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Commentary on Branigan and Pickering:
If priming is graded rather than all-or-none, can reactivating abstract structures be the underlying mechanism?

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B and P work within a framework that posits discrete linguistic units at various levels of granularity that must be operated upon by combinatorial mechanisms and rules (i.e., decomposition/recomposition). They argue that structural priming provides a powerful tool to study abstract, structural representations. We provide evidence that priming effects in production are better characterized as graded than as all-or-none and that priming need not arise from a mechanism that (re)activates a shared but abstract internal structure.

B and P work within a framework that posits discrete linguistic units at various levels of granularity that must be operated upon by combinatorial mechanisms and rules (i.e., decomposition/recomposition). They argue that structural priming provides a powerful tool to study abstract, structural representations. However, there are alternatives that better embrace the broader communicative function of language (Baayen, Shaoul, Willits & Ramscar, 2016; Baayen, Milin, & Ramscar, 2016). However, even within their framework, the experimental priming methodology that B and P depend on for their argument is more nuanced than what they have explored with choice between two syntactic structure as their measure of behavior. They assert that abstract structural processes can be studied independently from the contributions of individual words because priming arises even when words do not reappear. However often, priming effects are not all-or-none and effect sizes depend on what recurs. Thus systematically graded priming outcomes challenge the descriptive adequacy of B and P's theorizing about how lexical and syntactic knowledge interact. In contrast to B and P, we assert that priming effects in production are more informative when characterized as graded than as all-or-none and that priming need not arise from a mechanism that (re)activates a shared but abstract internal structure. We present examples from our own work that show systematic variation among the "structures" that generate priming, eschew a division between representation and process and exploit rather than tolerate differences among words.

In a single word inflected production task, the verb stem constitutes the structure that recurs and the requisite production, an inflected verb form, is specified by instruction rather than by a sentence context. Admittedly, this version of structural priming is severely constrained. Nonetheless, we have demonstrated that reaction time (RT) differences between regular *ed* and *ing* productions differ significantly

more when primed by a written stem than by a drawing of the action depicted by the stem (Feldman, Milin & Baayen, 2013a,b). These prime modality (drawing, word) differences impact the magnitude of priming rather than its presence or absence. Relative differences such as these constrain the abstractness of lemma representations and impose limitations on the independence of structural priming from lexical contributions.

In addition, differences in production times between verbs with high and low lemma frequency are larger when generating progressive (*ing*) than past tense (*ed*) inflected forms of regular verbs. These reliable differences (RT, accuracy) between various inflected word forms of the same verbs pose a challenge to an account based only on binding between a constituent structure rule and a lexical representation without reference to "features like tense, number or aspect".

Admittedly we confine structural priming to inflected word forms rather than sentential syntax but we emphasize that this is a useful tradeoff in that the task generates RT as well as accuracy data and having both eliminates some of the challenges that typically arise with the dichotomous data generated by the classical structural choice priming task. At a minimum, graded priming effects across variants of the structural priming methodology highlight the potential interdependence between lexical contributions and syntactic processing and challenge the descriptive adequacy of the B and P account of structural priming.

When verbs recur in prime and target structures, there is a benefit to production termed a *lexical boost* (Cleland & Pickering, 2003). The existence of the lexical boost argues against a purely structural account of priming in which lexical information fails to make contact with the central syntactic component. Nonetheless, B and P's structural priming account fails to anticipate graded, systematic lexical contributions due to differences among words.

In addition to manipulating degree of lexical specification (drawing, word) while matching output at production, we examined inflectional regularity. We observed that lower accuracy for irregularly than for regularly inflected past tense forms arises when generating a past tense inflection from a verb stem but not from a drawing of the same action. Here, negative priming between input and output structures is possible when lexical information is specified orthographically but not by a drawing. Interactions of prime modality with regularity such that a regularity effect manifests itself with productions from the written stem but not from a drawing of that same action challenge the claim that the lexical boost in production derives simply from repetition of a particular lemma (e.g., *dive*) that is unspecified for shared features such as tense, number, or aspect (Pickering & Branigan, 1998). Productions that share a lemma and convey the same action but prime differently depending on the availability of the stem, set limits on the abstractness of the "representations" that purportedly produce structural priming.

Absent from the B and P account of structural priming, even when enhanced by lexical boost, is an appreciation of the communicative function of language and the

requisite system's priority for reducing uncertainty and exploiting typicality (c.f., Ramscar, Dye & McCauley 2013). Elsewhere we have argued for the benefits of discrimination-based predictors in priming over more conventional lexical-distributional predictors (Milin, Feldman, Ramscar, Hendrix & Baayen, 2017). Key is that priming reflects not only the "similarities" between prime and target but also the similarities of the prime and the target to other words. Surely an appreciation of systematic differences in the probability distributions of the various alternatives deserves consideration such that all structural matches are not equivalent. Similarly, anticipating variation with respect to particular lexical entries and the syntactic relations in which they potentially participate by introducing prime and target items as random effects in analysis enriches insights into any variant of priming (Milin et al., 2017).

While structural priming may provide a useful method of investigating linguistic knowledge with significant benefits over acceptability judgments, the nuances of stem- as distinguished from drawing-based priming effects as well as a more functional characterization of syntactic patterning leads us to question whether the structural priming effect that B and P endorse is best characterized in terms of (re)activation of purely abstract syntactic representations.

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