

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

syntax is not the only level of linguistic representation that plays a role in priming the structure of an output sentence. Pickering & Branigan (1999) demonstrated, for example, that the effects of syntactic priming are enhanced by *lexical* overlap between primes and targets—specifically, between the particular verb used in primes and targets. And the success of priming is also affected by overlap of *semantic* structure in primes and targets, e.g., the mapping of thematic roles onto structural positions (Bernolet, Hartsuiker & Pickering, 2009; Chang, Bock & Goldberg, 2003; Hare & Goldberg, 1999; Hartsuiker et al., 1999; Hartsuiker & Westenberg, 2000).

In the current study, we extend this line of research to examine the influence of an even more abstract source of information on structural priming, probing the effects of overlap of conceptual event structure between primes and targets. To do this, we focus on motion events, which offer an event structure that allows for a relatively flexible mapping between event components and structural positions. Following Talmy (1985), we define a motion event as one in which a Figure experiences a change in location with respect to some Ground object. The details of a motion event may be elaborated by optionally specifying the Manner in which the Figure moves (e.g., bounce, drive) or the trajectory, or Path, that the Figure takes in relation to the Ground object (e.g., circle, exit, down). When describing a motion event, speakers make choices about which of these event components they want to mention and how they want to package information about those components in the sentence they produce. Some examples of motion event descriptions are given in (3): note that both manners and paths of motion may be encoded in a variety of different structural positions, if they are mentioned at all.

- (3) a. The ball bounced (around the tree).
b. The (bouncing) ball circled the tree.

English speakers usually prefer to use a sentence like (3a) when describing motion events, with information about manner of motion encoded early in the sentence (usually in the verb) and path information mentioned later (usually in a post-verbal prepositional phrase) or not at all, but this is a language-specific bias, and not a strict rule (Talmy, 1985).

Using events with this kind of flexibility in the mapping of event components to syntax allowed us to ask whether conceptual overlap between primes and targets boosts structural priming, just as linguistic overlap does. In addition, we asked whether speakers could be primed to produce dispreferred mappings of event components to linguistic structure. If it is possible to prime the way that speakers distribute information about events within a syntactic frame, this will provide additional evidence that they are taking conceptual structure into account as they prepare utterances.

Methods

Participants

Data were collected from 70 adult monolingual speakers of American English. Participants were students at the University of Delaware or the University of Pennsylvania and received either \$8 or course credit as compensation for participation.

Materials

Two kinds of stimulus items were constructed: 1) dynamic videos for elicitation of motion event descriptions and 2) prime sentences to be presented before each video.

Videos were created by animating clip-art images. Target events depicted 12 simple motion events in which an animate agent used an instrument or vehicle to move in a particular manner to a visible path endpoint. A still frame from one of the target events is given in Fig. 1: in the animation this still frame is taken from, the alien rides the car across the screen and into the mouth of the cave. Sixteen filler videos depicted animate agents involved in events that did not include a specific endpoint, like flying a kite.

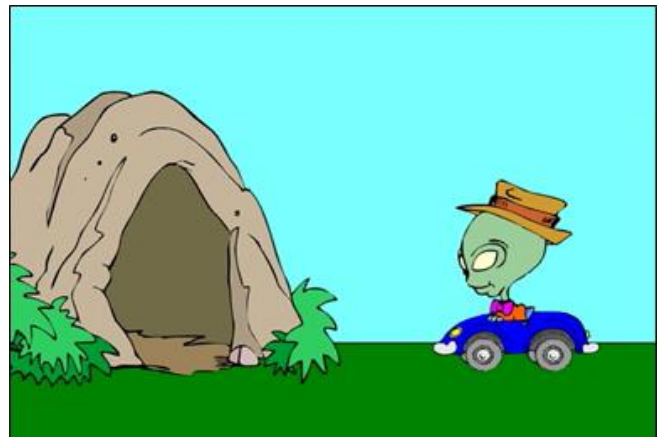


Figure 1: Still frame taken from a target event.

Six different sets of prime sentences were created that differed in their syntactic frame and in the degree to which they overlapped conceptually with the target event to which they were matched (Table 1). Two different syntactic frames were used in prime sentences. In the Complex Subject frame, the noun that labeled the agent of the event (i.e., the subject) was always modified by a prepositional phrase: [N_PP]_V_NP. The Complex VP frame had a simple noun phrase (NP) subject, but an additional structural position within the verb phrase (VP): NP_V_NP_PP.

Each frame was used to construct three different types of prime sentences that differed in their conceptual overlap with target events: Same Motion, Different Motion, and Syntax Only primes. Same Motion prime sentences overlapped with target events in two ways: they described an event of the same type as the target video (a motion event; conceptual overlap), and they included a verb that

Table 1: Types of prime sentences
All of these prime sentences were associated with the event pictured in Fig. 1

Complex Subject primes	[N_PP]_V_NP	manner in subject, path in verb
Same motion	The zebra on the motorcycle entered the garage.	
Different motion	The man in the helicopter circled the tower.	
Syntax only	The nurse with the freckles baked a pie.	
Complex VP primes	NP_V_NP_PP	path in verb, manner in post-verbal prepositional phrase
Same motion	The zebra entered the garage on a motorcycle.	
Different motion	The man circled the tower in a helicopter.	
Syntax only	The nurse baked a pie with skill.	

could also be used to describe the target event (lexical overlap). Different Motion prime sentences also overlapped with targets in event type (they described motion events), but the verb in these sentences could never be used to describe the target. Syntax Only primes used the same syntactic frames as Motion primes, but described events that did not overlap with the target either in event type (they did not describe motion events) or in the particular verb used.

For Motion primes (Same Motion and Different Motion), syntactic frame determined the distribution of manner and path elements to structural positions. Complex Subject frames preserved the manner-before-path ordering of information used in canonical English motion event descriptions, but encoded each element in a noncanonical structural position, with path encoded in the verb and manner information in the prepositional phrase that modified the subject NP. In Complex VP frames, motion event components were presented not only in dispreferred structural positions, but also in a dispreferred order of mention, with path encoded in the verb and manner encoded in a post-verbal prepositional phrase.

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 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 of the event. 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 sentences were 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 cave.
- c. Complex VP NP_V_NP_PP
The alien entered the cave in a car.

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.

- (5) 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

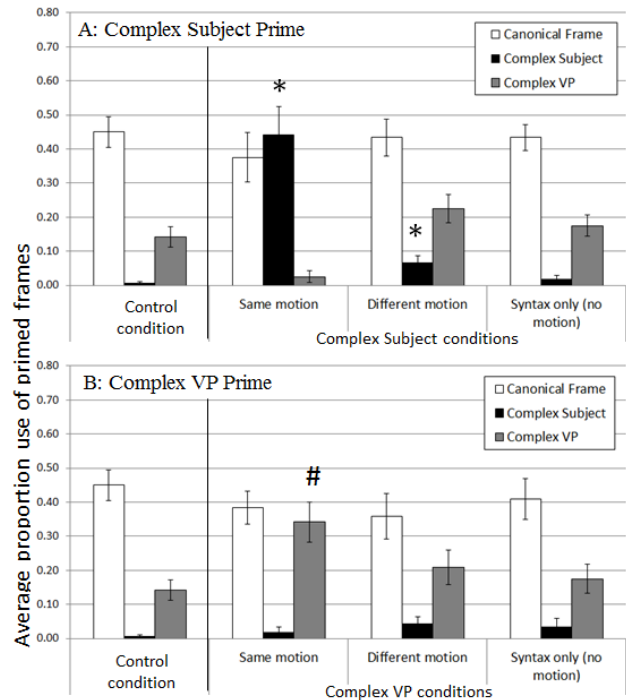


Figure 2: Use of primed syntactic frames in the Complex Subject (A) and Complex VP (B) conditions versus the No Prime control condition. Details about syntactic frames are given in the text (ex. 4). Proportion use is calculated from all syntactic frames used in event descriptions. Data from the control condition are repeated across graphs for ease of comparison. Use of this frame is significantly different from its use in the control condition: * $p < 0.001$, # $p < 0.05$

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.

- (7) a. # The alien entered the cave in a car.
 b. The alien drove a car into the cave.

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.

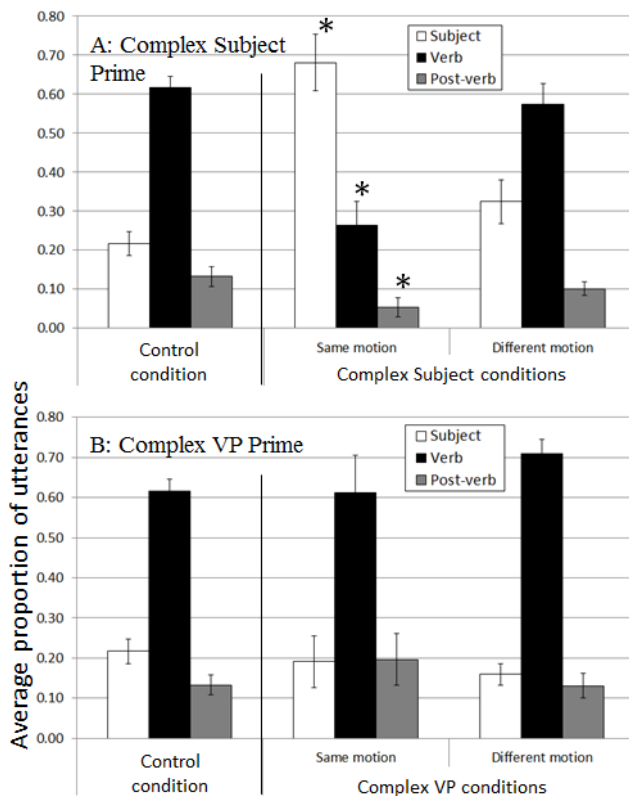


Figure 3: Location of first manner mention for utterances produced in the Complex Subject (A) and Complex VP (B) conditions versus the No Prime control condition. Manner locations are described in the text (ex. 5). Data from the control condition are repeated across graphs for ease of comparison. *Significantly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