Dealing with noise across participants, items, and experiments: The case of non-native morphological processing

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It has long been observed that there are striking differences between first language acquisition and the learning of subsequent languages later in life. Given appropriate exposure, acquisition of a first language (L1) is guaranteed and similar across individuals. In contrast, later acquisition of a second language (L2) rarely yields native-like outcomes and displays substantial inter-individual variability (Bialystok & Hakuta, 1999).

From a psycholinguistic perspective, such contrasts have fuelled a debate on whether the representation and processing of a non-native language relies on similar mechanisms to those employed by native speakers. One view is that L1–L2 differences (if they exist) can be attributed to factors such as speed of processing, or demands on general cognitive resources (e.g., Hopp, 2010; McDonald, 2006). Another view holds that non-native processing is fundamentally different, at least in specific linguistic domains to do with grammatical computation, as opposed to lexico-semantic representations (e.g., Clahsen & Felser, 2006; Neville et al., 1998; Ullman, 2005).

The investigation of morphologically complex words has played an important role in this debate, because a linguistic distinction can be made between two morphological operations that are otherwise very similar, but crucially differ in whether their products are lexical or grammatical: derivation (e.g., *hunt–hunter*) leads to the formation of new lexical entries, while inflection (e.g., *hunt–hunted*) expresses grammatical features by mapping them to specific forms.

Most studies have made use of priming paradigms, in which facilitation elicited by complex forms (e.g., *hunter* priming *hunt*) is interpreted as an indication of decomposition into morphological constituents (a robust and prevalent finding in L1 research, e.g., Rastle, Davis, Marslen-Wilson, & Tyler, 2000). However, previous morphological priming studies with L2 speakers have produced conflicting results and their interpretation is controversial. Derived forms have generally been found to efficiently prime their bases (e.g. Diependaele, Duñabeitia, Morris, & Keuleers, 2011; Silva & Clahsen, 2008), but that has not always been the case (Clahsen & Neubauer, 2010). Inflected forms have been reported to generate robust priming in some studies (e.g., Voga, Anastassiadis-Syméonidis, & Giraudo, 2014), while others found no priming – or even (numerical) inhibition (e.g., Neubauer & Clahsen, 2009; Pliatsikas, Johnstone, & Marinis, 2014).

We attribute the discrepancies in previous results to the presence of noise across participants, items, and experiments. High variability across participants is common in psycholinguistic experimentation, but especially so across bilinguals. Such heterogeneity is a hallmark of non-native acquisition and participants usually differ on many dimensions that can play important roles (e.g.,
age of acquisition, exposure, frequency of use). High variability across items is also a common problem, because many specific properties of words (e.g., frequency, orthographic neighbourhood) are known to modulate priming effects (e.g. Davis & Lupker, 2006). Finally, high variability across experiments is to be expected given the relatively small sample sizes that are typically used in psycholinguistics. All of these sources of variability lead to a large reduction in statistical power and the researchers' ability to make inferences is therefore severely limited.

In this talk, we will present solutions to these three sources of variability. In a first study (Jacob, Heyer, & Veríssimo, under review), conducted with 40 native and 36 non-native speakers of German, we eliminated inter-item variability by comparing lexical decision times on the same target word, which was preceded by a masked presentation of a related inflected or derived form. The results showed strong derivational priming in both the L1 and the L2 group, but smaller (and non-significant) inflectional priming in the L2 group only.

In a second study employing the same design (Veríssimo, Heyer, Jacob, & Clahsen, submitted), we assessed the role of by-participant variables by testing a large sample (n=91) of Turkish-German bilinguals, who had learned German at a range of different ages (0-38 years). Priming from derived forms was found to be unaffected by age of acquisition. Inflectional priming was present only for those participants who had acquired German before age 6, and sharply declined with increasing ages of acquisition. Measures of proficiency, exposure and daily use were not predictors of priming effects.

A third study was a meta-analysis of morphological (masked) priming studies with L2 speakers (Veríssimo, Heyer, & Patterson, in prep.), in which we aggregated the discrepant effects into precise average estimates of facilitation, and assessed which task and linguistic factors modulated these effects. The results showed an L2 morphological priming effect of $g=0.31[0.20, 0.42]$, that was nevertheless modulated by whether priming is inflectional or derivational. More specifically, both inflected and derived primes elicited facilitation, but while derivational priming was of moderate size ($g=0.49[0.33, 0.66]$), inflectional priming was small ($g=0.15[0.00, 0.31]$). Further analyses revealed a significant difference between studies employing long and short prime durations, such that inflectional priming is only present at longer presentations.

The combined results of our three studies reveal a clear signal against the background of experimental noise: they indicate that L2 morphological processing is native-like only for lexical-based derivation, but that the decomposition of inflectional exponents is severely compromised in L2 speakers. We propose that while the acquisition of derivational rules is operational throughout the lifespan, acquiring inflectional rules is progressively difficult after early childhood, which leads to increased storage of inflected forms.
References


