

2010; Novick et al. 2003). Importantly, such choices may be influenced by syntactic information that *prima facie* should be irrelevant to the syntactic alternation under consideration (Wasow et al. 2011). Furthermore, words—even syntactically impoverished bare nouns—are never processed in isolation from the entirety of their syntactic distributional information, and may prime each other via such distributions (Lester & Moscoso del Prado Martín 2016; Lester et al. 2017).

B&P survey clear evidence of priming among words, syntactic structures, and semantic structures. They also explain how simultaneous overlap between any two of these levels results in increased priming (the so-called boosts). One can account for these findings in two ways: (1) relationships among syntax, semantics, and lexicon are captured by additional interfaces whose only job is to combine information from separate modules (e.g., Jackendoff 2013); or (2) the relationships constitute connection weights between words and structures, which are directly related in memory (Diessel 2015). B&P appear to prefer the first option. However, short of undisputed neuropsychological evidence for the separation between these representational levels (which is not known to us), there is no way of distinguishing among three separated levels with connections between them, and a single level of representation with different degrees of overlap. Considering that priming effects are very similar in the three levels, and that overlap among them interacts, it seems more parsimonious to assume a single layer of representation, rather than positing three such encapsulated layers plus interconnections.

B&P's arguments rely on binary choices (such as PO/DO). However, it is unlikely that these choices could benefit from structural overlap in phrasal constituents; the critical variable depends only on where those phrases are placed. If there is no additional reason to adjust structures to accommodate the accessibility of sub-clausal units, then why would one? Whether there may be a task-driven confound remains a question for further study. However, notice that chronometric studies show that the locus of priming may not always be the clause, even when clause-structural overlap is present (Smith & Wheeldon 2001). Further, more comprehensive models of linguistic reproduction exist, which make distinctions beyond simple identity priming. Consider Dialogic Syntax (Du Bois 2014; Du Bois et al. 2014), which distinguishes among framing resonance, the locus of syntactic priming, and focal resonance, the aligning of meanings within syntactic alignment.

We emphasize that we are not advocating the position that syntactic priming is reducible to lexical, semantic, or pragmatic effects. To truly understand linguistic representation on the basis of processing, we must consider all possible sources of information from processing across all levels that are brought to bear on language use, including data from both experimental and observed contexts. This trend is already well underway in several major branches of linguistics. B&P's bold proposal to establish “a new basis for understanding the nature of language” stands to benefit from a full partnership with researchers drawing on a broad range of evidence to account for a system that dynamically responds to linguistic, cognitive, and interactional contexts.

Abstract: Structural priming is poorly understood and cannot inform accounts of grammar for two reasons. First, those who view performance as grammar + processing will always be able to attribute psycholinguistic data to processing rather than grammar. Second, structural priming may be simply an example of hysteresis effects in general action planning. If so, then priming offers no special insight into grammar.

Branigan & Pickering (B&P) argue that structural priming methods have “reached maturity” (target article, para. 2) to the point that they can inform not only language production and comprehension processes, but also the nature of grammar, as typically studied by linguists using different analytical tools and methods. This view appears overly optimistic; structural priming remains widely used but poorly understood, with little consensus about why the effect is observed or exactly what production and comprehension processes are promoted from prior exposure to a sentence. Moreover, the larger class of priming methods, to which B&P link structural priming, has been the target of extensive criticism and reassessment of what can be gleaned from the tasks (Cesario 2014). Here, we consider two perspectives on the nature of structural priming and their consequences for B&P's claims for grammar.

One perspective is that structural persistence is a strongly syntactic phenomenon: Encountering/producing a sentence somehow biases the language processing system to expect or produce a similar syntactic structure. B&P's logic is that, because the processing system draws on the grammar, patterns of priming must reveal the nature of the grammar. This thinking raises the classic issues of the competence-performance distinction. If language use is grammar + processing, there is a credit assignment problem for psycholinguistic data: Any linguistic behavior might reflect the grammar, processing mechanisms, or some combination. B&P make exactly this criticism of other psycholinguistic methods—for example, that Franck et al.'s (2010) studies of subject-verb agreement production might illuminate the nature of the grammar, or alternatively they might reflect production or comprehension processes and be uninformative about grammar. Crucially, this assignment problem applies equally to priming. Haskell et al. (2010) used priming to study agreement production and found that subject-verb agreement is sensitive to the statistical patterns in prior usage (the primes). These results could support a graded grammar in which statistical patterns shape grammatical representations (Bybee 2006). Researchers rejecting this approach, however, could instead attribute these priming data to processing, leaving the grammar untouched by the statistics of usage. Thus, given B&P's assumption of usage=grammar + processing, structural priming is just as much subject to interpretive uncertainty as any other measure.

Even more interpretive uncertainty arises from an alternative view of structural priming—that it is not strictly syntactic but rather a language example of a more general tendency to repeat prior actions. Cognitive models of motor planning suggest these reuse effects (termed *hysteresis effects*) arise because it is easier to recall a previously executed motor sequence than to generate alternative plans *de novo* (Rosenbaum et al. 2006). Our own research investigates the link between structural priming and domain-general plan reuse, and we have developed parallel tasks that yield reliable structural priming for dative sentence structures and priming of nonlinguistic manual actions in the same participants (Koranda et al. 2016). We also observed a parallel effect of priming strength in both domains: Preferred sentences and movements are more easily primed than unpreferred ones, a phenomenon previously observed in structural priming (Bock 1986). These findings raise the possibility that plan reuse may be a domain-general property of action planning. MacDonald (2013) suggested that a general plan reuse bias would ground patterns of language use in basic planning mechanisms, and the existence of a general plan reuse bias may also explain why some nonlinguistic motor sequences such as stacking blocks appear to prime sentence structure choices in language

Structural priming, action planning, and grammar

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Maryellen C. MacDonald^a and Daniel J. Weiss^b

^aDepartment of Psychology, University of Wisconsin–Madison, Madison, WI 53705; ^bDepartment of Psychology, The Pennsylvania State University, University Park, PA 16802.

mcmacdonald@wisc.edu djw21@psu.edu

<http://lcnl.wisc.edu/index.php/people/maryellen-c-macdonald/>

<http://psych.la.psu.edu/directory/djw21>

production or comprehension (Allen et al. 2010; Kaiser 2012). On this domain-general view, sequences in one type of action may potentiate an analogous sequence in another domain under certain task demands (Van de Cavey & Hartsuiker 2016). Clearly, the space of such domain-general priming effects is currently poorly understood, but if structural priming proves to be emergent from broader components of action planning, then there is little reason to expect that the phenomenon offers privileged insight into grammar.

Further investigation of the domain specificity versus generality of plan reuse will therefore be critical for gaining insight not only into priming as a tool, but also into the forces that shape implicit action choices, including, but not limited to, choices of syntactic structure. The mechanisms supporting plan reuse are likely to be highly conserved across domains and species, given that nonhuman primates exhibit homologous hysteresis effects (see Weiss & Wark 2009). A signature characteristic of hysteresis is asymmetry, such that a transition point between implicit action choices varies with prior history. For example, in studies in which reaching targets shift gradually clockwise or counterclockwise across trials, both human children and tamarin monkeys transition from left- to right-hand use at different points depending on past targets (Rostoft et al. 2002; Weiss & Wark 2009). Our ongoing work investigates whether similar perseverative asymmetries are found in both motor and language production tasks with gradual changes in parameters that promote one versus another hand/syntactic choice. If so, these findings would suggest that structural priming is a subcategory of a broader cognitive heuristic. A related opportunity to study the domain-general versus specific nature of planning is the investigation of individual differences in plan reuse across domains. For example, working memory tasks are a classic locus of individual differences in cognitive performance, and both spatial and verbal working memory loads appear to interact with hysteresis effects in motor planning (Spiegel et al. 2013). Such interactions are most consistent with a domain-general planning system, and individual differences in these interactions should further constrain theoretical accounts and also inform our understanding of priming. Indeed, individual differences in structural priming (Kaschak et al. 2011a; Kidd 2012) seem inconsistent with B&P's claims that priming reveals grammar, which is conceived as an abstract representation with only trivial variation across a language community. As we learn more about priming, we suspect that the lessons for grammar will not be the ones B&P promote but instead will suggest that the nature of domain-general action planning has an important role in patterns of syntactic structures in language use.

Structural priming is most useful when the conclusions are statistically robust

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Kyle Mahowald,^a Ariel James,^b Richard Futrell,^a and Edward Gibson^a

^aDepartment of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139; ^bPsychology Department, University of Illinois at Urbana-Champaign, Champaign, IL 61820.

kmahowald@gmail.com anjames2@illinois.edu futrell@mit.edu
egibson@mit.edu

Abstract: Branigan & Pickering (B&P) claim that the success of structural priming as a method should “end the current reliance on acceptability judgments.” Structural priming is an interesting and useful phenomenon, but we are dubious that the effect is powerful enough to test many detailed claims about specific points of syntactic theory.

Branigan & Pickering (B&P) claim that the success of structural priming as a method should “end the current reliance on

acceptability judgments.” The basis of such a claim rests on the premise that, not only is structural priming a robust psychological phenomenon, but also can be used to adjudicate between finer points of syntactic theory. While we agree that structural priming is an interesting and useful phenomenon, we have reservations as to whether there is sufficient statistical evidence to support all of the detailed claims made about specific points of syntactic theory.

For example, as a case study of what they call the “clearest example,” B&P discuss what priming studies tell us about passive constructions and, specifically, how priming studies push back against the standard generative grammar accounts of passives. The details of this argument rely on priming studies that go beyond asking whether Structure X in a prime sentence leads to an increased likelihood of a participant producing Structure X in a target sentence. Rather, it relies on evidence that locatives prime passives (Bock & Lobell 1990), that unergatives prime unaccusatives (Flett 2006), and that POs and DOs prime light verbs (Wittenberg 2014). Often, there is only one paper that investigates a particular research question, and B&P typically accept the results of that paper as delivering a statistically valid conclusion about the phenomenon in question.

In a meta-analysis in Mahowald et al. (2016b), we give evidence that structural priming is a robust and well-replicated phenomenon, but caution that studies of the type that B&P rely on for some of their conclusions (specifically, studies that ask whether some priming effects are greater than others or whether certain factors, such as age or L2 status, moderate priming effects) are statistically underpowered (with an average power of 53%, as determined by a p-curve analysis) and often do not use enough participants to warrant the conclusions drawn. Indeed, in studies of this sort, we recommend using several hundred participants – which almost no existing priming studies do.

While this is not evidence that the conclusions drawn in any one study that B&P referenced are misleading, we should be cautious not to assume that every individual study can be used as a building block in a larger syntactic theory. Rather, we should expect some studies to reach statistically significant conclusions (or fail to reach statistically significant conclusions) based on chance alone – and not just because of the experimental manipulation. This is of particular concern when there is only one unreplicated study on a particular phenomenon.

Of course, none of this is to say that structural priming should not be used alongside and sometimes instead of acceptability judgments (which have their own host of pitfalls). In the often messy world of empirical science, the availability of diverse, orthogonal methods that explore the same research question using different techniques is a feature, not a bug. So, insofar as B&P argue against the hegemony of one particular technique (acceptability judgments) in linguistics research, we agree. Insofar as they argue for the hegemony of a different technique (priming), we urge a healthy skepticism.

Priming methods in semantics and pragmatics

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Mora Maldonado,^{a,b} Benjamin Spector,^a and Emmanuel Chemla^b

^aInstitut Jean Nicod, Département d'Études Cognitives, École Normale Supérieure, PSL Research University, CNRS, EHESS, 75005 Paris, France;

^bLaboratoire de Sciences Cognitives et Psycholinguistique, Département d'Études Cognitives, École Normale Supérieure, PSL Research University, CNRS, EHESS, 75005 Paris, France.

mora.maldonado@ens.fr benjamin.spector@ens.fr
chemla@ens.fr
<http://mmaldonado.psycholinguae.fr/>
<https://sites.google.com/site/bspectorpage/>
<http://www.emmanuel.chemla.free.fr/>