Predicting is not explaining

targeted learning of the dative alternation in English

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Predicting is not explaining

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outline

1. background & issues
2. methods
3. data
4. results
5. discussion
6. conclusion
a mathematician and a linguist walk into a lab

a sample from a real conversation:

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(1) John gave the book to Mary. (PD)
\[ S_{AGENT} \quad V \quad O_{THEME} \quad \text{Prep} \quad O_{RECIPIENT} \]

(2) John gave Mary the book. (DO)
\[ S_{AGENT} \quad V \quad O_{RECIPIENT} \quad O_{THEME} \]
a mathematician and a linguist walk into a lab

data

a sample from a real conversation:

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    $S_{AGENT}$ V $O_{RECIPIENT}$ $O_{THEME}$

... typically, alternations are handled with predictive methods [Bre+07; Baa11]
outline of a typical parametric-model-based, predictive approach

- select a response variable (e.g., PD vs. DO)
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- fit parametric statistical models and interpret each coefficient as an effect of the corresponding variable
- compare the models
example: logistic regression/prediction [Bre+07]

(26) Model B: Relative magnitudes of significant effects

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Odds Ratio PP</th>
<th>95% C.I.</th>
</tr>
</thead>
<tbody>
<tr>
<td>nonpronominality of recipient</td>
<td>1.73</td>
<td>5.67</td>
<td>3.25–9.89</td>
</tr>
<tr>
<td>inanimacy of recipient</td>
<td>1.53</td>
<td>5.62</td>
<td>2.08–10.29</td>
</tr>
<tr>
<td>nongivenness of recipient</td>
<td>1.45</td>
<td>4.28</td>
<td>2.42–7.59</td>
</tr>
<tr>
<td>indefiniteness of recipient</td>
<td>0.72</td>
<td>2.05</td>
<td>1.20–3.5</td>
</tr>
<tr>
<td>plural number of theme</td>
<td>0.72</td>
<td>2.06</td>
<td>1.37–3.11</td>
</tr>
<tr>
<td>structural parallelism in dialogue</td>
<td>-1.13</td>
<td>0.32</td>
<td>0.23–0.46</td>
</tr>
<tr>
<td>nongivenness of theme</td>
<td>-1.17</td>
<td>0.31</td>
<td>0.18–0.54</td>
</tr>
<tr>
<td>length difference (log scale)</td>
<td>-1.16</td>
<td>0.31</td>
<td>0.25–0.4</td>
</tr>
<tr>
<td>indefiniteness of theme</td>
<td>-1.74</td>
<td>0.18</td>
<td>0.11–0.28</td>
</tr>
<tr>
<td>nonpronominality of theme</td>
<td>-2.17</td>
<td>0.11</td>
<td>0.07–0.19</td>
</tr>
</tbody>
</table>
problems

- math.: interesting... but then does your job as a linguist consist in making predictions?
problems

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problems

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- linguist: uh... not really
- math: and if I were to give you the true, unknown law of the data, could you tell me what feature of the law you are targeting with your parametric statistical models?
- linguist: ...
- linguist: (sobs)
predicting vs. explaining the dative alternation

- predicting:

- explaining:

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predicting vs. explaining the dative alternation

- predicting:
  - building an algorithm that poses as a native speaker of English when she formulates a construction involving a dative alternation
predicting vs. explaining the dative alternation

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predicting vs. explaining the dative alternation

- predicting:
  - building an algorithm that poses as a native speaker of English when she formulates a construction involving a dative alternation
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- explaining:
  - uncovering what drives the choice of one dative form over the other
predicting vs. explaining the dative alternation

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  - building an algorithm that poses as a native speaker of English when she formulates a construction involving a dative alternation
  - the algorithm does not need to tell us how the dative alternation works

- explaining:
  - uncovering what drives the choice of one dative form over the other
  - by building upon/targeting the above algorithm
method

targeted learning [LR11, monograph]

- Chambaz and Desagulier [CD15]
method

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- through causal analysis, we operationalize the set of scientific questions that we wish to address regarding the dative alternation
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- through causal analysis, we operationalize the set of scientific questions that we wish to address regarding the dative alternation
- we answer these questions by targeting some versatile machine learners borrowing from the latest advances in semi-parametric statistics
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targeted learning [LR11, monograph]

- Chambaz and Desagulier [CD15]
- through causal analysis, we operationalize the set of scientific questions that we wish to address regarding the dative alternation
- we answer these questions by targeting some versatile machine learners borrowing from the latest advances in semi-parametric statistics
- we derive estimates, confidence regions and \( p \)-values for well-defined parameters that can be interpreted as the influence of each contextual variable on the outcome PD vs. DO
data

the dative dataset [Bre+07]
available from the languageR package [Baa09]
## Categorical Contextual Information Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>vs.</th>
<th>Estimate</th>
<th>CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modality</td>
<td>written%spoken</td>
<td>0.0277</td>
<td>[-0.0031, 0.0585]</td>
<td>0.0776</td>
</tr>
<tr>
<td>AnimacyOfRec</td>
<td>inanimate%animate</td>
<td>0.0938</td>
<td>[0.0549, 0.1327]</td>
<td>0.0000</td>
</tr>
<tr>
<td>DefinOfRec</td>
<td>indefinite%definite</td>
<td>0.0395</td>
<td>[0.0102, 0.0688]</td>
<td>0.0083</td>
</tr>
<tr>
<td>PronomOfRec</td>
<td>pronominal%nonpronominal</td>
<td>-0.1398</td>
<td>[-0.2171, -0.0624]</td>
<td>0.0004</td>
</tr>
<tr>
<td>AnimacyOfTheme</td>
<td>inanimate%animate</td>
<td>0.0843</td>
<td>[0.0337, 0.1348]</td>
<td>0.0011</td>
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<td>DefinOfTheme</td>
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<td>-0.0568</td>
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### Categorical Contextual Information Variables - PD, decrease

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</table>
integer valued contextual information variables
(using a working model)
surprising results

- e.g., linguists know that PD is preferred when the theme is pronominal:
  
  Anthony sent it to you. (PD)
  ?? Anthony sent you it. (DO)
surprising results

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- further illustrates that the parameter matching pronominality of theme in a logistic regression model is an awkward function of the law of data
Simpson’s paradox

“a trend appearing in different data groups may reverse once these groups are combined”
Simpson’s paradox

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numerical example: “all other things being equal, switching theme from definite to indefinite yields a 5% decrease of the probability of PD”

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<th>definite</th>
<th>indefinite</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD</td>
<td>63</td>
<td>378</td>
</tr>
<tr>
<td>DO</td>
<td>28</td>
<td>858</td>
</tr>
</tbody>
</table>

uncontextualized data

*ER*(P_n) = \( \frac{63}{63+28} - \frac{378}{378+858} \approx 38\% 

*Ψ*(P^n_*) \approx -5\% (significant difference)
when explanation is sought, prediction is only a means to an end

- the take-home message on the dative alternation cannot be provided in the form of a fitted prediction model
when explanation is sought, prediction is only a means to an end

- the take-home message on the dative alternation cannot be provided in the form of a fitted prediction model
- e.g.,
  - we observed a significant decrease of the probability of obtaining PD when, all other things being equal, the theme is switched from nonpronominal to pronominal
  - a crude measure of statistical association such as the excess risk would have indicated a significant increase
  - this is an illustration of Simpson’s paradox
what we did

what we provide instead is two-fold:

- we framed our account of the dative alternation in a causal model ≠ prediction model
- we investigated the effect of each available, contextual information variable on the choice of PD over DO, resulting in a table of estimates, confidence intervals, and p-values
our approach is based on causal inference, machine learning, and semi-parametric statistics

- we operationalized the effect of any given element of context on the dative alternation as a functional evaluated at the true, unknown law of the data
- we also showed how to estimate this effect in a targeted way, under the form of that functional evaluated at an empirical law built specifically to estimate the corresponding effect
future work

our method can be applied to case-studies involving contrasts or alternations, such as

- the choice of the predeterminer *vs.* preadjectival position of intensifiers (*e.g.*, *quite* and *rather*),
- the choice of one word over a near-synonym (*e.g.*, *almost/nearly*, *big/large*, *broad/wide*, *freedom/liberty*, . . . the sky is the limit)
thanks for your attention!


