Verb clusters redux

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KU Leuven

CGSW 30
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Outline

1 One-slide summary
2 The data: dialect Dutch verb clusters
3 Theoretical background: dialectometry
4 Methodology: reverse dialectometry
5 Results
6 Main conclusion
Main goal
Explore the interaction between formal-theoretical and quantitative-statistical approaches to linguistics.

Central data
Word order variation in two- and three-verb clusters in 267 Dutch dialects.

Main result
Roughly 80% of the attested variation can be reduced to three grammatical microparameters: (i) whether or nor a dialect uses movement in deriving its verb clusters, (ii) whether or not there is an economy condition on movement, and (iii) a head parameter regulating the order of participles and infinitives vis-à-vis their selecting verbs.
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The data: dialect Dutch verb clusters

- in Dutch (like in many Germanic languages) verbs cluster together at the right edge of the (embedded) clause:

(1) dat hij gisteren tijdens de les gelachen heeft. 
that he yesterday during the class laughed has
‘that he laughed yesterday during class.’
The data: dialect Dutch verb clusters

- in Dutch (like in many Germanic languages) verbs cluster together at the right edge of the (embedded) clause:

\[ (1) \text{ dat hij gisteren tijdens de les gelachen heeft. } \]
that he yesterday during the class laughed has
‘that he laughed yesterday during class.’

- moreover, such verbal clusters typically show a certain degree of freedom in their word order:

\[ (2) \text{ dat hij gisteren tijdens de les heeft gelachen. } \]
that he yesterday during the class had laughed
‘that he laughed yesterday during class.’
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- moreover, such verbal clusters typically show a certain degree of freedom in their word order:

(2) dat hij gisteren tijdens de les heeft gelachen.
that he yesterday during the class had laughed
‘that he laughed yesterday during class.’
this word order freedom is typically a source of interdialectal variation:
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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.’  

b. dat ee et ook nie mag zien.

that you it also not may see

‘that you’re also not allowed to see it.’
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
   ‘that you’re also not allowed to see it.’  (✓12)
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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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:

(6)   Ik vind dat iedereen moet₁ kunnen₂ zwemmen₃.  
I find that everyone must can swim  
‘I think everyone should be able to swim.’  

(✓123)
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:

(6)  Ik vind dat iedereen moet₁ kunnen₂ zwemmen₃.
     I find that everyone must can swim
     ‘I think everyone should be able to swim.’       (√123)

(7)  a.  ...dat iedereen moet₁ zwemmen₃ kunnen₂.       (√132)
b.  ...dat iedereen zwemmen₃ moet₁ kunnen₂.       (√312)
c.  ...dat iedereen zwemmen₃ kunnen₂ moet₁.       (√321)
d.  *...dat iedereen kunnen₂ zwemmen₃ moet₁.  (*231)
e.  *...dat iedereen kunnen₂ moet₁ zwemmen₃.  (*213)
but once again, it is not the case that each of the four allowed orders is attested in all dialects:
but once again, it is not the case that each of the four allowed orders is attested in all dialects:

(8) **Midsland Dutch**

   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 mot kunnen zwemmen.  
   that everyone must can swim  
   ‘that everyone should be able to swim.’  

   (√123)

b. *dat iedereen mot zwemmen kunnen.  

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

d. *dat iedereen zwemmen kunnen mot.  

e. *dat iedereen kunnen zwemmen mot.  
   (∗321)
f. *dat iedereen kunnen mot zwemmen.  
   (∗231)

   (∗213)
more generally, the four possible cluster orders yield a total of 16 possible combinations, of which 12 are attested in Dutch dialects:
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<table>
<thead>
<tr>
<th>sample dialect</th>
<th>123</th>
<th>132</th>
<th>321</th>
<th>312</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beetgum</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hippolytushoef</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>*</td>
</tr>
<tr>
<td>Warffum</td>
<td>✓</td>
<td>✓</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Oosterend</td>
<td>✓</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Schermerhorn</td>
<td>✓</td>
<td>✓</td>
<td>*</td>
<td>✓</td>
</tr>
<tr>
<td>Visvliet</td>
<td>✓</td>
<td>*</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kollum</td>
<td>✓</td>
<td>*</td>
<td>✓</td>
<td>*</td>
</tr>
<tr>
<td>Langelo</td>
<td>✓</td>
<td>*</td>
<td>*</td>
<td>✓</td>
</tr>
<tr>
<td>Midsland</td>
<td>*</td>
<td>✓</td>
<td>✓</td>
<td>*</td>
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<tr>
<td>Lies</td>
<td>*</td>
<td>*</td>
<td>✓</td>
<td>*</td>
</tr>
<tr>
<td>Bakkeveen</td>
<td>*</td>
<td>*</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Waskemeer</td>
<td>*</td>
<td>✓</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
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in order to get a more complete picture of the variation, we can look at the results from the SAND-project:

- dialect interviews in 267 dialect locations in Belgium, France, and the Netherlands
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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
this state of affairs raises (at least) two fundamental questions for grammatical theory:

1. to what extent is this variation due to grammar-internal properties, and what part of it is grammar-external?

2. how can we draw the line between the two?

One possible position: Barbiers (2005): 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, ...)

In this talk I use quantitative-statistical methods to identify three grammatical (micro)parameters that together are responsible for the bulk of the variation.
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- this section presents a prototypical dialectometric analysis, which will serve as a stepping stone for the actual analysis in the next section
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- **starting point:** the raw data from 13 SAND-maps:
  - 4 about two-verb clusters ($3 \times$ AUXILIARY-PARTICIPLE, $1 \times$ MODAL-INFINITIVE)
  - 4 about three-verb clusters (modal-modal-infinitive, modal-auxiliary-participle, auxiliary-auxiliary-infinitive, auxiliary-modal-infinitive)
  - 3 about particle placement inside the cluster
  - 2 about morphology of the past participle
  - for a total of 67 linguistic variables in 267 locations
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- for a total of 67 linguistic variables in 267 locations
this yields a $267 \times 67$ matrix with one row per location and one column per linguistic variable, i.e. locations = individuals and linguistic phenomena = variables
<table>
<thead>
<tr>
<th>Location</th>
<th>AUX1(be.sg)-PART2</th>
<th>PART2-AUX1(be.sg)</th>
<th>AUX1(have.sg)-PART2</th>
<th>PART2-AUX1(have.sg)</th>
<th>AUX1(have)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midsland / Midslär</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Lies</td>
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<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>West-Terschelling</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Oosterend</td>
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<td>no</td>
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<td>yes</td>
</tr>
<tr>
<td>Hollum</td>
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<td>NA</td>
<td>NA</td>
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<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
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<td>Ferwerd / Ferwert</td>
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</tr>
<tr>
<td>Anjum / Eanjum</td>
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</tr>
<tr>
<td>Kollum</td>
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<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Visvliet</td>
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<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
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<td>Oosterbierum / Eebierum</td>
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<tr>
<td>Langelo</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
this yields a $267 \times 67$ matrix with one row per location and one column per linguistic variable, i.e. locations = individuals and linguistic phenomena = variables

step 1: convert the table into a $267 \times 267$ (symmetric) distance matrix, whereby for each pair of locations a distance between them is calculated based on the linguistic features they share
<table>
<thead>
<tr>
<th></th>
<th>Midsland</th>
<th>Lies</th>
<th>West-Terschelling</th>
<th>Oosterend</th>
<th>Holsum</th>
<th>Schiermonnikoog</th>
<th>Ferwerd / Ferwerdiel</th>
<th>Anjum / Anjumdiel</th>
<th>Kollum</th>
<th>Visvliet</th>
<th>Oosterbierum</th>
<th>Beet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midsland / Midsland</td>
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<td>0,357</td>
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<td>0,611</td>
<td>0,650</td>
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<td>0,00</td>
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<tr>
<td>Lies</td>
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<td>0,000</td>
<td>0,444</td>
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<td>0,588</td>
<td>0,375</td>
<td>0,471</td>
<td>0,563</td>
<td>0,444</td>
<td>0,444</td>
<td>0,632</td>
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<td>0,667</td>
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<td>0,632</td>
<td>0,600</td>
<td>0,500</td>
<td>0,00</td>
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<td>0,706</td>
<td>0,000</td>
<td>0,765</td>
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<tr>
<td>Ferwerd / Ferwerdiel</td>
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<td>0,000</td>
<td>0,667</td>
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<td>0,625</td>
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</tr>
<tr>
<td>Kollum</td>
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<td>0,444</td>
<td>0,632</td>
<td>0,563</td>
<td>0,625</td>
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<td>0,588</td>
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<td>0,000</td>
<td>0,353</td>
<td>0,625</td>
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<td>0,682</td>
<td>0,625</td>
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<td>0,588</td>
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<td>0,632</td>
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<td>0,462</td>
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<td>0,500</td>
<td>0,750</td>
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<td>0,813</td>
<td>0,500</td>
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<td>0,429</td>
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<td>0,571</td>
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<tr>
<td>Jorwerd / Jorwerdiel</td>
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<td>0,667</td>
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<td>0,846</td>
<td>0,545</td>
<td>0,667</td>
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<td>0,556</td>
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<td>0,588</td>
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<td>0,533</td>
<td>0,471</td>
<td>0,652</td>
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</tr>
<tr>
<td>Kloosterburen / Kloosterburen</td>
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<td>0,810</td>
<td>0,563</td>
<td>0,357</td>
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<td>0,333</td>
<td>0,636</td>
<td>0,706</td>
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<tr>
<td>Warffum</td>
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<td>0,438</td>
<td>0,667</td>
<td>0,737</td>
<td>0,525</td>
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<td>0,643</td>
<td>0,400</td>
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<td>0,550</td>
<td>0,773</td>
<td>0,650</td>
<td>0,739</td>
<td>0,722</td>
<td>0,389</td>
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<td>0,682</td>
<td>0,714</td>
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<td>0,783</td>
<td>0,762</td>
<td>0,800</td>
<td>0,778</td>
<td>0,471</td>
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<td>0,684</td>
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<td>0,682</td>
<td>0,650</td>
<td>0,652</td>
<td>0,773</td>
<td>0,762</td>
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<td>0,722</td>
<td>0,556</td>
<td>0,368</td>
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<td>Langelo</td>
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<td>0,739</td>
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<td>0,792</td>
<td>0,650</td>
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<td>0,550</td>
<td>0,500</td>
<td>0,700</td>
<td>0,00</td>
</tr>
</tbody>
</table>
this yields a 267×67 matrix with one row per location and one column per linguistic variable, i.e. locations = individuals and linguistic phenomena = variables

- 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: apply multidimensional scaling (MDS) to the distance matrix
this yields a $267 \times 67$ matrix with one row per location and one column per linguistic variable, i.e. locations = individuals and linguistic phenomena = variables

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

• step 2: apply multidimensional scaling (MDS) to the distance matrix

• MDS is a mathematical technique for reducing a multidimensional distance matrix to a low dimensional space in which each point represents an object from the distance matrix, and distances between points represents, as well as possible, dissimilarities between objects (Borg and Groenen, 2005)
this yields a $267 \times 67$ matrix with one row per location and one column per linguistic variable, i.e. locations = individuals and linguistic phenomena = variables

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

step 2: apply multidimensional scaling (MDS) to the distance matrix

step 3: project the data back onto a geographical map
• **note:** the linguistic variables (i.e. cluster orders) are used to determine the degree of similarity/difference between dialect locations.
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- these similarities and differences are then projected back onto a geographical map, which makes it possible to discern dialect regions based on what verb cluster phenomena they possess.
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- Shortcomings of this approach for our current purposes:
  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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• shortcomings of this approach for our current purposes:
  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.
Outline

1. One-slide summary
2. The data: dialect Dutch verb clusters
3. Theoretical background: dialectometry
4. Methodology: reverse dialectometry
5. Results
6. Main conclusion
Methodology: reverse dialectometry

- **proposal:** two changes to the classical dialectometric setup:
  1. Cluster orders are individuals rather than variables, i.e. instead of calculating differences between dialect locations, we measure differences between linguistic constructions.
  2. Theoretical analyses of verb cluster orders are decomposed in their constitutive parts, which makes it possible to include them as supplementary variables in the analysis.
Methodology: reverse dialectometry

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  1. Cluster orders are *individuals* rather than variables, i.e. instead of calculating differences between dialect locations, we measure differences between linguistic constructions.
  2. Theoretical analyses of verb cluster orders are decomposed in their constitutive parts, which makes it possible to include them as supplementary variables in the analysis.
starting point: a $31 \times 267$ data table whereby each cluster order represents a row and each dialect location a column
<table>
<thead>
<tr>
<th>Verb Cluster</th>
<th>Midsland</th>
<th>Lies</th>
<th>West_Tersch</th>
<th>Oosterend</th>
<th>Hoilum</th>
<th>Schiermonnik</th>
<th>Ferwerd</th>
<th>Anjum</th>
<th>Koijum</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUX₁(be.sg)-PART₂</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>NA</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>PART₂-AUX₁(be.sg)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>NA</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>AUX₁(have.sg)-PART₂</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>NA</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>PART₂-AUX₁(have.sg)</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>NA</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>AUX₁(have.pl)-PART₂</td>
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<td>no</td>
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</tr>
<tr>
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<td>yes</td>
<td>yes</td>
<td>yes</td>
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<td>yes</td>
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<tr>
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<td>yes</td>
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<tr>
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<tr>
<td>PART₁-AUX₁(have)-MOD₁</td>
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<td>yes</td>
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<tr>
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<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
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<tr>
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<td>no</td>
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<td>no</td>
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<td>INF₁-AUX₁(be.sg)-AUX₂(go)</td>
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<td>no</td>
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<td>no</td>
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</tr>
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<td>yes</td>
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<td>yes</td>
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<td>NA</td>
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<tr>
<td>AUX₁(have.sg)-MOD₂(INF₁)-INF₃</td>
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</tr>
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<td>INF₁-MOD₁(INF₁)-AUX₁(have.sg)</td>
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<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>
starting point: a $31 \times 267$ 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 of the 31 cluster orders is compared to each other cluster order on 267 variables (i.e. as many as there are dialect locations).
• starting point: a $31 \times 267$ 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 of the 31 cluster orders is compared to each other cluster order on 267 variables (i.e. as many as there are dialect locations)

• when we reduce the 31-dimensional distance matrix to a two-dimensional space, we can plot the differences and similarities between the cluster orders from the SAND-project
Two-dimensional representation of the 31 SAND-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
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closeness of points indicates how alike two verb cluster orders are
based on their geographical spread

if this likeness is the result of grammar, i.e. grammatical
microparameters, then verb cluster orders that are near one another
should be the result of the same parameter setting, i.e. parameters
create ‘natural classes’ of verb cluster orders
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in order to find those parameters, we can also encode the cluster orders in terms of their theoretical linguistic analyses
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example: Barbiers (2005)
Barbiers (2005) derives verb cluster orders as follows:
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- base order is uniformly head-initial → derives 12 and 123
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- base order is uniformly head-initial \(\rightarrow\) derives 12 and 123

\[
\begin{align*}
\text{(10)} & \quad VP_1 & \quad \text{(11)} & \quad VP_1 \\
& \quad V_1 & \quad VP_2 & \quad V_1 & \quad VP_2 \\
& & \quad V_2 & & \quad V_2 & \quad VP_3 \\
& & & & & \quad V_3
\end{align*}
\]
Barbiers (2005) derives verb cluster orders as follows:

- movement is VP-intraposition → derives 21 and 231, 312 and 132, and fails to derive 213
Barbiers (2005) derives verb cluster orders as follows:

- movement is VP-intraposition $\rightarrow$ derives 21 and 231, 312 and 132, and fails to derive 213

(12)
Barbiers (2005) derives verb cluster orders as follows:

- movement is VP-intraposition → derives 21 and 231, 312 and 132, and fails to derive 213

\[
\text{(12)}
\]

\[
\begin{array}{c}
\text{VP}_1 \\
\text{VP}_2 & \text{V}'_1 \\
\text{V}_2 & \text{V}_1 & t_{\text{VP}_2}
\end{array}
\]

\[
\text{(13)}
\]

\[
\begin{array}{c}
\text{VP}_1 \\
\text{VP}_2 & \text{V}'_1 \\
\text{V}_2 & \text{VP}_3 & \text{V}_1 & t_{\text{VP}_2}
\end{array}
\]
Barbiers (2005) derives verb cluster orders as follows:
- movement is VP-intraposition → derives 21 and 231, 312 and 132, and fails to derive 213

(14)
Barbiers (2005) derives verb cluster orders as follows:
- movement is VP-intraposition → derives 21 and 231, 312 and 132, and fails to derive 213
Barbiers (2005) derives verb cluster orders as follows:

- VP-intraposition can pied-pipe other material \( \rightarrow \) derives 321
  (movement of VP3 to specVP1 via specVP2 and with pied-piping of VP2)
Barbiers (2005) derives verb cluster orders as follows:

- VP-intraposition can pied-pipe other material \(\rightarrow\) derives 321
  (movement of VP3 to specVP1 via specVP2 and with pied-piping of VP2)

(16)
Barbiers (2005) derives verb cluster orders as follows:

- VP intraposition is triggered by feature checking: modal and aspectual auxiliaries enter into a(n eventive) feature checking relation with the main verb, while perfective auxiliaries enter into a perfective checking relationship with their immediately selected verb → rules out 231 in the case of MOD-MOD/AUX-V-clusters and 312 in the case of AUX-AUX/MOD-V-clusters
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(17) \[
\left[ VP_1 \; \text{mod}_{\text{uEvent}} \left[ VP_2 \; \text{mod}_{\text{uEvent}} \left[ VP_3 \; \text{inf}_{\text{iEvent}} \right] \right] \right]
\]
Barbiers (2005) derives verb cluster orders as follows:

- VP intraposition is triggered by feature checking: modal and aspectual auxiliaries enter into a(n eventive) feature checking relation with the main verb, while perfective auxiliaries enter into a perfective checking relationship with their immediately selected verb → rules out 231 in the case of MOD-MOD/AUX-V-clusters and 312 in the case of AUX-AUX/MOD-V-clusters

(17) \[ [VP_1 \text{mod}_{u\text{Event}}] [VP_2 \text{mod}_{u\text{Event}}] [VP_3 \text{inf}_{i\text{Event}}] ] \]

(18) \[ [VP_1 \text{aux}_{u\text{Perf}}] [VP_2 \text{mod}_{i\text{Perf},u\text{Event}}] [VP_3 \text{inf}_{i\text{Event}}] ] \]
from this theoretical account we can distill the following micro-parameters:

- [± base-generation]: can the order be base-generated?
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and the 31 SAND cluster orders can be encoded in terms of these micro-parameters
<table>
<thead>
<tr>
<th></th>
<th>Barbiers-base generation</th>
<th>Barbiers-movement</th>
<th>Barbiers-spec-plied-piping</th>
<th>Barbiers-feature checking-failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUX1(be.sg)-PART2</td>
<td>yesBase</td>
<td>noMvt</td>
<td>noPiedP</td>
<td>noFeatCheckFail</td>
</tr>
<tr>
<td>PART2-AUX1(be.sg)</td>
<td>noBase</td>
<td>yesMvt</td>
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</tr>
<tr>
<td>AUX1(have.sg)-PART2</td>
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<td>INF2-MOD1(sg)</td>
<td>noBase</td>
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</tr>
<tr>
<td>MOD2-MOD3-MOD1(sg)</td>
<td>noBase</td>
<td>yesMvt</td>
<td>noPiedP</td>
<td>yesFeatCheckFail</td>
</tr>
<tr>
<td>MOD1(sg)-MOD2-INF3</td>
<td>yesBase</td>
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<td>noBase</td>
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<tr>
<td>INF3-MOD2-MOD1(sg)</td>
<td>noBase</td>
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</tr>
<tr>
<td>MOD1(sg)-AUX2(have)-PART3</td>
<td>yesBase</td>
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</tr>
<tr>
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<tr>
<td>AUX1(be.sg)-AUX2(go)-INF3</td>
<td>yesBase</td>
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<td>noBase</td>
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<tbody>
<tr>
<td></td>
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Outline

1. One-slide summary
2. The data: dialect Dutch verb clusters
3. Theoretical background: dialectometry
4. Methodology: reverse dialectometry
5. Results
6. Main conclusion
Results

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how many: the number of parameters responsible for the verb cluster variation = the number of dimensions we reduce our data set to.

what they are: the identity of those parameters = the interpretation of the dimensions.
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• in order to know what those parameters are, we need to interpret the first three dimensions
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- **BarBen.NomInf (0.425)**: Barbiers and Bennis (2010): the infinitival main verb is nominalized
- **Bader.VMod (0.398)**: Bader (2012): the complement of a modal verb precedes the modal
Results: Dimension 1

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Dimension 1 vs. Barbiers & Bennis’s (2010) nominalized infinitives
Dimension 1 vs. Bader's (2012) VMod-constraint

![Graph showing Verb clusters redux]
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  - set to 'yes' when at least one of these conditions is not met

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- two recalcitrant cluster orders:
  - 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 microparameter—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.
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Results: Dimension 2

- SchmiVo.MAPHC: Schmid and Vogel (2004): "If A and B are sister nodes at LF, and A is a head and B is a complement, then the correspondent of A precedes the one of B at PF."

- Barbiers.base.generation: Barbiers (2005): head-initial base structure
Results: Dimension 2

- highest $\eta^2$-values:

<table>
<thead>
<tr>
<th>Dimension 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SchmiVo.MAPhc</td>
<td>0.379</td>
</tr>
<tr>
<td>Barbiers.base.generation</td>
<td>0.309</td>
</tr>
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- 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?
• **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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  - set to ‘yes’ if the cluster ends in a descending order
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<table>
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<tr>
<th>FinalDescent_yes</th>
<th>FinalDescent_no</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>132</td>
<td>123</td>
</tr>
<tr>
<td>321</td>
<td>312</td>
</tr>
<tr>
<td>231</td>
<td>213</td>
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• $\eta^2$ of FinalDescent: 0.382
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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 microparameter—concerns the degree to which a cluster order diverges from a strictly head-final order
Results: Dimension 3

[...]

\[ \eta^2 \text{ values: dimension 3} \]

- SchmiVo.MAPch 0.701
- Bader.base.order 0.686

▶ SchmiVo.MAPch: Schmid and Vogel (2004): "If A and B are sister nodes at LF, and A is a head and B is a complement, then the correspondent of B precedes the one of A at PF."

▶ Bader.base.order: Bader (2012): a strictly head-final base order
Results: Dimension 3

- highest $\eta^2$-values:

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</table>

- SchmiVo.MAPch: Schmid and Vogel (2004): “If A and B are sister nodes at LF, and A is a head and B is a complement, then the correspondent of B precedes the one of A at PF.”

- Bader.base.order: Bader (2012): a strictly head-final base order
there is a very strong correlation between a head-final base order and the third dimension in the analysis
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this means that the third source of variation in Dutch verb clusters—i.e. the third microparameter—concerns the question of whether a dialect diverges from a strictly head final order or not
Results: Conclusion

- interpreting the first three dimensions of the quantitative analysis of the verb cluster data in the Syntactic Atlas of Dutch Dialects allows us to construct the following (rough) parametric account of verb cluster ordering:
  
1. a head-final base order
2. which dialects can diverge from or not: $\pm$ 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 $\pm$ ModInf&PartAux (dimension 1)
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[Other points related to dialect divergence, economy of movement, and headedness parameter]
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Outline

1 One-slide summary

2 The data: dialect Dutch verb clusters

3 Theoretical background: dialectometry

4 Methodology: reverse dialectometry

5 Results

6 Main conclusion
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- the considerable variation found in Dutch verb cluster orders can be reduced to three grammatical microparameters:
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  1. The order of modals and auxiliaries vs. the verbs they select: $\pm \text{ModInf}\&\text{PartAux}$
  2. The degree of divergence from a head-final order: $\text{EconomyOfMovement}$
  3. Adherence to a head-final order or not: $\pm \text{Movement}$

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
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References II

