The Influence of Conceptual Structure on Structural Priming

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Abstract
This priming study investigates the role of conceptual structure during language production, probing how English speakers encode information about motion events. Participants read prime sentences aloud before describing dynamic motion events. Primes differed in 1) syntactic frame, 2) distribution of manner and path elements within frames, and 3) degree of conceptual overlap with target events. Results demonstrate that the conceptual level of representation matters during production: structural priming decreased as degree of conceptual overlap between primes and targets decreased, and became nonexistent when there was no overlap. Conceptual overlap also weakly licensed priming of the mapping of event components to syntactic positions.

Keywords: syntactic priming; event structure; motion events.

Introduction
When producing sentences, speakers have to make choices about how they want to map elements from the conceptual representation of their message—the idea they want to convey—onto linguistic representations, and ultimately, onto the utterances we use to convey messages. Different mapping choices may result in utterances that convey roughly the same information but that differ in the way that information is linguistically encoded and, as a result, in the pragmatic implications of the utterance. In the current study, we investigate the way that conceptual structure comes into play as speakers formulate utterances.

The structural priming paradigm provides a useful means for probing the representations that speakers access during language production. This paradigm builds on the observation that speakers tend to repeat linguistic structures that they have recently used or observed others using. Repetition of linguistic structure is well-documented in corpora of natural speech (e.g., Gries, 2005), and experimental work has shown that speakers can be induced (or “primed”) to repeat particular structures in controlled settings as well (e.g., Bock, 1986; Bock & Loebell, 1990; Hartsuiker, Kolk & Huiskamp, 1999; Pickering & Branigan, 1998; see Pickering & Ferreira, 2008 for an overview).

Knowledge of the kind of abstract structures that speakers can be primed to repeat is informative about the nature of the representations that are accessed during language production. Bock & Loebell (1990) demonstrated, for example, that speakers are more likely to produce a passive sentence like “The church was struck by lightning” when they are first asked to repeat another passive sentence (1a) or an active sentence that shares the same surface syntax as the passive (1b) than when they are primed with an active sentence that does not share the syntactic structure of the passive (1c).

(1) a. The man was hit by the bulldozer.
   b. The man was walking by the bulldozer.
   c. The man drove the bulldozer.

These findings are widely accepted as evidence that speakers can be primed to produce a particular syntactic structure independent from the meaning it conveys, and hence, that syntactic structure is an independent level of representation that speakers access during language production.

It is important to point out, however, that in many studies of structural priming there is significant overlap in the semantic and/or conceptual nature of the events being evoked in primes and targets. For example, studies that investigate priming of the English ditransitive (2a) and prepositional dative (2b) are hampered by the fact that in English, the use of these frames is so tightly tied to the class of events they describe (i.e., transfer events) that prime sentences must describe situations that have the same event structure as targets.

(2) a. The girl gave the dog some ice cream.
   b. The girl gave some ice cream to the dog.

Given this tight mapping between syntactic and semantic/conceptual structure, it is not clear whether successful priming in studies like these is based solely on repetition of syntactic structure, or whether priming is also driven by overlap between the kind of event evoked in primes and targets. Indeed, it has been well-established that...
语法不仅是一个语言的表层结构，它还包括了能够通过语义结构对语境进行编码的抽象表达。即，单词的语法位置决定了它们在句子中所扮演的角色。这种语法位置的差异可以导致不同的语义结构。例如，在英语中，“the dog chased the ball”与“The ball was chased by the dog”两个句子中的“chase”一词在语法上虽然相同，但在语义上却大相径庭。

因此，语言的语法结构不仅是表层的，它们还反映了更深层次的语义关系。这种关系通过语义结构的层次来体现，这些层次反映了语言的深层结构。换句话说，语言的语法结构是一个层次结构，其中每个层次都有其特殊的语义功能，它们共同构成了一个复杂的语义结构。

同时，语法结构对语义的理解也具有重要的影响。例如，在句子“John ate the apple”中，“ate”一词的语法位置决定了它所代表的语义关系，即“John”是动作的执行者，“apple”是动作的对象。这种语法位置的差异不仅影响了句子的语义理解，还影响了句子的语用意义，即句子在实际语境中的应用。

因此，语法结构不仅仅是语言的表层结构，它们还反映了语言的深层结构和语义关系，对语言的语义理解和语用意义具有重要的影响。
Procedure and Design
Prime sentences and dynamic events were presented on a computer screen. At the beginning of each trial, a prime sentence appeared on the screen. Participants read the sentence aloud, and then hit the spacebar to move on to the next item. After the sentence disappeared from the screen, a crosshair was displayed briefly to redirect attention to the center of the screen, and then the video began. Participants watched the event unfold, and then viewed a still image of the final frame of the animation as they provided a description. Event descriptions were recorded by the experimenter using a digital audio recorder.

Experimental conditions differed between subjects and were distinguished by the type of prime sentence presented before video stimuli. There were seven experimental conditions: one for each of the six types of prime sentence (Table 1) and a control condition in which no prime sentence was presented before videos were viewed and described. To encourage them to pay attention to the stimuli, participants in all conditions were informed that they would be asked to participate in a memory task after viewing all of the stimuli. The design and results of the memory task are not discussed here.

Coding and Data Analysis
Participant descriptions of target events were transcribed and coded by hand. Utterances were coded for two dependent variables: syntactic frame use and structural position of first manner mention.

Data are presented for the use of three syntactic frames: the canonical frame used by English speakers for describing motion events (4a), and the frames used in Complex Subject (4b) and Complex VP (4c) primes.

(4) Coding of syntactic frames

a. Canonical frame  
   NP_V_PP  
   The alien drove into the cave.

b. Complex Subject  
   [N_PP]_V_NP  
   The alien in the car entered the garage.

c. Complex VP  
   NP_V_NP_PP  
   The alien entered the garage.

Coding of syntactic frames was strict: in particular, sentences with complex subjects (more than just a determiner and a noun) were excluded from counts of Canonical and Complex VP frames.

Words or phrases that referred to instruments (e.g., “car”) or the agent’s manner of motion (e.g., “driver,” “driving,” “riding”) were coded as Manner mentions. Manners were coded as appearing in subject position—either as a subject modifier or encoded in the subject itself (5a), as the main verb of the sentence (5b), or in a post-verbal position (5c).1

1 While it is true that neither of sentences (5b) and (5c) provide explicit encoding of the Manner of the motion event described (i.e., in both cases the alien could be trapped in the trunk of a moving car rather than driving it), in both sentences Manner of motion can be inferred from the information provided.
Coding of manner location

a. Manner in subject
   The alien in the car … / The driver …

b. Manner in verb
   The alien drove …

c. Post-verbal manner
   The alien entered the cave in a car.

Results

Syntactic Priming

Figure 2 shows the proportion of use of coded syntactic frames in participants’ motion event descriptions. In the absence of a prime sentence, speakers produced the Canonical frame more often than any other frame; they never produced sentences that used the Complex Subject frame; and they used the Complex VP frame about 14% of the time. When primed with the Complex Subject frame (Fig. 2A), participants significantly increased their use of this frame only in the two motion event priming conditions. Use of this frame decreased as the degree of conceptual overlap between primes and targets decreased, and there was no evidence of priming in the Syntax Only condition, where there was no conceptual overlap. When primed with the Complex VP frame (Fig. 2B), participants increased their use of that frame only in the Same Motion condition, which overlapped with the target event both in event structure and in verb use. Again, there was no priming of the use of this frame in the Syntax Only condition.

These observations were tested using multilevel mixed logit modeling with crossed random intercepts for Subjects and Items. Binary values at the trial-level for use of the Complex Subject and Complex VP frames were modeled using Condition (Control, Same Motion, Different Motion, Syntax Only) as a first-level fixed factor. Modeling revealed a main effect of Condition for each primed frame: use of the Complex Subject frame was significantly higher than its use in the control condition in both the Same Motion and Different Motion conditions (both \( p<0.001 \), and use of the Complex VP frame was significantly higher than its use in the control condition only in the Same Motion condition (\( p<0.05 \)).

Event Component Mapping

Figure 3 shows the proportion of utterances in which participants first mentioned the manners of motion events in the three coded locations: subject, verb, and post-verb. In the control condition, participants mentioned the manner of target events most often in the verb and less often in the subject and in post-verbal positions. Participants in the Complex Subject conditions (Fig. 3A), who were primed with sentences in which manner information appeared in the subject of the sentence, were more likely to encode manner in the subject only in the Same Motion condition, in which primes provided both a lexical and a conceptual boost. Speakers in this condition who were successfully primed to produce the Complex Subject frame, then, were producing sentences like (6), in which manner information is encoded in the subject and path information in the verb.

(6) The alien in the car entered the cave.

Participants in the Complex VP conditions (Fig. 3B), who were primed with sentences in which manner was encoded in a post-verbal phrase, did not exhibit any effects of priming on event component mapping. Participants in this condition who were successfully primed to produce the Complex VP frame, then, were not producing sentences like (7a), in which path information is encoded in the verb and manner information after the verb. Instead, these speakers repeated the syntactic frame they were primed with, but mapped event components to that frame in their preferred order of mention, producing sentences like (7b), in which manner is encoded in the verb and path in a post-verbal modifier.

(7a) The alien drove the car into the cave.

(7b) The alien entered the cave in a car.
Multilevel logit modeling was performed as described above on binary values at the trial-level for production of manner in subjects, verbs, and post-verbal positions using Condition (Control, Same Motion, Different Motion) as a first-level fixed factor. Separate sets of models were run for Complex Subject and Complex VP primes. Modeling revealed a main effect of Condition for the Complex Subject primes. Production of subject manners in the Same Motion condition was significantly higher than in the Control condition \((p<0.001)\). In addition, production of manners in verbs \((p<0.001)\) and in post-verbal positions \((p<0.05)\) was significantly lower in the Same Motion condition vs. Control. Location of manner encoding in the Different Motion condition was not significantly different from Control for the Complex Subject primes, and no effects of Condition were found for location of manner encoding in the Complex VP primes.

**Figure 3**: Location of first manner mention for utterances produced in the Complex Subject (A) and Complex VP (B) conditions versus the No Prime control condition. Manner locations are described in in the text (ex. 5). Data from the control condition are repeated across graphs for ease of comparison. *Significantly different from control at \(p<0.05\).

**Conclusions**

Syntactic priming in this study was successful only when primes and targets overlapped in event structure. If the prime overlapped with the target both in verb and in event type, use of the primed syntactic structure was most likely, and if the prime and the target shared some more general conceptual structure—i.e., if they were both motion events—priming of syntactic structure was also boosted. When there was no conceptual overlap between primes and targets, syntactic structure was not primed.

In addition, priming of the mapping of event components to linguistic structure was successful when there was conceptual overlap between primes and targets. However, speakers were only willing to deviate from canonical mappings when event components were mapped to syntax in the preferred order. As long as primes respected the English bias to mention manners before paths, speakers were willing to put that manner information in a noncanonical position in the sentence, but they were unwilling to violate that bias to produce a structure in which paths were mentioned before manners.

Taken together, these results demonstrate that the conceptual level of representation matters during language production. In addition, they suggest that we should take a second look at studies that have claimed to find evidence of syntactic priming without controlling for possible sources of conceptual overlap.

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**References**


