

# Syntactic priming persists while the lexical boost decays: Evidence from written and spoken dialogue <sup>☆</sup>

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## Abstract

Four experiments in written and spoken dialogue tested the predictions of two distinct accounts of syntactic encoding in sentence production: a lexicalist, residual activation account and an implicit-learning account. Experiments 1 and 2 showed syntactic priming (i.e., the tendency to reuse the syntactic structure of a prime sentence in the production of a target sentence) and a lexical boost of syntactic priming (i.e., an enhanced priming effect when the verb in prime and target was the same). Experiments 3 and 4 varied the number of filler sentences between prime and target (lag) and showed that lexical enhancement of priming is short-lived, whereas the priming effect is much more long-lived. These results did not depend on whether the modality of prime and target was written or spoken. The persistence of priming supports the view that syntactic priming is a form of implicit learning. However, only a multi-factorial account, in which lexically-based, short-term mechanisms operate in tandem with abstract, longer-term learning mechanisms can explain the full pattern of results.

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Speakers tend to repeat themselves and each other. Among other things, they repeat words (Brennan & Clark, 1996), description schemes for spatial locations (Garrod & Anderson, 1987), and syntactic structure (Bock, 1986). Although repetition is sometimes deliberate, in other cases it comes about through automatic processes (Pickering & Garrod, 2004). Studies on syntactic repetition have led to the emergence of two distinct theories of syntactic processing in production. One theory emphasizes the role of lexical representations in the selection of syntactic structure. On that account,

syntactic alternatives, such as actives and passives, are represented as units in the mental lexicon and connected to units for verbs that allow these alternatives, such as *to hit* or *to chase*. Speakers repeat syntax because the syntactic units maintain some residual activation, which promotes repeated selection (e.g., Cleland & Pickering, 2003; Pickering & Branigan, 1998).

Another theory proposes that there is continuity between the acquisition of abstract syntactic structure in childhood and adult syntactic processing. On that account, adults continue to learn mappings between message-level representations and abstract syntactic representations, for example the mapping between a message that specifies that an entity with the role of agent operates on another entity with the role of patient and a passive sentence structure. Speakers repeat syntax because when they process a given message with a given sentence structure, they implicitly learn somewhat better how to express that message with that structure (e.g., Bock & Griffin, 2000; Chang, Dell, & Bock, 2006).

These theories differ in their assumptions about the functional locus of the processes responsible for priming (internal or external to the mental lexicon) and about the nature of these processes (residual activation or learning). As a result, these theories make different predictions about the influence of lexical variables on priming, about the longevity of priming, and about the longevity of lexical influences on priming. This article aims at arbitrating between these theories and therefore puts these predictions to the test.

Much evidence for syntactic priming has been gathered in a paradigm in which the participants repeat sentences and describe pictures under the guise of a memory task (Bock, 1986). On critical trials, a target picture directly follows one of two syntactic variants of a prime sentence, and can be described using either structure. For example, a picture of a waitress offering drinks to some people at a cocktail party could be preceded by a so-called prepositional object (PO) dative prime sentence (1a) or by a double-object (DO) dative (1b). There is a priming effect if speakers produce a Prepositional Object (2a) more often after a Prepositional Object prime than after a Double Object prime, and conversely choose a Double Object (2b) more often after a Double Object prime than after a Prepositional Object prime.

- (1a) A rock star sold some cocaine to an undercover agent
- (1b) A rock star sold an undercover agent some cocaine
- (2a) The waitress offers the drinks to the party-goers
- (2b) The waitress offers the party-goers the drinks

Previous studies have compellingly demonstrated that syntactic priming taps into syntactic processing (it occurs in the absence of overlap at the levels of lexical items, thematic roles, or sentence prosody; Bock, 1989; Bock & Loebell, 1990). Syntactic priming has been found using a range of constructions (e.g., Ferreira, 2003; Griffin & Weinstein-Tull, 2003; Hartsuiker, Kolk, & Huiskamp, 1999; Hartsuiker & Westenberg, 2000), several tasks (e.g., Branigan, Pickering, & Cleland, 2000a; Potter & Lombardi, 1998), in English (e.g., Bock, 1986), Dutch (e.g., Hartsuiker & Kolk, 1998b), and German (e.g., Scheepers, 2003), and between the languages of bilinguals (Bernolet, Hartsuiker, & Pickering, in press; Desmet & Declercq, 2006; Hartsuiker, Pickering, & Veltkamp, 2004; Loebell & Bock, 2003; Meijer & Fox Tree, 2003; Schoonbaert, Hartsuiker, & Pickering, 2007). Syntactic priming effects have further been observed in children acquiring language (Brooks & Tomasello, 1999; Huttenlocher, Vasilyeva, & Shimpi, 2004), children who stutter (Anderson & Conture, 2004), and people with aphasia (Hartsuiker & Kolk, 1998a; Saffran & Martin, 1997). This kind of priming occurs from production to production (e.g., Bock & Griffin, 2000) but also from comprehension to production (e.g., Bock, Dell, Chang, & Onishi, 2007; Branigan et al., 2000a). Syntactic priming has been observed in experiments, but also in corpora of naturalistic speech (Gries, 2005).

Syntactic priming effects have been accounted for in a lexicalist, residual activation account (Pickering & Branigan, 1998) and in an implicit-learning account (Bock & Griffin, 2000; Chang et al., 2006; Chang, Dell, Bock, & Griffin, 2000). There is considerable empirical support for both theories. In particular, the lexicalist residual activation account of Pickering and Branigan (1998) assumes that processing a prime sentence would activate a lexical-syntactic node representing a certain syntactic choice, and for as long as that node is more active than usual it will have an increased probability of selection. Pickering and Branigan (1998) incorporated that assumption in a verbal model which was based on Roelofs's (1992) computational model of lexical access. They extended Roelofs' model with lexical-syntactic or *combinatorial* nodes (roughly corresponding to the argument structures of a verb) and with "active links" between lemma nodes for verbs and combinatorial nodes. Given the processing of a prime sentence with a certain verb and a certain structure (e.g., the verb *give* with a Prepositional Object dative), the link between the relevant verb lemma and combinatorial node would become more active. Because of the active links between verbs and combinatorial nodes, the model predicts a *lexical boost* of priming: If the target sentence uses the same verb as the prime sentence, there should not only be priming because of the combinatorial nodes' residual activation, but also because of the extra activation

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