Mixed categories and gradient grammatical constraints

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Question

How is speaker choice in a lexico-syntactic alternation influenced by the mixed-category status of one of its alternants?

Hypothesis

ENVIRONMENT PROTOTYPICALITY: ***Alternants are preferred in environments prototypical of their syntactic category/categories.***

Alternation

We investigate

needs to be done ~ ***needs doing***

in British English.

Both alternants are acceptable in many contexts:

The couch *needs to be cleaned* [the *to be* form]
The couch *needs cleaning* [the *ing* form]

This is not completely free variation:

You *need to be shown* the way
?You *need showing* the way

?We all *needed to be cooled* down after the debate
We all *needed cooling* down after the debate

But the awkward variants do occur:

Kewell *needs showing* the exit door.
-- posting on AC Milan v. Liverpool forum: http://forum2.mobile-review.com/archive/index.php/t-64777.html

This is a bug and the ubuntu/ethereal package *needs teaching* to use 'sudo' (user-password) instead of 'su'.
-- posting on Ubuntu forums: http://ubuntuforums.org/showthread.php?t=49563

Mixed Categories in the Alternation

- English gerunds are a mixed category (Malouf 2000:31) with both verbal nominal properties:
  - **Verbal:** gerunds can govern other NPs
  - **Verbal:** gerunds are modified by adverbs, not adjectives
  - **Nominal:** gerund phrases have NP-type external distributions
  - **Mixed:** optional subject can be accusative or genitive
- But the past participle has no nominal properties
- On our hypothesis, *needs doing* should be favored in more prototypically nominal environments
- *needs to be done* should be favored in more prototypically verbal environments

Semantic (Near) Equivalence

The ideal stochastic lexico-syntactic variable is not subject to categorical meaning-based constraints (see, e.g., Weiner and Labov 1983)

We investigated 4 possible categorical semantic constraints:
- Proposals 1-3, by Murphy (referenced in Murray, Frazer, & Simon 1996)
- Proposal 4, our own

Counter-examples to all these proposals occur in the BNC

➢ ***Categorical semantics do not drive the alternation***

Semantic-determination Proposals

Proposal 1: *to be* implies agent as possessor
John's car needs to be washed (⇒ John will wash my car)
John's car needs washing (⇏ John will wash my car)

But:

He said Prost would almost certainly be granted his super licence, but said *his behaviour in using "insulting terms" in his criticism of FISA would still need to be considered by the world council next month*. [BNC]

Agent = *the world council* ≠ possessor

Proposal 2: *ing* implies benefit to subject
My books need to be sold (⇒ Being sold benefits the books)
My books need selling (⇏ Being sold benefits the books)

But:

If the reservoir is holed then *the remote brake servo will not be working and needs removing*. [BNC]

The remote brake servo does not benefit from being removed

Proposal 3: *ing* implies pre-existing subject
My paper needs to be written
(*?) My paper needs writing

But:

I do not believe that the current management at British Rail is capable of building the project, although I believe that *it needs building*. [BNC]

Subject (*the project*) does not exist yet

Proposal 4: achievement and state verbs (Vendler 1957) require *to be*

Achievement (instantaneous event) and state verbs lack a progressive tense, so can you use the *-ing* alternant for these?

(*?) The form needs finding
(*?) The facts need facing

But:

39 *ing* achievements, 47 *to be* achievements
5 *ing* states, 28 *to be* states

Needs ~ as a stochastic variable

- Alternation not driven by identifiable semantic constraints
- A gradient/stochastic approach is thus reasonable
- We use *mixed-effects logistic regression* (Agresti 2002, Benor & Levy 2006, Bresnan et al., 2007, Jaeger 2008) as a modeling framework:
  - Categorical and continuous constraints both influence a probabilistic outcome
  - Constraint strength identifiable with coefficient magnitude
  - Constraints can "dominate" one another by having successively larger coefficients
  - "Ganging up" and other softer effects also possible

Dataset

- 1004 automatically extracted, hand-filtered and hand-annotated examples from the BNC.
- *Retrospectively sampled* (Agresti 2002) for balance: 502 examples of each alternant.

Potential sources of variation (*model predictors*)

reference levels in *italics*
significances:
* $p < .05$
** $p < .01$
*** $p < .001$

CATEGORICAL PREDICTORS
animacy (animate v. *inanimate*)
concreteness (concrete v. *abstract*) ***
definiteness (definite v. indefinite v. *unclear*) **
pronoun (pronominal v. *nonpronominal*)
relativization (relative clause v. *non-relativized*) ***
construction's tense (future v. past v. *present* v. other) ***
inflection of *need* (-ed v. *other*)
modality (spoken v. *written*)
aspect (state v. process v. extended event v. instant event v. *unclear*) ***
presence of negation ***
presence of modal
presence of conjoined material
presence of verb particle ***

QUANTITATIVE PREDICTORS
subject length (smoothed log; length in words)
verb length (in syllables) ***
verb frequency (smoothed log; from CELEX) ***

POST-VERBAL MATERIAL
post-verbal dependent length (smoothed log; length in words) ***
ambiguously-attached phrase length (smoothed log; length in words)***

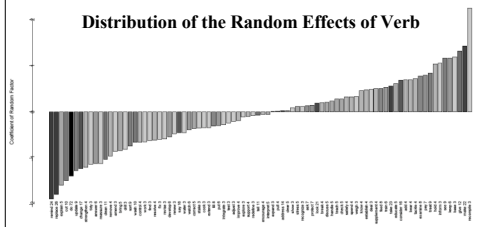
Sites needed to be monitored (post-verbal dependent) continuously (ambiguously attached phrase) in order to pick up fluctuations.

RANDOM EFFECT OF VERB
Each verb can have its own idiosyncratic preference for an alternant
➢ These preferences are assumed to be normally distributed

Model Results: verb-specific preferences

- Verbs vary considerably in their idiosyncratic preferences
  - Standard deviation of estimated random effects = 0.546
- Some common verbs, such as *do, remind,* and *replace*, have strong preferences

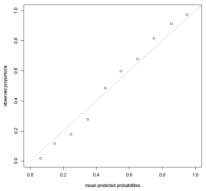
Distribution of the Random Effects of Verb



Plot of the estimated preferences for verb with 3+ attestations (darker bars = more attestations). Positive bars favor *to be*; negative bars favor *ing*.

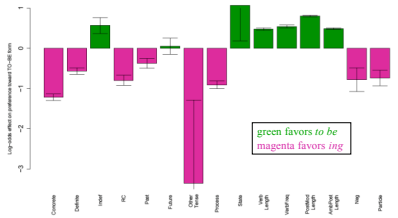
Model Results: Other (*fixed*) effects

Quantiles of Predicted & Observed Probabilities of *to be*



Probabilities predicted from a regression using only the significant factors.
- Regression model classifies 83% correctly (baseline = 50%)
- Predicted and observed probabilities tightly correlated (R^2=.99)

Significant Effects on Log-odds of *to be*



Plot of the estimated effects on the log-odds of *to be* for each factor. Quantitative predictors have been standardized.
- 14 significant predictors of the log-odds of *to be* alternant
- Each factor has an additive effect on the log-odds

Favoring *ing* alternant:
- concrete subject
- relative clause
- process verb
- verb particle
- definite subject
- past tense
- negation

Favoring *to be* alternant:
- indefinite subject
- increased verb length
- increased post-verbal material length
- state verb
- increased verb frequency

Structural Bias & environment prototypicality

- We quantify environment prototypicality *probabilistically*
  - Theoretically, we want the *structural bias*: $\frac{P(\text{Environment}|NP)}{P(\text{Environment}|VP)}$
  - In practice, we crudely approximate this with the first constituent C_1 following the *need*-selected verb: $\frac{P(C_1|NP)}{P(C_1|VP)}$
- High structural bias should favor the (nominal) *needs doing*
- **RESULT**: When added to the model, structural bias is of marginal significance (likelihood-ratio test: p=0.07)
  - ***BUT*** it is highly correlated (ρ=-0.91) with post-verbal dependent length
  - Significance of the latter drops dramatically (to p=.03)
- **Future work**: disentangle from dependent length with finer-grained measures of structural bias

Conclusions

- *needs to be done* ~ *needs doing* is, like the dative alternation (Bresnan et al., 2007) or *that*-omission (Jaeger, 2006), driven by gradient constraints, not catgeorical ones
- Speakers are aware of the gerund's mixed category status when composing a sentence and are influenced by environment prototypicality when choosing between mixed and single category forms