**Grammatical Factors in Morphological Processing: Evidence from Allomorphy**

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**Introduction:** Research into language processing often makes reference to two levels of analysis: the domain-general level characterised by quantitative-distributional factors ("subsymbolic" in Hay and Baayen 2005), and the domain-specific, grammatical level. Schools of thought differ in whether, and to what extent, the latter should be reduced to the former. Many studies of lexical processing have taken a strongly distributional view (Baayen et al, 2011), in which grammatical factors are given little explanatory power. Understanding which grammatical factors do play a role beyond distributional effects has thus received limited attention (Marantz, 2013). Here, we show how grammatical information, namely sensitivity of a stem to contextual allomorphy, can be integrated into a model of lexical processing, implying a role for both distributional and grammatical factors.

**Lexical processing:** Work on the processing of morphology has identified a range of factors influencing lexical recognition. Many of these are quantitative-distributional factors such as Frequency (Taft 1979) and Inflectional Entropy of a lemma (Moscoso Del Prado Martín et al, 2004), which are calculated over entire lexicons. Grammatical characteristics, such as (ir-)regularity, can be modeled as separate levels of representation in the mental lexicon (Crepaldi et al, 2010) or as points on a scale (Baayen and Moscoso del Prado Martín 2005, Fruchter et al 2013). Our study focuses on **allomorphy**, where a morpheme has distinct variants in distinct environments, such as the phonological or sentential context. English irregular verbs have allomorphs like *go~went~gone* which are (morpho)-**syntactically** conditioned, e.g. by tense. This kind of allomorphy also extents to certain nouns and adjectives (e.g. *good~better~best*). Conversely, allomorphy of the indefinite article (*a~an*) is **phonologically** conditioned: the first segment of the following word determines the shape of the allomorph. This type can also be seen in the realization of the plural suffix, *cat**s**~dog**s**~walrus**es*** (/ts/~/gz/~/səz/). Many other words show no allomorphy (e.g. *to*, *walking*, *happy*). The current study investigated how sensitivity to allomorphy, which is information that must be listed to different degrees along with each morpheme/lemma, influences lexical processing. We hypothesized the following cline, from least to most regular: **Syn**tactic < **Phono** < **None**.

**Methods:** A new variable coded for sensitivity to allomorphy among **stems**. It was introduced as ***HasAllos***. Trials from the BLP lexical decision dataset (N = 78; 700,000 items; Keuleers et al, 2012) were annotated for the most complex allomorphy type each item interacts with (Table 1). Mixed effects regression models were then fit to the full by-trial dataset with log-transformed Frequency, Orthographic Length, Orthographic Neighborhood, Inflectional Entropy and HasAllos as predictors. RTs and accuracy ratings were modeled (separately) as the dependent variables.

**Results:** Items with allomorphy were reacted to faster overall than None items, and Syn items were reacted to faster overall than Phono ($p < 0.001$, Table 2). Accuracy scores showed the same pattern ($p < 0.001$, Table 3). Table 4 provides the regression results for RTs, revealing facilitatory effects for both levels of HasAllos (contrast coded); Accuracy patterned identically.

**Discussion:** These findings indicate that not all information relevant to processing is distributional. In particular, the main result is unexpected on a purely distributional view: the *less* productive a process is (Syn < Phono < None), the *more* a given word receives a "boost" in lexical recognition, perhaps in order to facilitate lookup in the mental lexicon. Such a finding stands in contrast to views under which the amount of information associated with a word is inhibitory, as measured by RT and accuracy on lexical decision tasks (e.g. Milín et al., 2009). Further investigation of allomorphic variables is needed, particularly in terms of their interaction

with other factors (Baayen and Moscoso del Prado Martín, 2005; Fruchter, 2013), replication in other languages, and an explicit model of irregular form lookup in the mental lexicon.

**Tables:**

Table 1: English Examples

| **item** | *and* | *walking* | *go* | *went* | *dog* | *dogs* |
|---|---|---|---|---|---|---|
| **HasAllos** | none | none | syn | none | phono | none |

Table 2: Reaction Times (in ms)

| $M_{NONE}$ | $M_{PHONO}$ | $M_{SYN}$ |
|---|---|---|
| 639.5 | 624.5 | 556.2 |

Table 3: Accuracy Scores

| $M_{NONE}$ | $M_{PHONO}$ | $M_{SYN}$ |
|---|---|---|
| 0.921 | 0.926 | 0.972 |

Table 4: Regression Results for normalized RT

| | **Estimate** | **(SE)** | ***p*-value** |
|---|---|---|---|
| **Intercept** | 0.272 | 0.0041 | <0.001 ** |
| **Frequency** | -0.123 | 0.0002 | <0.001 ** |
| **Orthographic length** | 0.025 | 0.0003 | <0.001 ** |
| **Orthographic neighborhood** | -0.003 | 0.0001 | <0.001 ** |
| **Inflectional Entropy** | -0.086 | 0.0007 | <0.001 ** |
| **HasAllos - phono VS none** | -0.039 | 0.0008 | <0.001 ** |
| **HasAllos - syn VS phono** | -0.022 | 0.0002 | <0.001 ** |

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