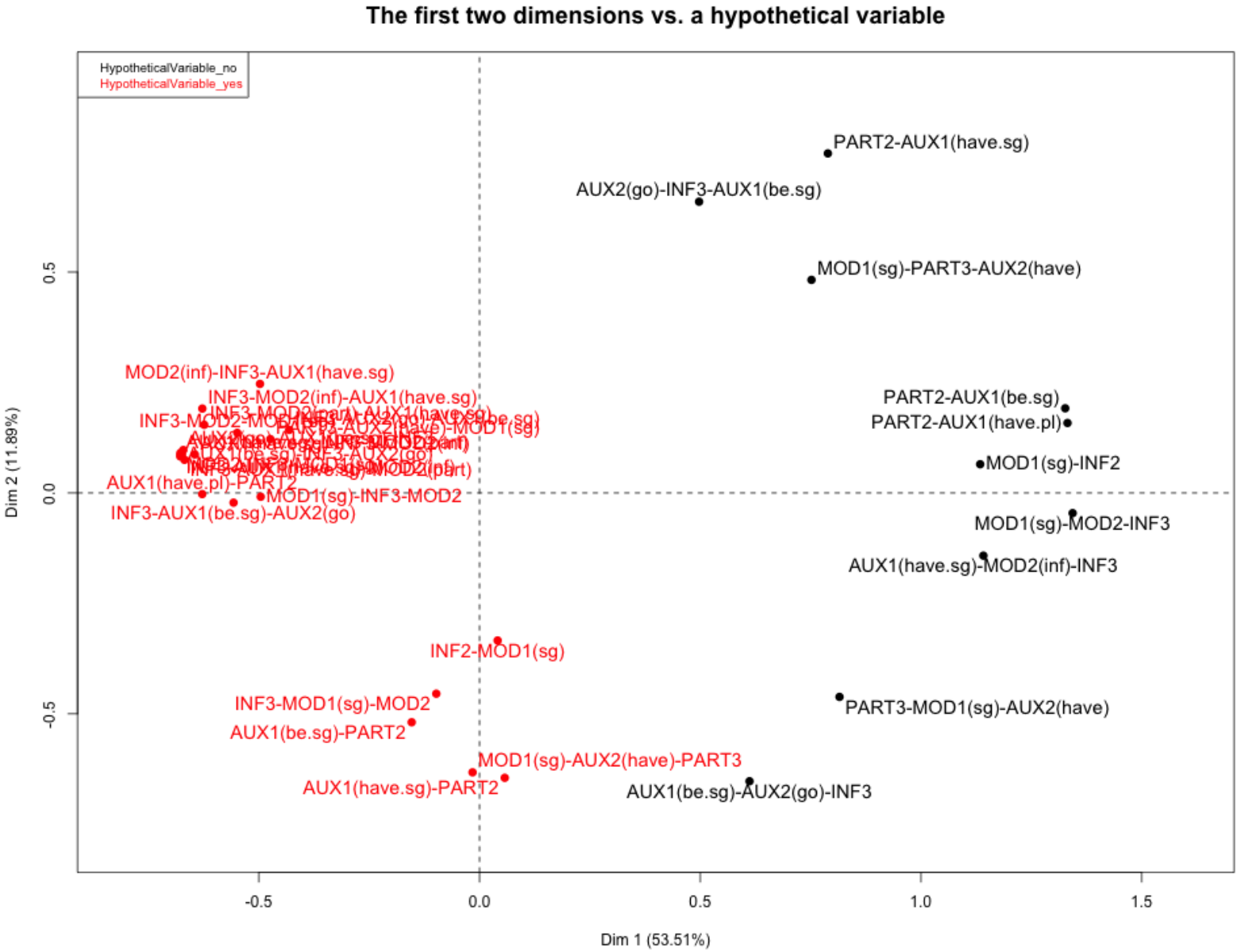
  1. visual inspection of a color-coded map


The first two dimensions vs. a hypothetical variable
HypotheticalVariable_no
HypotheticalVariable_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
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
AUX1(be.sg)-PART2
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	dimension 1	**dimension 2**
HypotheticalVariable	0.861	0.043

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     - **word of caution:** η^2 also goes up if the number of possible values of the categorical variable goes up (Richardson (2011)) → safest option is to look for variables with a high η^2 ***and*** only two or three possible values

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	dimension 1	**dimension 2**
HypotheticalVariable_yes	-5.082	-1.130
HypotheticalVariable_no	5.082	1.130

3 – The results: Dimension 1

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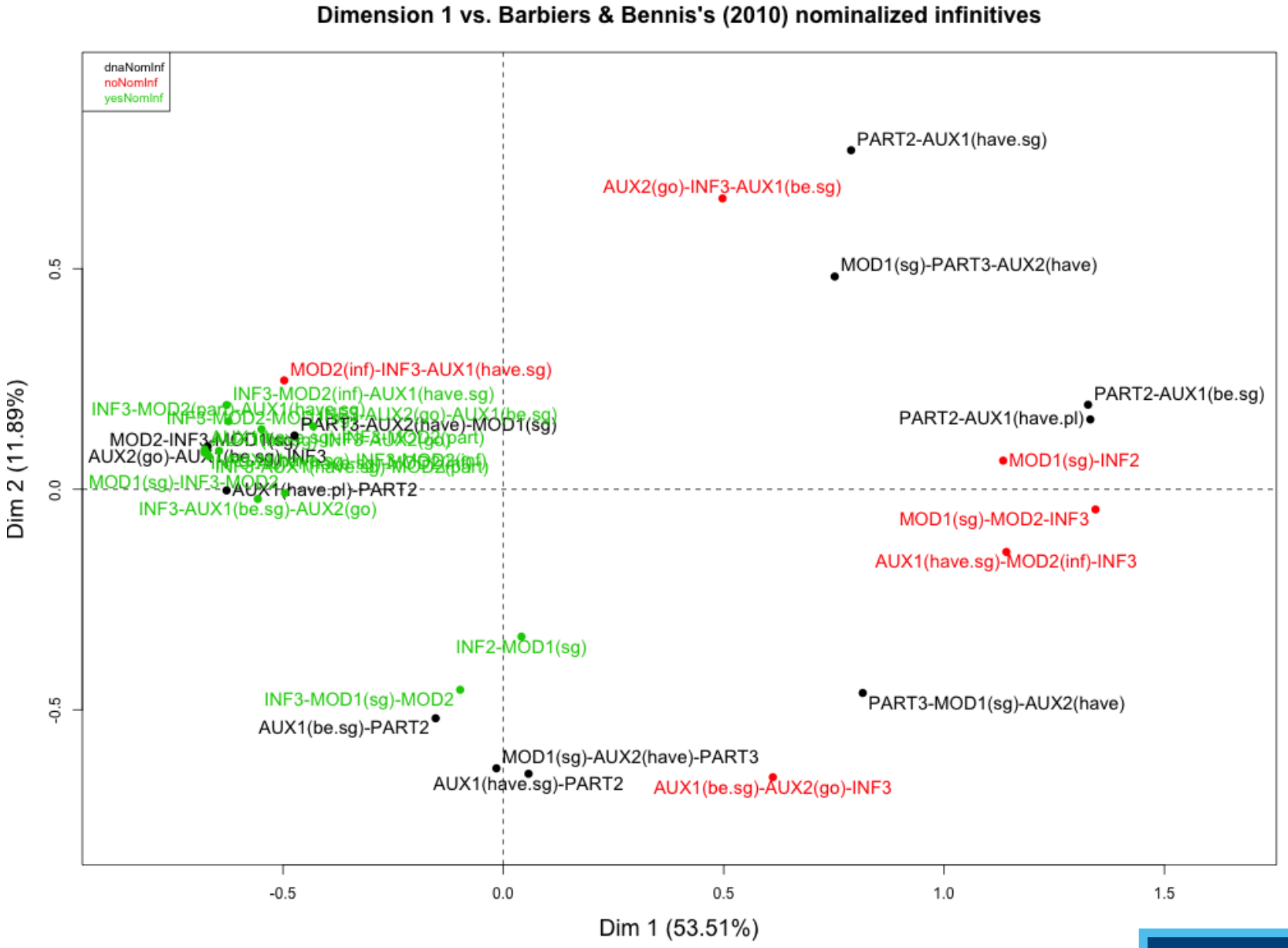
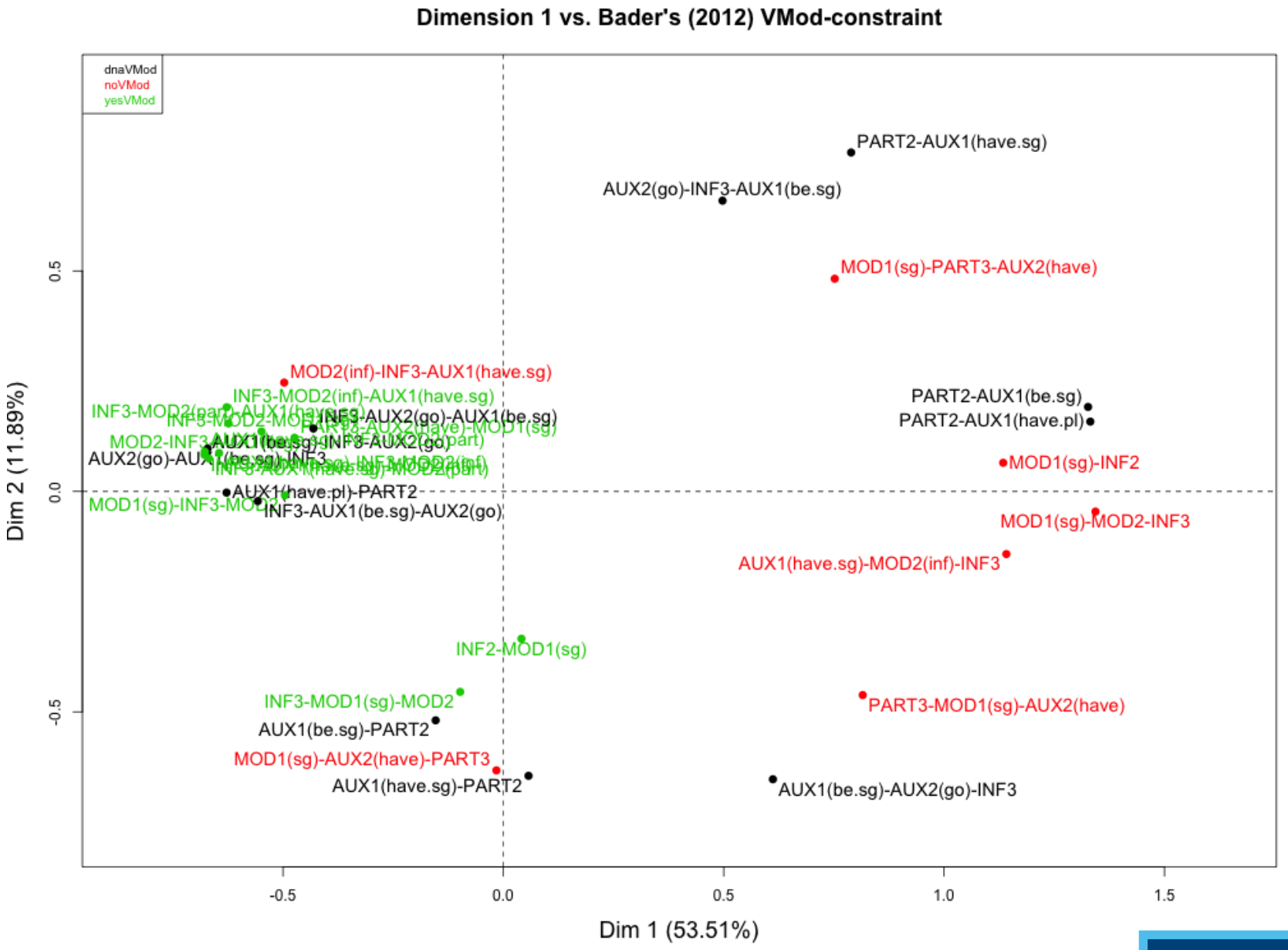
- confirmed by v-test:

	v-test dimension 1
yesNomInf	-3.303
yesVMod	-3.090


Dimension 1 vs. Barbiers & Bennis's (2010) nominalized infinitives
dnaNomInf
noNomInf
yesNomInf
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)
PART3-AUX2(have)-MOD1(sg)
MOD2-INF3-MOD1(sg)
AUX2(go)-AUX1(be.sg)-INF3
MOD1(sg)-INF2
MOD1(sg)-INF3-MOD2
AUX1(have.pl)-PART2
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%)


Dimension 1 vs. Bader's (2012) VMod-constraint
dnaVMod
noVMod
yesVMod
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)
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
-0.5
0.0
0.5
1.0
1.5

3 – The results: Dimension 1

- **note:** while both variables propose a general split that seems well represented on dimension 1, there are a number of verb clusters orders for which they are irrelevant (because the cluster doesn't contain the relevant configuration)

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- **note:** while both variables propose a general split that seems well represented on dimension 1, there are a number of verb clusters orders for which they are irrelevant (because the cluster doesn't contain the relevant configuration)
- let's try to strengthen our interpretation of dimension 1 by incorporating those points
- Abels (2011): there seems to be a correlation between the position of infinitives vs. modals on the one hand and the position of participles vs. auxiliaries on the other

3 – The results: Dimension 1

- new variable: InfMod.AuxPart:

3 – The results: Dimension 1

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  - set to 'no' when the modal precedes the infinitive (when present) and the participle precedes the auxiliary (when present)

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  - set to 'yes' when at least one of these conditions is not met

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- η^2 of InfMod.AuxPart: 0.6142

3 – The results: Dimension 1

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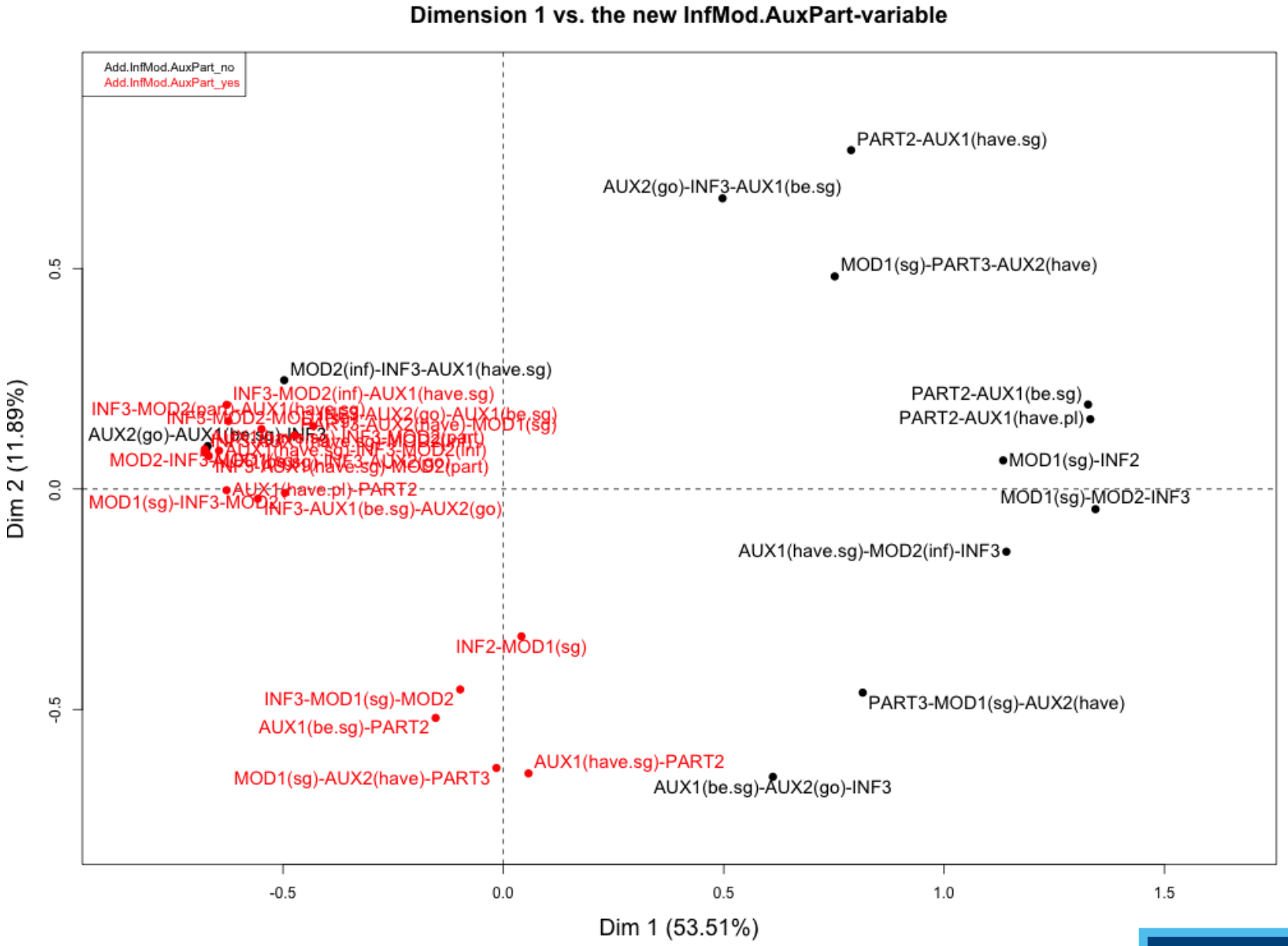
  - set to 'yes' when at least one of these conditions is not met
- η^2 of InfMod.AuxPart: 0.6142

	v-test dimension 1
InfMod.AuxPart_yes	-4.292
InfMod.AuxPart_no	4.292


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)
INF3-MOD1(sg)-MOD2
PART3-MOD1(sg)-AUX2(have)
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

3 – The results: Dimension 1

- **note:** this new variable aligns very nicely with the first dimension

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  - two recalcitrant cluster orders:

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    - AUX2(go)-AUX1(be.sg)-INF3: possibly spurious: this is an order that seems excluded in any cluster in Dutch (only two hits in the whole of SAND)

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  - two recalcitrant cluster orders:
    - AUX2(go)-AUX1(be.sg)-INF3: possibly spurious: this is an order that seems excluded in any cluster in Dutch (only two hits in the whole of SAND)
    - MOD2(inf)-INF3-AUX1(have.sg)

3 – The results: Dimension 1

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    - AUX2(go)-AUX1(be.sg)-INF3: possibly spurious: this is an order that seems excluded in any cluster in Dutch (only two hits in the whole of SAND)
    - MOD2(inf)-INF3-AUX1(have.sg)
- **this means** that the first (and most important) source of variation in Dutch verb clusters—i.e. the first micro-parameter—concerns the placement of modals and auxiliaries vs. the verbs they select

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  - two recalcitrant cluster orders:
    - AUX2(go)-AUX1(be.sg)-INF3: possibly spurious: this is an order that seems excluded in any cluster in Dutch (only two hits in the whole of SAND)
    - MOD2(inf)-INF3-AUX1(have.sg)
- **this means** that the first (and most important) source of variation in Dutch verb clusters—i.e. the first micro-parameter—concerns the placement of modals and auxiliaries vs. the verbs they select
- it sets apart dialects that consistently place infinitives to the right and participles to the left from those that don't

3 – The results: Dimension 2

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- highest η^2-values:

	dimension 2
SchmiVo.MAPhc	0.379
Barbiers.base.generation	0.309

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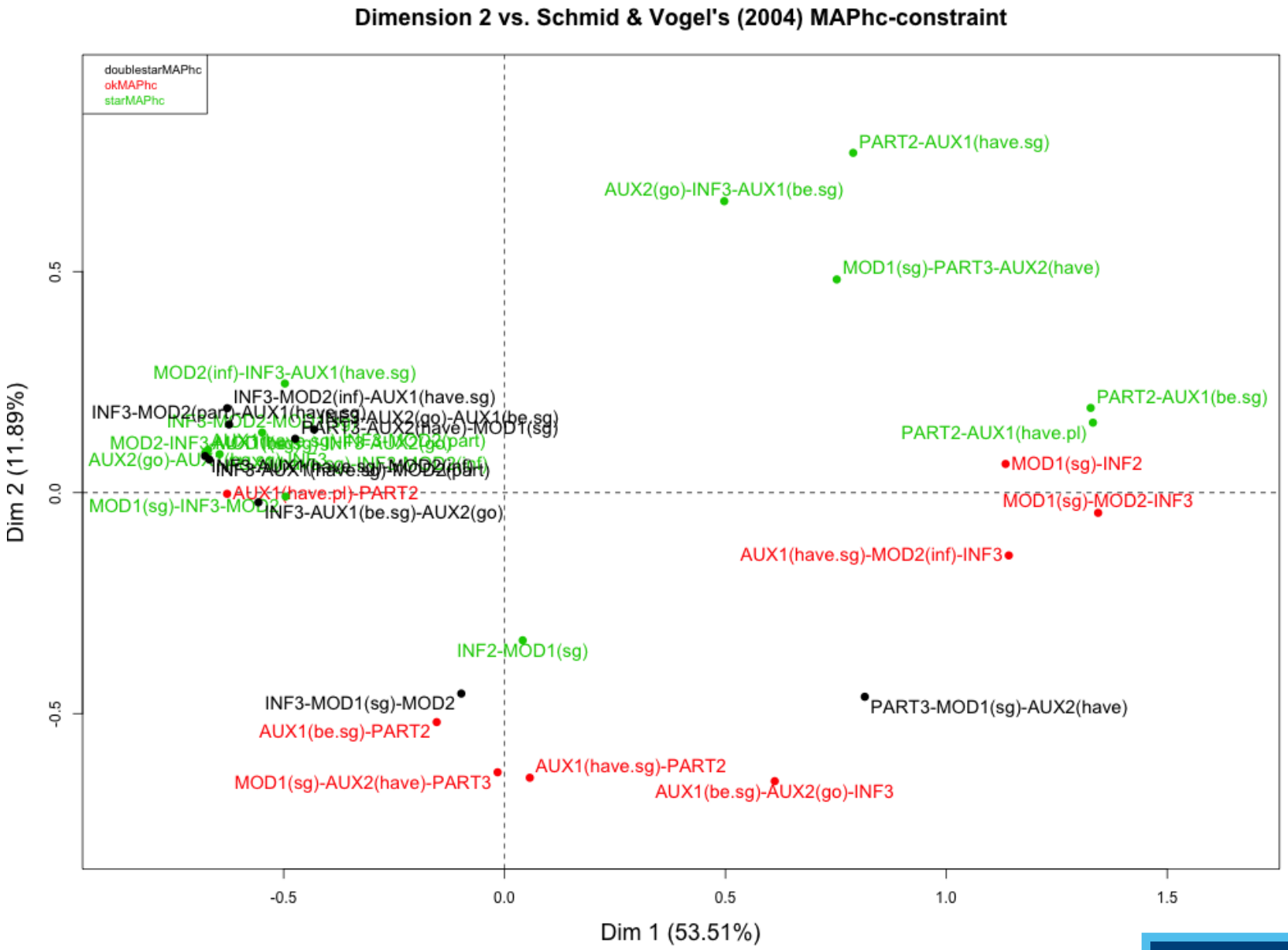
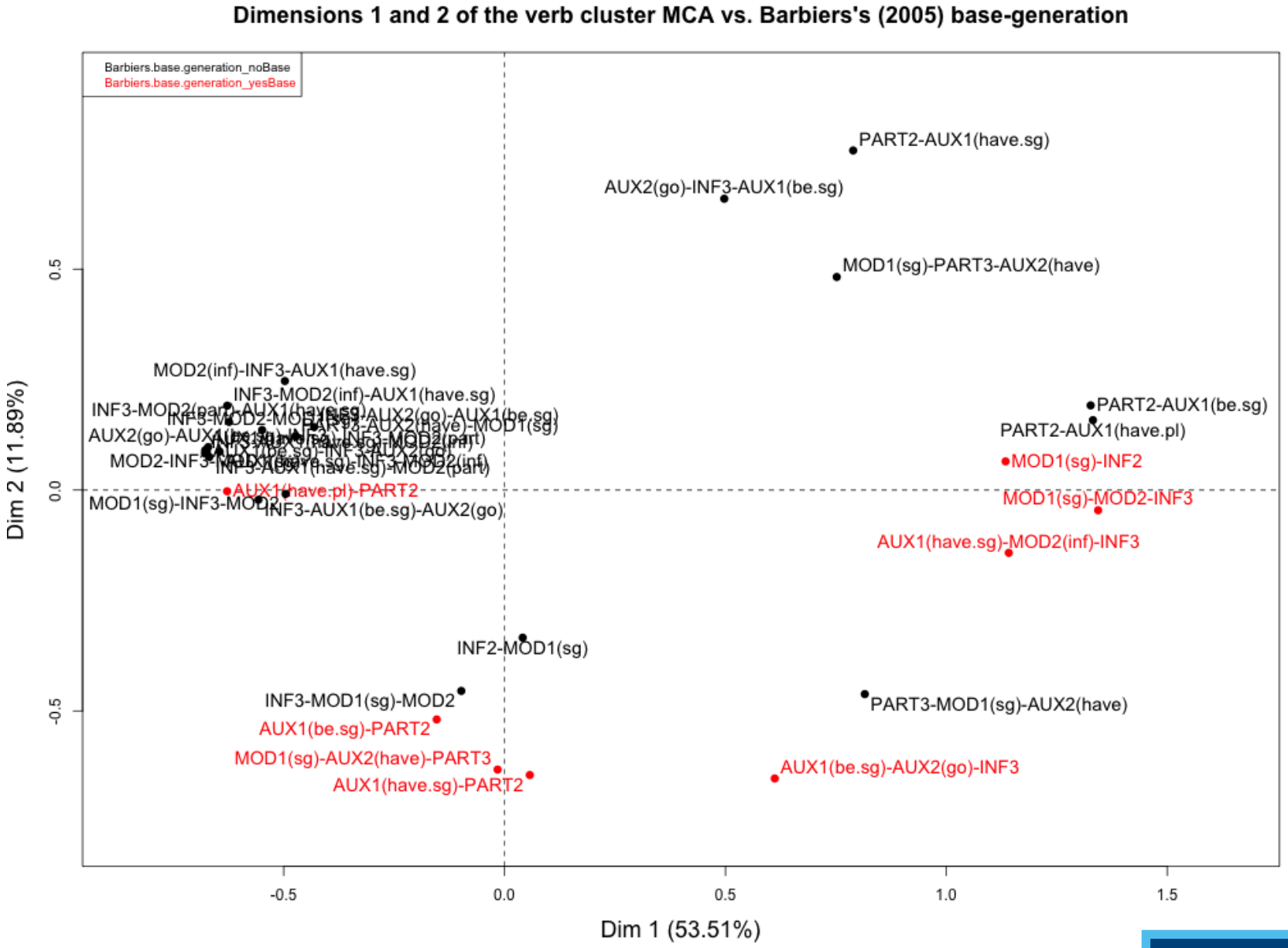
- confirmed by v-test:

	v-test dimension 2
Barbiers.base.generation_no	3.044
SchmiVo.MAPhc_starMAPhc	2.855
SchmiVo.MAPhc_okMAPhc	-3.044


Dimension 2 vs. Schmid & Vogel's (2004) MAPhc-constraint
doublestarMAPhc
okMAPhc
starMAPhc
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-MOD2(part)-AUX1(have.sg)
PART3-AUX2(have)-MOD1(sg)
PART2-AUX1(be.sg)
PART2-AUX1(have.pl)
MOD1(sg)-INF2
MOD1(sg)-MOD2-INF3
AUX1(have.pl)-PART2
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
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


Dimensions 1 and 2 of the verb cluster MCA vs. Barbiers's (2005) base-generation
Barbiers.base.generation_noBase
Barbiers.base.generation_yesBase
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
PART3-MOD1(sg)-AUX2(have)
AUX1(be.sg)-PART2
MOD1(sg)-AUX2(have)-PART3
AUX1(be.sg)-AUX2(go)-INF3
AUX1(have.sg)-PART2
Dim 2 (11.89%)
Dim 1 (53.51%)
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
1.5

3 – The results: Dimension 2

- **note:** just as was the case with dimension 1, the variables culled from the literature leave room for improvement in interpreting dimension 2

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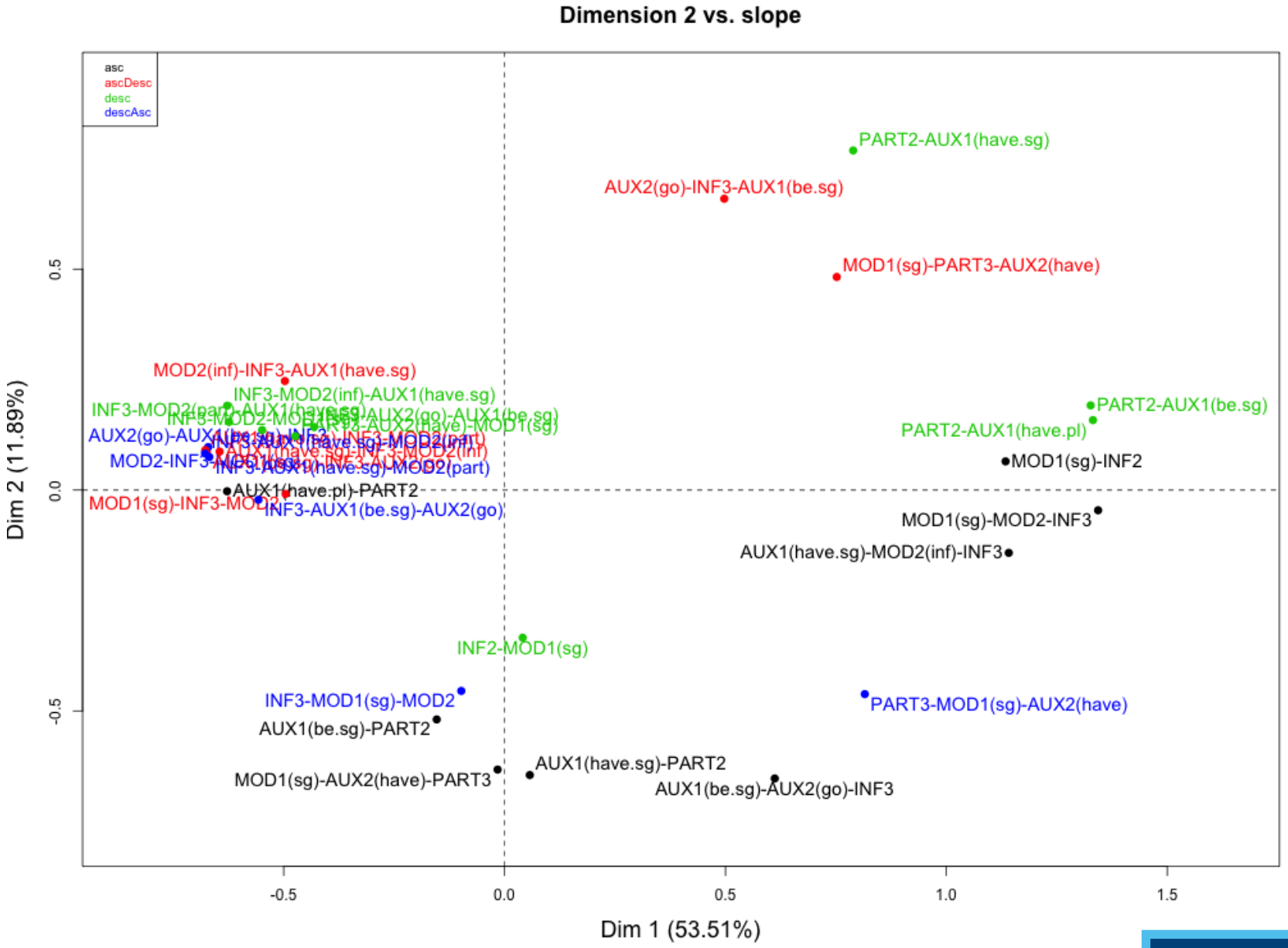
- **note:** just as was the case with dimension 1, the variables culled from the literature leave room for improvement in interpreting dimension 2
- another variable that does well is slope ($\eta^2 = 0.422$): is the order ascending, descending, first-ascending-then-descending, or first-descending-then-ascending?


Dimension 2 vs. slope
asc
ascDesc
desc
descAsc
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
AUX1(have.pl)-PART2
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
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

3 – The results: Dimension 2

- **note:** ascDesc and desc pattern towards the positive values of dimension 2, while asc and descAsc tend to yield negative values for this dimension

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- new variable: FinalDescent:

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  - set to 'yes' if the cluster ends in a descending order

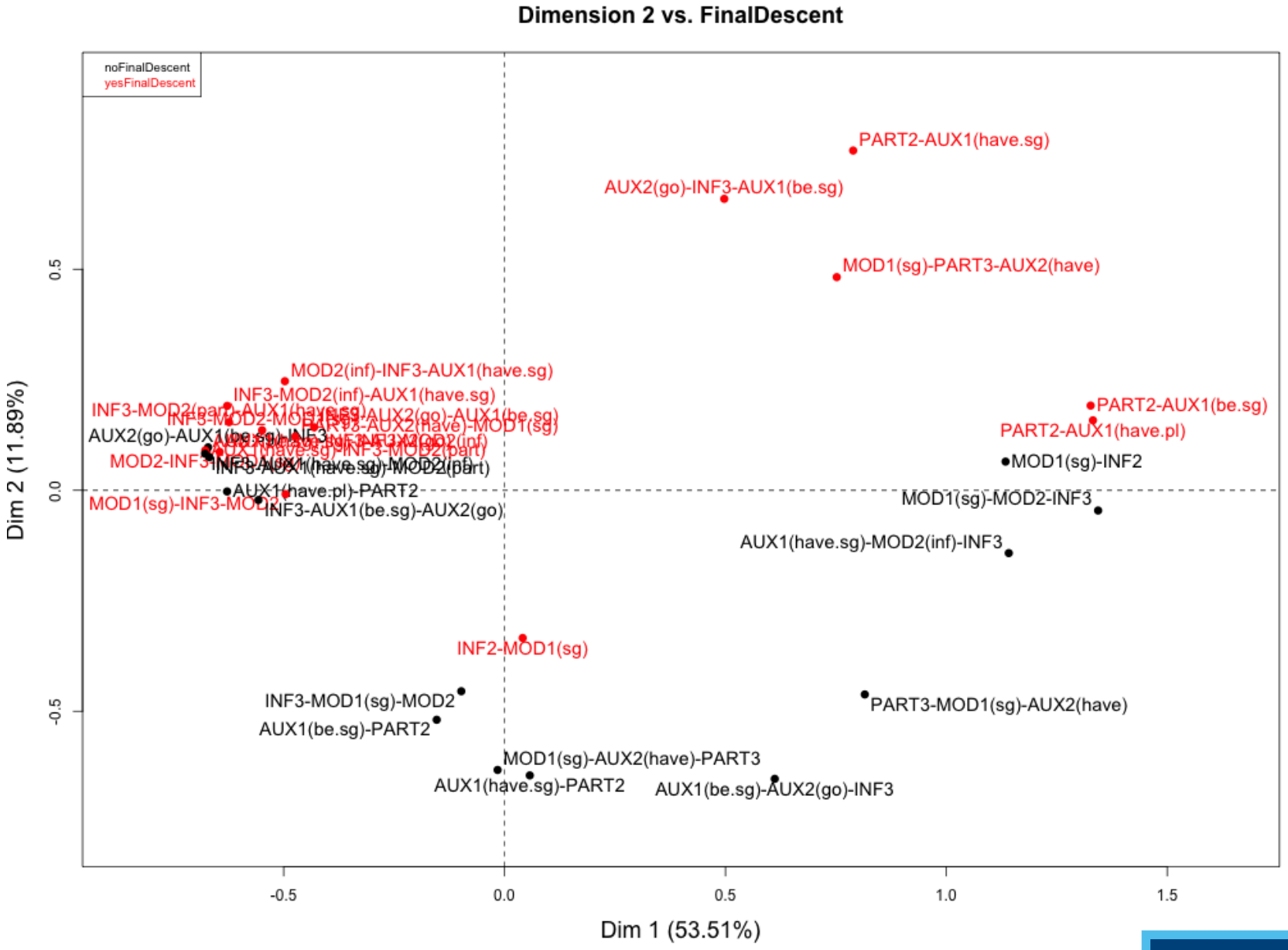
3 – The results: Dimension 2

- **note:** ascDesc and desc pattern towards the positive values of dimension 2, while asc and descAsc tend to yield negative values for this dimension
- new variable: FinalDescent:
  - set to 'yes' if the cluster ends in a descending order
  - set to 'no' if it ends in an ascending order

3 – The results: Dimension 2

- **note:** ascDesc and desc pattern towards the positive values of dimension 2, while asc and descAsc tend to yield negative values for this dimension
- new variable: FinalDescent:
  - 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


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

3 – The results: Dimension 2

- η^2 of FinalDescent: 0.382

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	v-test dimension 2
FinalDescent_yes	3.387
FinalDescent_no	-3.387

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	v-test dimension 2
FinalDescent_yes	3.387
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- possible theoretical interpretation of FinalDescent: it groups together cluster orders which are 0 or 1 movement operations away from a strictly head-final order (i.e. 132, 321, 231), from those that require at least two movement operations (123, 312, 213)

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  - caveat: two-verb clusters $\rightarrow$ there are only two possible orders, so you can always get from one to the other with one movement operation

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FinalDescent_yes	3.387
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  - caveat: two-verb clusters $\rightarrow$ there are only two possible orders, so you can always get from one to the other with one movement operation
- **this means** that the second source of variation in Dutch verb clusters—i.e. the second micro-parameter—concerns the degree to which a cluster order diverges from a strictly head-final order

3 – The results: Dimension 3

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- highest η^2-values:

	dimension 3
SchmiVo.MAPch	0.701
Bader.base.order	0.686

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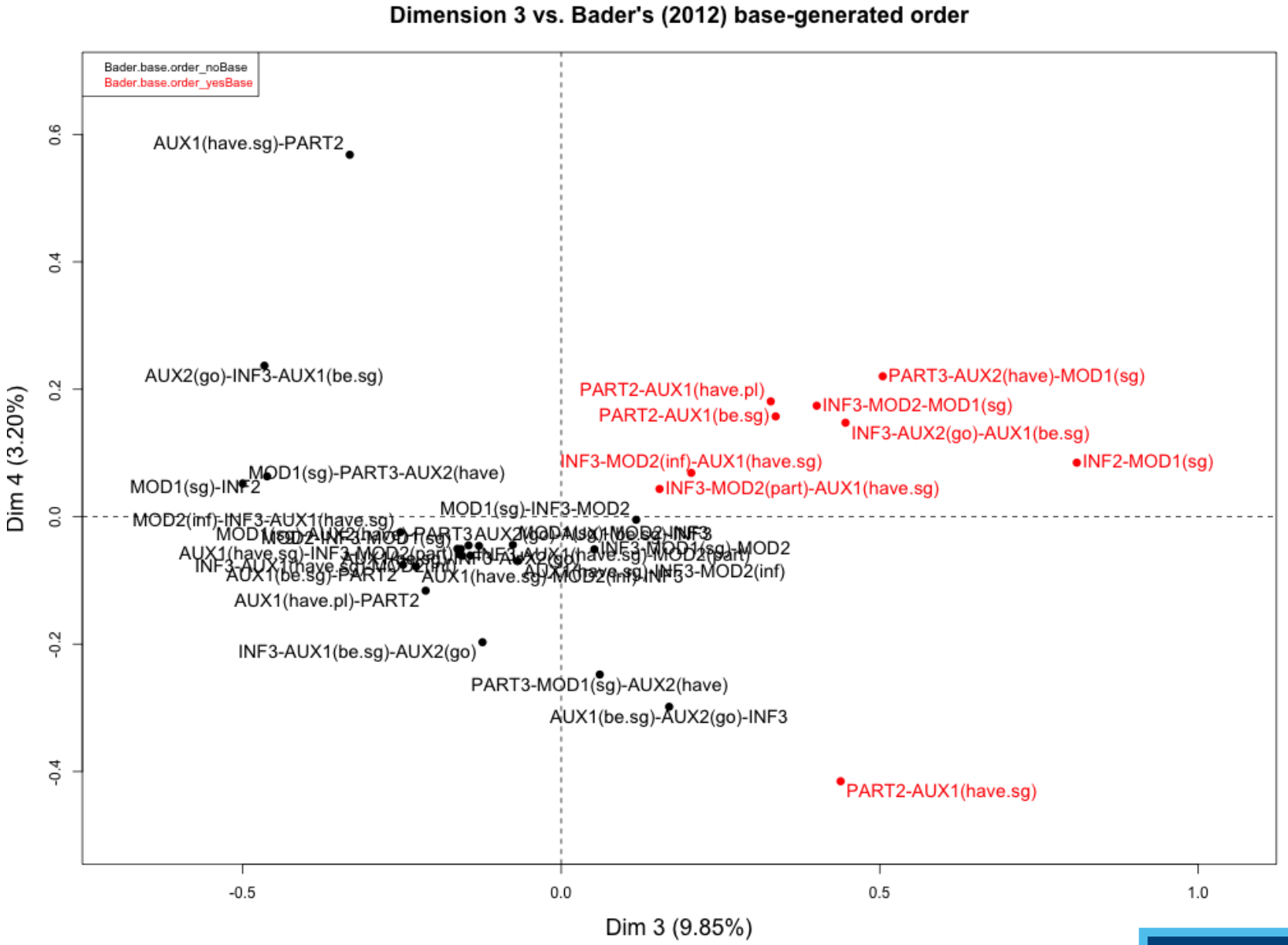
  - Bader.base.order: Bader (2012): a strictly head-final base order

- confirmed by v-test:

	v-test dimension 3
SchmiVo.MAPch_okMAPch	4.537
Bader.base.order_yes	4.537


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)-AUX2(go)
AUX1(be.sg)-PART2
AUX1(have.sg)-MOD2(inf)-INF3
INF3-MOD2(inf)
AUX1(have.pl)-PART2
INF3-AUX1(be.sg)-AUX2(go)
PART3-MOD1(sg)-AUX2(have)
AUX1(be.sg)-AUX2(go)-INF3
PART2-AUX1(have.sg)
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)
Dim 4 (3.20%)
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.5
0.0
0.5
1.0
Dim 3 (9.85%)

3 – The results: Dimension 3

- there is a *very* strong correlation between a head final base order and the third dimension

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- there is a *very* strong correlation between a head final base order and the third dimension
- **this means** that the third source of variation in Dutch verb clusters—i.e. the third micro-parameter—concerns the question of whether a dialect diverges from a strictly head final order or not

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- there is a *very* strong correlation between a head final base order and the third dimension
- **this means** that the third source of variation in Dutch verb clusters—i.e. the third micro-parameter—concerns the question of whether a dialect diverges from a strictly head final order or not
- **as an aside:** we can use this technique to evaluate theories of base-generation (based on η^2-values):

	dimension 1	**dimension 2**	**dimension 3**
head-initial	0.126	0.309	0.130
head-final	0.006	0.101	0.686
mixed (Barbiers and Bennis (2010))	0.146	0.039	0.193
mixed (Abels (2011))	0.044	0.027	0.014

4 – Outline

KU LEUVEN

4 – Conclusion

- the considerable variation found in Dutch verb cluster orders can be reduced to three grammatical microparameters:

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3. adherence to a head-final order or not: [±Movement]

4 – Conclusion

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2. the degree of divergence from a head-final order: [±MoreThanOneMovement]
3. adherence to a head-final order or not: [±Movement]

4 – Conclusion

- the considerable variation found in Dutch verb cluster orders can be reduced to three grammatical microparameters:
  1. the order of modals and auxiliaries vs. the verbs they select: [±ModInf&PartAux]
  2. the degree of divergence from a head-final order: [±MoreThanOneMovement]
  3. adherence to a head-final order or not: [±Movement]

4 – Conclusion

- the considerable variation found in Dutch verb cluster orders can be reduced to three grammatical microparameters:
  1. the order of modals and auxiliaries vs. the verbs they select: [±ModInf&PartAux]
  2. the degree of divergence from a head-final order: [±MoreThanOneMovement]
  3. adherence to a head-final order or not: [±Movement]
- more generally, there is room for fruitful collaboration between formal-theoretical and quantitative-statistical linguistics:

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  3. adherence to a head-final order or not: [±Movement]
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  1. the order of modals and auxiliaries vs. the verbs they select: [±ModInf&PartAux]
  2. the degree of divergence from a head-final order: [±MoreThanOneMovement]
  3. adherence to a head-final order or not: [±Movement]
- 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
- **note:** this means we have to allow for ***noise*** in the data: the grammatical microparameters cut the empirical cake into a number of pieces, but within each piece extra-grammatical factors might further blur the picture

4 – Conclusion

- the considerable variation found in Dutch verb cluster orders can be reduced to three grammatical microparameters:
  1. the order of modals and auxiliaries vs. the verbs they select: [±ModInf&PartAux]
  2. the degree of divergence from a head-final order: [±MoreThanOneMovement]
  3. adherence to a head-final order or not: [±Movement]
- 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
- **note:** this means we have to allow for ***noise*** in the data: the grammatical microparameters cut the empirical cake into a number of pieces, but within each piece extra-grammatical factors might further blur the picture
  - e.g. the possible influence of question type on the SAND-data

5 – References I

Abels, Klaus. 2011. Hierarchy-order relations in the germanic verb cluster and in the noun phrase. *GAGL* 53:1–28.

Bader, Markus. 2012. Verb-cluster variations: a harmonic grammar analysis. Handout of a talk presented at "New ways of analyzing syntactic variation", November 2012.

Barbiers, Sjef. 2005a. Variation in the morphosyntax of ONE. *The Journal of Comparative Germanic Linguistics* 8:159–183.

Barbiers, Sjef. 2005b. Word order variation in three-verb clusters and the division of labour between generative linguistics and sociolinguistics. In *Syntax and variation. Reconciling the biological and the social*, ed. Leonie Cornips and Karen P. Corrigan, volume 265 of *Current issues in linguistic theory*, 233–264. John Benjamins.

Barbiers, Sjef, and Hans Bennis. 2010. De plaats van het werkwoord in zuid en noord. In *Voor Magda. Artikelen voor Magda Devos bij haar afscheid van de Universiteit Gent*, ed. Johan De Caluwe and Jacques Van Keymeulen, 25–42. Gent: Academia.

Haegeman, Liliane, and Henk van Riemsdijk. 1986. Verb projection raising, scope, and the typology of verb movement rules. *Linguistic Inquiry* 17:417–466.

Huijbregts, Riny, and Henk van Riemsdijk. 2014. What happened to Principles & Parameters? The role of parameters in RES(UG). Unpublished manuscript, Utrecht/Arezzo.

5 – References II

Nerbonne, John, and William A. Kretzschmar Jr. 2013. Dialectometry++. *Literary and Linguistic Computing* 28:2–12.

Richardson, John T.E. 2011. Eta squared and partial eta squared as measures of effect size in educational research. *Educational Research Review* 6:135–147.

Schmid, Tanja, and Ralf Vogel. 2004. Dialectal variation in German 3-Verb clusters. *The Journal of Comparative Germanic Linguistics* 7:235–274.

Wurmbrand, Susanne. 2005. Verb clusters, verb raising, and restructuring. In *The Blackwell Companion to Syntax*, ed. Martin Everaert and Henk van Riemsdijk, volume V, chapter 75, 227–341. Oxford: Blackwell.