

effects are usually small to moderate, and for adequately powered designs, many items and/or participants are needed. This limits the usefulness of the paradigm for studies involving children and patients. Moreover, for secure interpretation of SP effects, many conceptual and linguistic variables (frequencies of words and word combinations, plausibility, etc.) must be taken into account; for production experiments, suitable ways of reliably eliciting the target utterances must be found.

Of course, similar considerations hold for other paradigms. One issue, however, pertains specifically to SP – in particular, to the canonical variant of the paradigm in which the speakers' choices of grammatical structures are recorded. As the authors discuss, the design of SP experiments requires the existence of pairs of roughly equivalent structures (e.g., active and passive) for participants to choose between. Therefore, it is challenging to use SP in research on properties of grammatical representations, such as subject-verb agreement or fixed word order (e.g., in English polar questions), for which no alternatives exist in the language. Thus, the authors' statement that "priming can be used similarly to investigate the representation of any aspect of linguistic structure" (sect. 1.4, para. 4) seems overly optimistic.

I am also not convinced that, as B&P propose in section 1.4 of the target paper, "priming effects arguably implicate a direct relationship between representation and behavior" (sect. 1.4, para 2; see also sect. 1.5, para. 1: "It [structural priming] provides evidence that is directly informative about mental representations"). They propose that comprehension-to-production priming reflects on shared representations rather than processing components specific to production or comprehension; they also argue that SP effects differ from judgements, chronometric, or neurobiological data collected in other paradigms by being uncontaminated by processing influences: "It is hard to see how the explanation of priming could depend on processing assumptions" (sect. 1.4, para. 9). The authors acknowledge that priming may occur for reasons other than similarity of representations, but they believe that such effects should be easy to identify through careful experimentation.

It is not clear to me why comprehension-to-production priming necessarily reflects on shared representations rather than shared processes, and why the authors believe that it is easy to separate effects of the similarity of representations from other causes of priming. They point out that priming effects occur "without awareness or explicit recall of the prime stimulus and are generally believed to be automatic and resource free" (sect. 1.4, para. 2). However, processes that occur without awareness and that are largely automatic are still processes. Most important, these processes change the speaker's language use: After presentation of a prime, the primed structure is more readily available than it was before. Thus, SP effects do not only reflect on the degree of similarity between linguistic representations or processes, but also on their malleability. This is why SP often is seen as a form of implicit learning (e.g. Bock & Griffin 2000; Chang et al. 2006).

In addition to changing the availability of known structural alternatives, SP can introduce new constructions into a person's repertoire. For instance, in a reading study, Fraundorf and Jaeger (2016) showed priming for sentences such as *The car needs cleaned*, which featured a structure (*need* + past participle) that was not part of the participants' dialect. This effect generalized to structurally similar sentences featuring *will* + past participle, as in *The copier will recycled*. Interestingly, facilitation for *will* sentences after exposure to *need* sentences occurred only in participants who were not familiar with the *need* + past participle construction before the experiment but not in participants whose dialect permitted this construction. Fraundorf and Jaeger speculated that this pattern arose because only the former group expected encountering unfamiliar structures. Whatever the merits of this specific account, the results illustrate, first, that SP can alter a person's linguistic repertoire, and, second, that such changes are subject to multiple influences, including the person's expectations about the utterances likely to occur in the current context. This latter conclusion is supported

by several other recent studies (e.g., Myslin & Levy 2016). Fraundorf and Jaeger reported a comprehension study. Maybe speakers' choices in production experiments are less readily affected by other variables than prime-target similarity. It seems highly unlikely, however, that they are entirely impervious to such influences, or, as B&P suggest, that it is trivial to separate them from structural similarity effects.

In sum, the claim that SP offers an unobstructed route to linguistic representations seems incorrect to me. SP shows how grammatical choices change with experience. Choices are behaviour, and like any other type of complex behaviour, they are based on stored knowledge and cognitive processes using this knowledge. The authors note that acceptability judgements suffer from "source ambiguity" – uncertainty about the origins of observed effects. Exactly the same holds for SP and, in fact, any other psycholinguistic

The syntax of priming

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Abstract: Priming reflects the reactivation of processing routines that map strings of words onto semantic representations (and vice versa) without the mediation of syntactic structure, including the "flat structure" that Branigan & Pickering (B&P) propose. Key evidence for this claim comes from the possibility of priming relations involving subject-verb sequences, which are not syntactic constituents.

Language provides a way to map meaning onto form and vice versa. We know, from direct observation, that the form side of the mapping consists of a string of words, inflected in some languages and bare in others, arranged in a particular order. And we know, from inference, that the meaning side includes at its core a representation of a predicate and its argument(s), along with ways to express information-related contrasts and scopal relations.

We do not know how form and meaning are related to each other. It is generally assumed that the relationship is mediated by a syntactic representation that organizes words into ever-larger hierarchically organized constituents. Drawing on the hypothesis that priming is sensitive to constituent structure, Branigan & Pickering (B&P) argue for a comparatively flat syntactic structure, as illustrated in Figure 1.

Another idea, common in work on cognitive science, proposes a direct mapping between strings of words and semantic representations, mediated by processing operations that make no reference to traditional syntactic structure (e.g., O'Grady 2015). On this view, a sentence such as *Andy reads books to children* is mapped onto a semantic representation by the processing operations paraphrased in (1).

- (1) *Andy reads books to children.*
- a. *Andy* is identified as the first argument of the predicate *read*: (a = Andy)
 READ
 <a...>
 - b. *books* is identified as the second argument of *read* (b = books)
 READ
 <a b...>
 - c. *children* is identified as the third argument of *read* (c = children)
 READ
 <a b c>

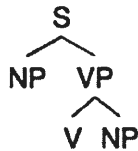


Figure 1 (O’Grady). Flat syntactic structure.

In this approach, priming is the product of processing: The activation of the three operations in (1) favors their reactivation, in the same order, at the next opportunity – the classic priming effect.

One way to tease apart the two views of priming is to focus on VP constituents, whose existence is posited by the flat-structure theory (see Fig. 1) but not by the direct-mapping theory, which eschews syntactic structure. A constituent-based account of priming such as B&P’s makes two predictions: (1) constituents (such as VP) should trigger priming effects; and (2) non-constituents should not. I will focus here on the latter prediction, with special attention to the subject–verb relation.

Because subjects and verbs do not form a constituent, B&P’s theory predicts an absence of priming effects for this relation. In contrast, the direct mapping view predicts that there could and should be priming effects of this type, because there is a processing operation that associates a clause’s first argument with the verb (see [1a]). To my knowledge, there have been no specific tests of this claim, but several candidate phenomena come to mind, of which I will mention four here.

First, it is well known that certain items manifest variation in the type of agreement they trigger in the verb. *Neither* is one such word (for a discussion of a similar effect with certain collectives, such as *couple*, see Bock et al. 2007).

- (2) a. *Neither* is satisfactory.
- b. *Neither* are satisfactory.

If the choice of number agreement (*is* versus *are*) in these patterns could be primed by the choice made in a previous pattern with a similar type of subject, we would have prima facie evidence of priming by a subject-verb combination, contra the constituent-based theory.

A second candidate phenomenon occurs in languages that allow partial agreement with a coordinate NP subject. As illustrated in (3), verbs in Tsez can agree either with a full coordinate NP, yielding a plural form, or with just the nearest conjunct, giving a singular form. (Tsez is a Nakh-Dagestanian language spoken in the NE Caucasus; the data below are from Polinsky [2009]; ABS = absolutive, PL = plural, PST = past, M = masculine, SG = singular.)

- (3) a. Full agreement with the subject:
 kid-no uži-n b-ik’-s.
 girl-ABS boy-AND PL-go-PST
 The girl and the boy went.
- b. Partial agreement with the subject’s second conjunct:
 kid-no uži-n Ø-ik’-s.
 girl-ABS boy-AND M,SG-go-PST
 The girl and the boy went.

Here again, evidence that either pattern of subject-verb agreement triggers a priming effect would create a challenge for a constituent-based theory but not for a theory based on processing operations and direct mapping.

A third phenomenon of interest involves optional subject marking, which is especially common in ergative languages. The following example is from the Tibeto-Burman language Mongsen Ao (McGregor 2009, p. 496). (ERG = ergative, DET = determiner, PRS = present, DECL = declarative)

- (4) *a-hən (nə) a-tʃak tʃaʔ-əʔ-ɹ-ùʔ*
 DET-chicken ERG DET-paddy eat-PRS-DECL
 The chickens are eating paddy.

Because ergative case marks a relationship between a subject and a transitive verb, its primability would further challenge either the existence of VPs, or the viability of the view that priming faithfully reflects constituent structure, or both.

Finally, given possible independent restrictions on certain types of inflectionally triggered structural priming (Santesteban et al. 2015), it is important to consider subject-verb relationships that do not involve this phenomenon. The scopal ambiguity illustrated in (5) is a case in point.

- (5) *Everyone didn’t finish the project.*

This sentence permits two interpretations: *Not everyone finished*, with wide scope for the negative, and *No one finished*, with wide scope for the universal quantifier. Viau et al. (2010) showed that children’s access to the first interpretation increases significantly when primed by exposure to similar sentences in contexts that support the *not every* reading. Although B&P suggest that scopal relations are represented at a special level of semantic structure, the fact they can be primed by a subject–verb combination creates a potential problem for the constituent-based account.

Priming is important in its own right and as a window into the workings of language. In the best case, it may even provide insights into the nature of syntactic representations. Crucially, however, those insights may well point to a type of sentential architecture quite different both from the widely held view and from B&P’s proposal.

Structural priming is a useful but imperfect technique for studying all linguistic representations, including those of pragmatics

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Abstract: Structural priming is a useful tool for investigating linguistics representations. We argue that structural priming can be extended to the investigation of pragmatic representations such as Gricean enrichments. That is not to say priming is without its limitations, however. Interpreting a failure to observe priming may not be as simple as Branigan & Pickering (B&P) imply.

We agree with Branigan & Pickering’s (B&P’s) central thesis: Structural priming is a good methodological candidate for investigating linguistic representations. Structural priming, however, can be used to investigate representations used in pragmatics, as well as in semantics and syntax.

Bott and Chemla (2016) and Rees and Bott (2015; 2016) find that scalar implicatures – the prototypical pragmatic enrichment can be primed. For example, Bott and Chemla showed that sentences with enriched interpretations of *some* (*some à some but not all*) prime higher rates of enrichment in subsequent target sentences than sentences with basic *some* (where *some* takes its literal meaning, i.e., *some and possibly all*). These results suggest that another layer of representation could be added to Figure 1 in B&P, with corresponding links to the lexicon. The representations involved would be at the sentence level (S & not[S’]), where S refers to the basic, unenriched sentence, and S’ to the informationally stronger sentence (a sentence involving a stronger expression, e.g., *all* in the case of *some*). Evidence that such a representation was independent of lexical material was given by the demonstration that sentences with implicatures associated with one expression, for example, *some*, could prime implicatures associated with another – for example, the numbers (from at least N to