26

Syntax and Speaking

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26.1 Introduction

Our syntactic knowledge guides what we say and how we speak. In turn, what we say and how we speak reflect the structure of our syntactic knowledge. Thus, studies of syntax and studies of speaking can be mutually informative, at least in principle. In this contribution, I discuss how syntactic theories are an essential part of theories of speaking, and how studies of speaking may (or may not) inform studies of syntax.

Before going into the main discussion, I would like to introduce the basic architecture of the model of sentence production that is widely accepted in the literature, focusing on syntactic aspects.

26.2 Syntactic Processes in Speaking

Traditionally, speaking is viewed as involving a transformation of conceptual representations to articulatory-motor or manual-motor representations (Garrett 1975). Accordingly, models of speaking normally assume that speakers start from pre-linguistic conceptual representations, often referred to as *message representations*. The most extensive discussion, as far as I am aware, is Levelt (1989). According to Levelt, message representation is a multi-component level of representation that includes spatial, kinesthetic, and propositional representations. The most explicitly discussed subcomponent is the propositional representation, which encodes information such as semantic categories (e.g. event, person, manner, place, and so on), function–argument structures, semantic types, and thematic information. Questions such as how speakers build these representations as they prepare utterances remain largely unaddressed, though there is an interesting line of studies that investigates how relational and non-relational components of message representations are prepared in speech

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planning mainly using eye-tracking during speaking (e.g. Griffn & Bock 2000; Gleitman et al. 2007; see Chapter 23 for further discussion of eye-tracking).

Using (potentially partial) message representations, speakers build some form of grammatical representations. The dominant view in the literature, represented by models like Garrett (1975), Bock and Levelt (1994), and Bock and Ferreira (2013), is that speakers first use thematic representations to build grammatical-functional representations that are similar to the f-structure in Lexical Functional Grammar (Bresnan 1982). This stage of processing is often called the functional level of processing (Bock & Levelt 1994). In the Bock and Levelt model, it is assumed that constituent structures are not yet represented at this stage of processing, but grammatical functional structures (e.g. subject, direct object, indirect object, verb) are represented. Thematic information is used to assign grammatical functions to words (or more precisely, *lemmas*, the mental representations that contain syntactic and semantic information but not phonological information; see Kempen & Huijbers (1983) and Levelt, Roelofs, & Meyer (1999)). How grammatical functions are assigned to lemmas is not entirely clear, but Bock and Levelt (1994) assumed that speakers access the subcategorization information of verbs that encodes which thematic role corresponds to which grammatical functions. Speakers may also use other conceptually encoded information, for example animacy information for grammatical function assignment (McDonald, Bock, & Kelly (1993), among others). Some researchers also argue that speakers may develop a strategy to assign grammatical functions based on the statistical regularity between thematic roles and grammatical functions (e.g. patients tend to get the object function; Iwasaki 2010). It has also been proposed that the subcategorization information of verbs is used only for internal arguments, but not external arguments (Momma, Slevc, & Phillips 2016, 2018).

Once speakers assign appropriate grammatical functions to appropriate lemmas, they then build constituent structures using the functional structures. The exact nature of constituent structure representation is a matter of debate in the literature. Some argue that this level of representation is relatively impoverished. My view (elaborated below) is that constituent structural representation is rich enough to encode arbitrary and subtle constraints of grammar. Traditionally (at least since Garrett (1975)), speakers were assumed to first encode the dominance relation between constituents, independently of the linear order relation (precedence relation), though some argue that dominance and precedence relations are simultaneously represented (e.g. Pickering, Branigan, & McLean 2002). Finally, speakers linearize the constituents encoded in the dominance representation for phonological encoding. After phonological encoding, speakers then convert the phonological representations into motor representations, which results in articulation.

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26.3 The Nature and Quality of Syntactic Representation in Speaking

In sentence production, speakers construct some sort of syntactic representation of their utterances in real time. Most models of sentence production assume that speakers build hierarchical and abstract representations (Garrett 1975, 1988; Kempen & Hoenkamp 1987; Levelt 1989; Bock & Levelt 1994; F. Ferreira 2000; F. Ferreira & Engelhardt 2006; V. Ferreira & Slevc 2007; Bock & Ferreira 2013). But what are the empirical reasons to believe that speakers represent abstract hierarchical structures in real time? This question is central in discussing the relationship between studies of syntax and studies of speaking because syntactic theories are relevant for theories of speaking to the extent that syntactic theories capture the nature of representations that speakers construct in real-time production.

26.3.1 Abstractness

First, what is the evidence that speakers construct abstract representations of sentences in real-time production? Syntactic theories typically define structural rules and constraints over abstract categories of syntax (nouns, verbs, prepositions, noun phrases, verb phrases, prepositional phrases, etc.) rather than over specific individual words. For example, phrase structure rules are rules defined over lexical and phrasal categories rather than individual words (except for lexicalized rules). Selectional constraints (specifically, c-selectional constraints, Grimshaw 1990) are defined over syntactic categories rather than over individual words. Constraints on long-distance extractions are typically defined over phrasal categories (e.g. subjacency constraints, Chomsky 1977; *that*-trace constraint, Perlmutter 1968). Thus, in most if not all syntactic theories, syntactic representations are not only hierarchically organized, but abstract. But again, in principle, speakers' real-time representations of their own utterances may or may not be abstract.

Before I discuss evidence for the abstractness of syntactic representations, let me clarify what it means for syntactic representations to be abstract. By abstract syntactic representations, I mean syntactic representations that capture structural generalizations across different surface strings in a manner that is not reducible to other factors. Critically, the issue of whether syntactic representations are abstract is orthogonal to the issue of whether syntactic representation is disconnected from meaning or function, because abstract representations can have meanings and functions. Thus, the view that syntactic representations are intimately tied to meaning and function is perfectly compatible with most syntactic theories (despite occasional claims to the contrary; see Adger (2018) for clarification).

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There are three lines of evidence that speakers' real-time representations of their utterances are abstract. The first piece of evidence comes from speech errors. As discussed above, Garrett (1975) (see also Fromkin (1971); Nooteboom (1973)) observed that speakers often exchange words that appear far apart in linear distance. Interestingly, when words are exchanged, the two words involved share the same syntactic category. For example, nouns exchange with nouns but not with verbs, and verbs exchange with verbs but not with nouns. This constraint on word exchange error is known as the syntactic category constraint (Dell, Oppenheim, & Kittredge 2008). The same is true for substitution errors (Fromkin 1971; Nooteboom 1973). There is also some experimental evidence suggesting that lexical competition (the presumed source of exchange and substitution errors) is restricted to words of the same category, even when the two words are closely matched in meaning (Momma, Buffinton, Slevc, & Phillips ~~2014~~). The very existence of the syntactic category constraint suggests that the abstract syntactic category is causally involved in controlling what speakers say, even when they err.

The second line of evidence comes from a phenomenon known as *syntactic priming* (also referred to as *structural priming* or *structural persistence* in the production literature). Syntactic priming is a well-established phenomenon in which speakers tend to reuse the structure that they recently encountered when more than one structural alternative is suitable for expressing the same message. For example, Bock (1986) showed that speakers are more likely to describe a picture of an event using passive sentences like (1d) as opposed to active sentences like (1c), after they encountered passive sentences like (1b) compared to (1a).

(1) a. One of the fans punched the referee. [active prime
b. The referee was punched by one of the fans. [passive prime]
c. Lightning is striking the church. [active target]
d. The church was being struck by the lightning. [passive target]

Bock (1986) also found that dative alternations such as (2) can be syntactically primed. That is, it was shown that speakers are more likely to use the same dative structure as the structure they encountered in prime sentences like (2).

(2) a. A rock star sold some cocaine to an undercover agent. [prepositional dative prime]
b. A rock star sold an undercover agent some cocaine. [double object prime]
c. The man is reading a story to the boy. [prepositional dative target]
d. The man is reading the boy a story. [double object target]

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Syntactic priming effect has been replicated numerous times, with diverse languages and diverse structural alternations (Japanese scrambling: Tanaka, Tamaoka, & Sakai (2007); Dutch dative alternation: Hartsuiker & Kolk (1998); Control vs. raising in English: Griffn & Weinstein-Tull (2003); English complementizer choice: V. Ferreira (2003); English Spray-Load alterations: Chang, Bock, & Goldberg (2003); noun phrases involving modifications in English: Cleland & Pickering (2003) and in American Sign Language: Hall, Ferreira, & Mayberry (2015); see Pickering & Ferreira (2008) for a review). Importantly, syntactic priming can be observed without any overlap in content or function words between prime and target words in the structure (see, e.g., Bock 1989) although repeating content words, especially the head of primed structures, increases the magnitude of syntactic priming (this additional priming is known as lexical boost in the literature (Cleland & Pickering 2003; Pickering & Branigan 1998). The fact that syntactic priming can be obtained without lexical overlap suggests that the representations of sentences that speakers construct during sentence planning involve abstract syntactic representations (Bock 1989).

Finally, speakers show sensitivity to the grammatical constraints that are hard to define without positing abstract representations. For example, consider the following sentences.

(3) a. Who do you want to dance with?
b. Who do you wanna dance with?
c. Who do you want to dance?
d. * Who do you wanna dance?

As can be seen in these examples, when *who* is the subject of *dance*, using *wanna* instead of *want to* results in less acceptable sentences (this pattern of acceptability has been noted at least since Lakoff (1970)). Though the robustness of this pattern across different speakers is sometimes questioned (e.g. Wasow & Arnold 2005), it is relatively clear that many adult speakers are sensitive to this constraint (e.g. Karins & Nagy 1993; Zukowski & Larson 2009; Kweon & Bley-Vroman 2011). In the generative tradition, the unacceptability of (3d) is attributed to the presence of a *wh*-trace in between *want* and *to*, which blocks the contraction. In accordance with this acceptability pattern, in an elicited production task, Zukowski and Larson (2009) showed that typical adults produce *wanna* approximately five times more frequently in sentences like (3b) than in the sentences like (3d). To the extent that this constraint is due to the presence of a *wh*-trace intervening between *want* and *to*, this result shows that (adult) speakers are constructing sentence representations involving a *wh*-trace, a textbook case of abstract representation. In a similar vein, prosodic process is conditioned by empty categories. F. Ferreira and Engelhardt (2006) argued that the normally mandatory vowel reduction of *to* as in *to the party* does not occur when the object of *to*

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is a *wh*-trace or a NP-trace (see also F. Ferreira 1988). Additionally, Franck et al. (2006) reported that the pattern of agreement errors known as *agreement attraction* (see below for more details) is sensitive to the presence of empty categories intervening between the two elements participating in agreement relations. Thus, there are multiple lines of evidence that suggest that various aspects of production behaviors are influenced by abstract syntactic representations. Any theories of production that deny the existence of abstract syntactic representations must explain these data by some other means.

Thus, the syntactic category constraints in speech errors, the lexical independence of syntactic priming, and the effects of empty categories on phonological contraction, prosody, and agreement errors suggest that speakers' real-time representations of sentences are abstract, in the sense that categories of syntax like nouns, verbs, prepositions, noun phrases, verbs phrases, prepositional phrases, and even empty categories, are causally involved in determining what we say and how we speak.

26.3.2 Hierarchy

Second, what is the evidence that speakers build hierarchical representations in real-time production? Uncontroversially, sentences can be analyzed as hierarchically organized. Sentences consist of phrases, which consist of smaller phrases, which consist of words, which consist of morphemes, the smallest linguistic units that carry meaning. In line with this observation, varieties syntactic theories assume that sentences are hierarchically organized (Kaplan, Bresnan, ~~et al.~~ 1982; Chomsky 1986, 1995; Pollard & Sag 1994). However, in principle, speakers' real-time syntactic representations may not be hierarchically organized. The fact that sentences can be analyzed as hierarchically organized does not necessarily mean that speakers build hierarchical structures for production or comprehension (e.g. Frank, Bod, & Christiansen 2012).

Nevertheless, there are at least three pieces of evidence that suggest speakers' real-time representations are hierarchically organized. First, Fromkin (1971) observed that speakers frequently make speech errors such as the following (taken from Fromkin, Rodman, & Hyams (2011) and Fromkin (1971)):

(4) Seymour sliced the salami with a knife. → Seymour sliced a knife with the salami. [phrasal exchange]

(5) tend to turn out → turn to tend out [word exchange]

(6) salute smartly → smart salutely [morpheme exchange]

These exchange errors suggest that speakers manipulate phrasal, lexical, and morphemic representations as units when they plan utterances. Exchange errors occur when two planned units are bound to wrong syntactic positions. These errors suggest that speakers, at some stage of

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production processes, manipulate the representational units that are embedded in bigger-sized representational units. In other words, sentence planning involves processes that are sensitive to different levels of syntactic hierarchy (morphemic, lexical, and phrasal levels).

Second, Garrett (1975) observed that word exchange errors like (5) often occur at a distance, crossing phrasal and sometimes even clausal boundaries. On the other hand, he observed that phonemic exchange errors (e.g. *darn boor* for an intended, *barn door*) and morphemic exchange errors (e.g. *a back trucking out* for an intended, *a truck backing out*) occur locally, mostly involving two phonemes or morphemes belonging to immediately adjacent words. Garrett argued that for an exchange error to occur, two units involved in the exchange must be represented simultaneously in mind. He called this condition that applies to exchange errors *computational simultaneity*. The fact that word exchange errors are relatively unconstrained by linear proximity suggests that linear proximity is not a strong determinant of whether two words are represented simultaneously. On the other hand, linear proximity is a strong determinant of whether two phonemes are represented simultaneously. From this contrast, Garrett argued that speakers represent sentences hierarchically at the level of syntax but linearly at the level of morphology and phonology.

Finally, speakers produce agreement mostly correctly. Because agreement is indisputably a hierarchy-sensitive relation, the very fact that speakers can do agreement mostly correctly suggests that the production system respects hierarchical relations. If speakers do not represent hierarchical structures in some way, it is unclear how speakers produce correct agreement most of the time. Of course, speakers do occasionally make mistakes in agreement production, especially when a plural noun is close (under some definition of distance) to the singular subject noun in subject–verb agreement (e.g. *the key to the cabinets are rusty*, Bock & Miller 1991). It might seem at first that this type of agreement error suggests that agreement production isn't hierarchical, but even agreement errors are sensitive to hierarchical relations (Bock & Cutting 1992; Vigliocco & Nicol 1998; Franck, Vigliocco, & Nicol 2002; Eberhard, Cutting, & Bock 2005; Franck et al. 2006; though see Gillespie & Pearlmutter 2011). More importantly, regardless of whether agreement *errors* are hierarchy-sensitive, it is clear that non-erroneous agreement production, by and large, shows sensitivity to hierarchy (Bock & Cutting 1992). Thus, the patterns of speech errors, syntactic priming, and agreement production all suggest that speakers represent hierarchical representation during real-time speaking.

26.3.3 Quality of Syntactic Representations

So far, I have discussed the (relatively uncontroversial) view that speakers' syntactic representations are hierarchical and abstract. But that does not

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necessarily mean that the nature of real-time syntactic representations speakers generate is captured by syntactic theories, which are mostly based on acceptability judgment data. Syntactic representations involved in making acceptability judgments and syntactic representations involved in speaking could potentially be mismatched. For example, speakers' representations of sentences may not be as detailed and elaborate as representations involved in acceptability judgment tasks.

Using acceptability judgments, syntacticians have discovered varieties of subtle constraints on sentence structures; e.g. syntactic island constraints (Ross 1967; see also Chapter 9), *that*-trace constraints (Perlmutter 1968; see also Chapter 10), and various other conditions on long-distance extractions, e.g. goal arguments cannot be extracted from double object constructions (Kuroda 1968; Baker & Brame 1972; Merchant 2001). If speakers are sensitive to these subtle constraints, speakers must be able to represent sentence structures that are detailed enough to encode these syntactic constraints. Certainly, even if speakers do obey these constraints, the representations used for making acceptability judgments and the real-time representations used for guiding speaking may not be identical. However, to the extent that speakers obey the same constraints that govern acceptability judgment patterns, there is little motivation to have a different theory of representations for each task (see Phillips & Lewis (2013) for discussion). Thus, syntactic theories offer a representational foundation for theories of speaking, to the extent that syntactic theories capture the nature of speakers' real-time sentence representation that guides their utterances.

It is worth clarifying at the outset that speakers do produce utterances that are generally judged to be unacceptable, often by mistake. For example, speakers use the non-target tense (e.g. *a university that IS celebratING its 50th anniversary a couple of years ago*; taken from the UCLA speech error corpus), use non-target agreement morphology (e.g. *the key to the cabinets ARE rusty*), produce prepositions twice in pied-piped constructions (e.g. *to which we have committed ourselves TO*; taken from the UCLA speech error corpus), produce wrong case-markers in case-marking languages like Japanese, and so forth. All these grammatical errors can be found in naturally occurring speech (Fromkin 1971~~; Iwasaki 2010),~~ and some of these errors can be reliably elicited in experimental settings. For example, subject–verb agreement and pronominal agreement errors can be reliably elicited (Bock & Miller 1991; Bock, Nicol, & Cutting 1999). Case-marking errors can also be experimentally induced (Iwasaki 2010). However, the critical question is not what speakers end up saying, but what speakers' syntactic representations are as they plan their utterances. Many of the errors introduced above can be explained by assuming an imperfect memory or internal repairs of speech. For example, subject–verb agreement and pronominal errors can be attributed to a misretrieval of subject number features when speakers try to encode a verbs' morphological forms; see,

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for example, Badecker and Lewis (2007) for a cue-based retrieval model of agreement attraction in production. See also Wagers, Lau, and Phillips (2009) for a review of agreement attraction in comprehension. Case-marking errors can be due to internal repairs of sentences, as acknowledged by Iwasaki. For example, when Japanese speakers use the accusative case for a passive subject (which should receive the nominative case) by mistake, they may be simply starting to produce a scrambled OSV sentence (or a subject-dropped active sentence) and then they repair it into a passive sentence after they have uttered the object noun. Iwasaki argued against this possibility because scrambled OSV sentences are not very frequent in Japanese. But in Iwasaki's data, case-marking errors were also remarkably infrequent (there were 48 case-marking errors out of 2,596 relevant utterances). Certainly, the burden of proof is on the side that argues that what speakers actually said and their representation of their own sentences during planning can dissociate from each other. However, it is premature to conclude, based on speech error data, that speakers represent ill-formed syntactic structures during sentence planning.

More importantly, speakers' errors are not random in kind. As reviewed above, speakers make morphosyntactic errors relatively frequently (e.g. tense errors, agreement errors, case-marking errors), but they rarely violate basic phrase structure constraints (due to the syntactic category constraint introduced above). They also obey more non-obvious constraints like island constraints, the *that*-trace constraint, and some other non-obvious constraints on extractions rather strictly. For example, Pearl and Sprouse (2013) showed that island-violating sentences are vanishingly rare, at least in child-directed speech. Based on the child-directed speech in the *Child Language Data Exchange System* (CHILDES) corpus (MacWhinney 2014), they found precisely zero instances of sentences violating complex NP islands, subject islands, *whether* islands, and adjunct islands. This lack of utterances violating islands means that speakers do not produce sentences that violate island constraints, or at least not frequently enough to appear in the sample Pearl and Sprouse investigated. Certainly, this lack of island violation might reflect simply the lack of opportunities for speakers to speak complex sentences in which island constraints can potentially be violated. However, F. Ferreira and Swets (2005) conducted an experiment in which speakers produced sentences such as the following.

(7) ? This is the donkey that I don't know where it is from.

This sentence contains a resumptive pronoun, a pronoun that occurs instead of a gap and is coreferential to the filler, in an island context (see Chapter 8, and also Ross 1967; Chomsky 1986; Heestand, Xiang, & Polinsky 2011; Polinsky et al. 2013). In this experiment, speakers were given ample opportunities to violate the island constraint. However, instead of violating the syntactic island, speakers chose to use a resumptive pronoun, at

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least the vast majority of times. Island-violating utterances with no resumptive pronouns are 1.4 percent without a production deadline and 3.1 percent with a production deadline. Resumptive pro-nouns are normally judged to be relatively unacceptable. However, unacceptable does not necessarily mean ungrammatical, and a recent study suggests that resumptive pronouns are judged to be better than an island-violating gap in a forced choice task, suggesting that resumptive pronouns inside islands may actually be grammatical in English (Ackerman, Frazier, & Yoshida 2018, but see Heestand et al. 2011; Polinsky et al. 2013). If this view on resumptive pronouns is correct, speakers seem to avoid sentences that are ill-formed due to the violation of island constraints (see Chapters 7 and 8 for extensive discussion of resumptive pronouns).

Speakers also rather rarely violate the *that*-trace constraint (see Chapter 10). For example, Phillips (2013) observed that speakers never violated the *that*-trace constraint in a naturalistic corpus (0 instances of *that*-trace violation in 13 cases of subject extractions from embedded clauses). Experimentally, my collaborator and I found that speakers (n = 52) almost never produced *that* in sentences such as (8), even when they were primed to produce *that* half the time (using a method similar to V. Ferreira 2003).

(8) Who does the chef think (*that) is splashing the doctor?

Speakers in our experiment produced *that* (violating the *that*-trace constraint) containing *wh*-extractions from the embedded subject position such as in (8) only around 1 percent of the time out of more than 1,400 utterances involving *wh*-extraction from the embedded subject position. This is particularly striking, considering that the production of *that* was syntactically primed half the time. Thus, instances of *that*-trace violations in production are vanishingly rare, in both naturalistic and experimental settings. This rather strict avoidance of *that*-trace violations is not due to a general avoidance of producing *that* in *wh*-sentences. In the same experiment with the same set of participants, we found that speakers produced *that* in sentences containing *wh*-extraction from the matrix subject position such as in (9a) around 50 percent of the time, and they produced *that* in sentences containing *wh*-extraction from the embedded object position such as in (9b) around 7 percent of the time.

(9) a. Who thinks (that) the monk is splashing the doctor?
b. Who does the chef think (that) the monk is splashing?

Thus, speakers produce *that* when producing *that* does not result in a violation of grammatical constraints. Note, however, that speakers were much less likely to produce *that* in the sentences containing the extraction from the embedded object position than in the sentences containing the extraction from the matrix subject position. This pattern is consistent with the corpus study by Phillips (2013). Phillips found only 2

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instances of *that* production among 161 utterances containing extraction from the embedded object position. Thus, speakers seem to be, for currently unknown reasons, much less likely to produce *that* in utterances containing extraction from the embedded object position, such as in (9b), than in utterances containing extraction from the matrix subject position, such as in (9a) (see Chapter 10 for further discussion of this point). Nevertheless, these results suggest that speakers avoid violating the *that*-trace constraint rather strictly, even when they are encouraged to, via syntactic priming.

Finally, another study that my collaborators and I are currently conducting shows that speakers readily say sentences like (10a) but almost never produce sentences like (10b), according to the observation that an extraction of goal objects in double object constructions is ~~ungrammatical~~ (Kuroda 1968; Baker & Brame 1972; Merchant 2001).

(10) a. Who is the chef giving the book to? [prepositional dative]
b. *Who is the chef giving the book? [double object dative]

The data collection is still ongoing (n = 24 so far), but we found only 1 instance of sentences like (10b) in 432 trials. In the overwhelming majority of the trials, speakers used the prepositional dative structures such as in (10a). This contrast is unlikely to be due to an artifact of the task or due to a general dispreference of speakers to use double object dative structures in *wh*-sentences. The same speakers in the same experiment, with minimally different picture stimuli, readily produced both types of sentences:

(11) a. Who is giving the book to the chef? [prepositional dative]
b. Who is giving the chef the book? [double object dative]

In sum, speakers readily used both prepositional and double object dative structures in sentences with matrix subject extraction, but not in sentences with goal object extractions. Speakers do not produce sentences that violate constraints of long-distance extraction, including island constraints, the *that*-trace constraint, or the constraint on indirect object extraction in double object constructions.

So far, I have argued, perhaps rather optimistically, that the real-time syntactic representations that speakers build during production are isomorphic to representations of sentences described by syntactic theories built on acceptability judgment data. However, I should note that some evidence, mainly from syntactic priming studies, suggests that speakers' syntactic representations are not as detailed as I suggested. For example, Bock, Loebell, and Morey (1990) showed that sentences such as *The wealthy widow drove her Mercedes to the church* syntactically prime the prepositional dative production as much as real prepositional datives, presumably because both of them share the NP–PP sequence. They also showed that locative sentences like *The foreigners were loitering by the broken traffic light*

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primed passive sentences as much as real passive sentences, presumably because they both contain an auxiliary verb and a *by*-phrase (but see Ziegler, Bencini, Goldberg, & Snedeker 2019). In turn, the findings could be taken to suggest that sentence representation may not be detailed enough to distinguish between arguments and adjuncts or between agentive *by*-phrase and locative *by*-phrase. However, I should note that the fact that a certain tool (e.g. syntactic priming) is insensitive to a certain hypothesized difference is not evidence that the difference does not exist; i.e. the absence of evidence is not evidence for absence (see also the discussion of syntactic priming below).

In this section, I have reviewed the viewpoint that speakers represent abstract hierarchical representations that are detailed enough to encode subtle grammatical constraints. To the extent that this view is correct, syntactic theories provide theories of representations that are an essential part of theories of speaking, in the sense that theories of mental representations are essential for theories of mental processes.

26.4 Limitations and Potential Utility of Production Studies in Syntax

So far, I have considered the view that speakers represent abstract hierarchical representations that are detailed enough to encode subtle grammatical constraints in real-time production. Thus, there is little reason to believe that the nature of representations used in acceptability judgment tasks and the nature of representations used in constructing sentences during speaking are different. If this view is right, production data should reflect our syntactic knowledge, and thus production data should be relevant in developing theories of syntax, at least in principle. Next I will discuss how production data may (or may not) be useful in syntactic theorizing.

26.4.1 Limitations

Let me start with the limitations of production studies. Perhaps the most obvious limitation is that it is hard to control what people say. This makes it challenging to use production experiments to study varieties of key phenomena in syntactic theories (e.g. *wh*-movement with embeddings, comparatives, sentences involving multiple quantifiers, and sentences involving different types of pronouns and anaphora, among others). Researchers can devise a task that elicits complex sentences, but doing so requires creativity (see, e.g., F. Ferreira & Swets 2005). Also, complex tasks are often subject to criticisms on the basis of external validity (but see Mook 1983). In general, running production experiments on many syntactically interesting phenomena is challenging from a practical perspective.

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Furthermore, speaking is a complex behavior that is influenced by a currently unknown number of factors, one of which is syntactic knowledge. This is more or less true for other behaviors like acceptability judgments, but it is likely that the number of factors that influence production behaviors is vastly greater than the number of factors that influence acceptability judgment or comprehension tasks (~~Fodor (1983) has made a related point;~~ see also Chapters 1, 4, and 5 for discussion of the factors affecting acceptability). As a result, it is not straightforward to attribute observed differences in production behaviors to a specific cause, especially in non-experimental settings. For example, it may be tempting to infer that a particular sentence structure is not grammatical if one fails to see any instances of such a sentence structure in a naturalistic corpus (see Chapter 25 for related discussion). However, there are many potential reasons why speakers may avoid producing it. For instance, as I reported above, sentences with an embedded object extraction and an overt complementizer are rare in both naturalistic and experimental data. However, this does not mean that the structure is ungrammatical (or less grammatical than some baseline). Indeed, acceptability judgment data suggest that such sentences are likely to be grammatical (Ritchart, Goodall, & Garellek 2016). Speakers can avoid a particular sentence structure for a variety of reasons, and currently, there is no good understanding of what those reasons could be. Thus, making inferences about sentence representations based on production data is risky, likely riskier than making inferences about representations based on acceptability judgment data.

A related issue is that production data are fundamentally ill-suited to test the type of predictions that syntactic theories routinely make; i.e. a certain construction should be ungrammatical. Production data cannot offer definitive evidence that the structure is ungrammatical. Of course, this does not mean that production data should be ignored. The absence of evidence that a structure is grammatical can strengthen independent evidence that a certain construction is ungrammatical. However, there is an in-principle limitation of production data, and without complementary methods such as acceptability judgment, it is not possible to test the predictions of syntactic theories that a certain structure should be ungrammatical.

26.4.2 Potential Utilities

Of course, the fact that production studies on syntactically interesting phenomena are difficult does not mean that production studies are irrelevant for the study of syntactic representations. Indeed, production studies can corroborate or challenge insights from syntactic theories and, in the best-case scenario, they may even offer tests for competing theories of syntactic representations (with some caveats).

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26.4.2.1 Providing Converging Evidence

Some production studies can offer converging evidence for the basic distinctions and theoretical constructs that most syntactic theories have postulated based on acceptability judgment data. For example, as I discussed above, Fromkin (1971) and Garrett (1975) both showed, by analyzing speech errors, that basic theoretical constructs of syntactic theories, like morphemes, words, phrases, and abstract lexical and phrasal categories do exist as a unit in the speaker's mind, corroborating the acceptability judgment data combined with various constituency tests. Also, the fact that there is a syntactic priming effect (Bock 1986) suggests that phrasal categories are representational units of language. Melinger and Dobel (2005) suggest that simply presenting a verb in isolation is sufficient to obtain a syntactic priming effect for the structure that is strongly associated with that verb, suggesting that verbs encode some category-level syntactic information about their complements, in accordance with most theories of syntax (c-selection; see also Pickering & Branigan 1998). Griffn and Weinstein-Tull (2003), using sentence-recall tasks (cf. Potter & Lombardi 1990), showed that speakers were more likely to recall sentences like *John believed that Mary was nice* than near-synonymous object raising sentences like *John believed Mary to be nice*, after producing another sentence with an object raising construction (e.g. *A teaching assistant reported the exam to be too difficult*) compared to sentences with object control constructions (e.g. *Allen encouraged his roommate to be more studious*). This result corroborates the distinction between object raising and object control structures. Furthermore, Momma et al. (2018) and Momma and Ferreira (2019), using a variant of extended picture word-interference task (Meyer 1996; Schriefers, Teruel, & Meinshausen 1998), showed that speakers plan verbs with different timing when producing sentences with unaccusative verbs compared to when producing sentences with unergative verbs, suggesting that the unaccusative–unergative distinction is relevant at some level of representation (at either a thematic or a syntactic level). Also, as discussed above, speakers rather strictly obey constraints like island constraints, the *that*-trace constraint, and constraints that prohibit extracting goal arguments from double object constructions. These results do not necessarily distinguish between competing syntactic theories and analyses, in the sense that these are basic distinctions and theoretical constructs that most if not all syntactic theories postulate, but they do offer converging evidence that strengthens the foundations of existing syntactic theories.

26.4.2.2 Evaluating Competing Theories of Representations

Production studies may also be able to offer tests for two competing syntactic hypotheses that are hard to evaluate solely on the basis of

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acceptability judgment data, though with caveats. I introduce three case studies that may potentially be relevant for evaluating competing hypotheses in syntax.

26.4.2.2.1 *Passives*

In the syntax literature, how passive sentences should be analyzed is a major topic of research, because it has major consequences for broader theories of syntax, such as Case theory, the theory of movement, theta theory, theories of argument structures, and theories of acquisition. Roughly speaking, there are (at least) two lines of thought. Some propose that passives are derived from active counterparts (Chomsky 1957) or from underlying structures shared between actives and passives (Chomsky 1986) via movement operations. Others argue that passives are formed by lexical rules that change the argument structure of verbs (Freidin 1975; Bresnan 1982; Pollard & Sag 1994).

In the production literature, Bock, Loebell, and Morey (1992) argued that passives are not derived transformationally (see also Branigan & Pickering 2017), based on results from production experiments. In their experiments, speakers read aloud the following types of sentences as prime sentences.

(12) a. Five people carried the boat.
b. The boat was carried by five people.
c. The boat carried five people.
d. Five people were carried by the boat.

Subsequently, speakers described pictures that can be described by active sentences with an inanimate subject, such as the following:

(13) The alarm clock awakened the boy.

They measured the proportion of active sentences such as (13) in speakers' responses to the pictures. They found that speakers were more likely to produce active sentences like (13) after the active sentence primes like (12a) and (12c) than after the passive primes like (12b) and (12d). This is a standard syntactic priming effect (Bock 1986). More critically, they found that speakers were more likely to produce active sentences with inanimate subjects like (13) after the primes with inanimate subjects like (12b) and (12c) than primes with animate subjects like (12a) and (12d). In other words, Bock and colleagues found that speakers tend to preserve the mapping between animacy and the surface subject position, regardless of the voice of the prime sentences. I call this the animacy-function priming effect. Bock and colleagues (see also Pickering & V. Ferreira 2008) suggested that, on the ~~movement~~ account, speakers should show no (or weaker) animacy-function priming effect when the primes are passive sentences. This is because the animate argument (five people) is the

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underlying object in (12d). Speakers should tend to preserve the mapping between the animacy and object positions, so they should tend to use the animate argument (five people) as an underlying object if the transformational account is correct. This animacy-function priming effect for the deep object position should cancel out with the animacy-function effect for the surface subject position. Contrary to this prediction, their results showed that speakers produce more active sentences with inanimate subjects like (13) after primes like (12b) than (12d). Thus, speakers showed the tendency to preserve the mapping between the animacy and surface subject position, but not the mapping between animacy and the deep object position. Based on this pattern, Bock and colleagues argued that the transformational account of passives cannot explain their production data.

The validity of this argument depends on at least three assumptions, none of which can be false for the argument to hold. First, it was assumed that the passive transformation has a corresponding processing operation that transforms active sentences to passive sentences (in line with the *Derivational Theory of Complexity*, see Fodor, Bever, & Garrett 1974; Berwick & Weinberg 1986; Phillips 1996). Second, it was assumed that an animacy-function priming effect could be obtained for non-subject positions (so that the effect cancels out the competing animacy-function priming effect for the surface subject position). Third, the animacy-function priming effect should be equally sensitive to both levels of representations (underlying and surface representations). If all these assumptions are correct, their data may speak against the movement account of passive sentences. But each assumption can be challenged. This is not to argue that the results from Bock et al. (1992) are irrelevant to syntactic theorizing or should be ignored. Instead, the point is that the assumptions about the relationship between the representational claims and the behavioral effects need to be spelled out and tested independently.

26.4.2.2.2 *Syntactic Unaccusativity*

Intransitive verbs can be classified into two subclasses: unergative verbs, whose sole argument is an agent (e.g. *run*), and unaccusative verbs, whose sole argument is a patient (or theme, e.g. *fall*). This basic distinction is not in dispute; there are various signs of unaccusativity across different languages (including in the production data; Momma et al. 2018). The question is whether unaccusative–unergative distinctions are realized not only at the level of semantics, but also at the level of syntax. Kim (2006) showed that speakers were more likely to use passive sentences to describe a picture after prime sentences with unaccusative verbs compared with active transitive verbs. This result suggests that passives and unaccusatives are representationally similar, as syntactic accounts of unaccusative verbs suggest. As Kim admitted, alternative interpretations are possible if one assumes that a repetition of thematic role-grammatical function correspondence or thematic role-linear position correspondence can also

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induce a syntactic priming effect. However, if syntactic priming is insensitive to the mapping between thematic structures and linear order, as suggested by Bock and Loebell (1990) (but see Chang et al. 2003), Kim's results may suggest that unaccusative and passive sentences share the same (or similar) syntactic structures above and beyond the difference in thematic structures.

In comparison to Kim (2006), Flett (2006) showed that Spanish speakers tended to reuse postverbal or preverbal subject structures in unaccusative sentences, to the same degree after unergative and unaccusative primes. But this result does not show that unaccusative sentences and unergative sentences are indistinguishable syntactically. It shows that syntactic priming is sensitive to surface word order similarity (Tanaka et al. 2007) and is relatively insensitive to the thematic structure or non-surface syntactic structure. Thus, with an important caveat that the syntactic priming may not be purely syntactic, the result from Kim (2006) might suggest that unaccusatives are syntactically like passives.

26.4.2.2.3 *Representation of Ellipsis*

In the syntax literature, there is a debate about the representational nature of ellipsis sites. Some argue that the ellipsis site contains syntactic structure in addition to semantic structure (e.g Chung, Ladusaw, & McCloskey 1995; Merchant 2001). Others argue that only semantic structure is contained in the ellipsis site (e.g. Ginzburg & Sag 2000; Culicover & Jackendoff 2005). Xiang, Grove, and Merchant (2014) tested these possibilities using syntactic priming. In their study, they had speakers read the following sentence fragments:

(14) a. First Ralph sang a song to Sheila, and then [prepositional dative prime]
b. First Ralph sang Sheila a song, and then [double object prime]

These fragments of prime sentences were continued with one of the following:

(15) a. Marcus sang one to her. / Marcus sang her one. [non-ellipsis]
b. Marcus did. [ellipsis]
c. Marcus groaned. [neutral control]

In (15a), the continuation again contained the prepositional dative or double object dative structure overtly, and the VP structure matched with the VP structures of the preceding sentences. In (15b) the VP was elided, so there was no overt PD or DO structure. In (15c), the verb was an unrelated verb that did not bear an ellipsis dependency relation to the preceding clause. Xiang et al. found that speakers were more likely to use the structure that they encountered in the initial clause in the non-ellipsis condition and the ellipsis condition, but not in the neutral control condition.

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Again, with the important caveat that the syntactic priming may be sensitive to thematic structures, Xiang and colleagues' data may suggest that the ellipsis site contains syntactic representations that cause priming.

26.4.2.3 Caveats

Through the discussion of specific production studies, I have argued that production data can be relevant to syntactic theorizing but that the interpretation of these studies depends on the hypotheses about how representational claims connect to behavioral predictions. Such hypotheses can be called *linking hypotheses*, and they can vary independently from representational hypotheses (see Chapter 22 for extensive discussion of this and related issues). This point has long been noted in the comprehension literature (e.g. Miller & McKean 1964; Fodor et al. 1974; Berwick & Weinberg 1986; Phillips 1996; Townsend & Bever 2001; Marantz 2005; Phillips & Lewis 2013). For example, the derivational theory of complexity is a linking hypothesis that claims that more complex structures (e.g. in terms of the number of nodes in syntactic representations or in terms of the number of transformations necessary to derive a sentence, among other potential complexity measures) take more time to compute and thus more time to comprehend. When the derivational theory of complexity (which assumes that the number of transformations is a complexity measure) and transformational theory of passive sentences are combined, it is possible to predict that passive sentences should take more time to understand than active sentences (due to an additional transformation operation). Let's say that this prediction is incompatible with some behavioral data. That would mean that either the representational hypothesis is wrong or the linking hypothesis is wrong (e.g. Berwick & Weinberg 1986). Thus, even when behavioral data go against certain representational hypotheses, it is not always straightforward to make a strong inference about representations. This is especially so when the behavior of interest involves complex processes that are aected by multiple factors, as in the case of sentence production. It is necessary to spell out and test the assumed linking hypotheses before the behavioral data (including both production data and acceptability judgment data) can be used to support or disconfirm representational claims. This difficulty of connecting behavioral data and representational claims may be frustrating to psycholinguists (including myself) because it often prevents them from making a strong claim about representations based on psycholinguistic data. But that does not mean that the problem can be ignored.

26.4.3 Other Issues

26.4.3.1 Syntactic Priming as a Privileged Source of Data

Above, I have introduced varieties of syntactic priming studies and their potential utility and limitations in investigating the nature of syntactic

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representations. In short, syntactic priming can be used as a tool for investigating potential representational similarities between different sentences. In this sense, syntactic priming studies can provide an additional source of data for syntactic theories, provided that the precise cause of syntactic priming can reasonably be identified. I suspect that this claim is rather uncontroversial. However, some researchers have made the stronger claim that syntactic priming should be a privileged source of data for syntactic theories (Branigan & Pickering 2017). In short, Branigan and Pickering argued that syntactic priming should be more privileged than acceptability judgment, because it is implicit, because it is not (or less) affected by parsing factors, and because it can directly examine representations (rather than just whether a sentence is grammatical or not). They argued that acceptability judgment tasks, in comparison, require explicit decision-making tasks, that they involve the source ambiguity problem (explained below), and that they can only assess whether a sentence belongs to a set of grammatical sentences without being combined with constituency tests, which they argued are independently problematic. This claim is particularly relevant to the central theme of this handbook, so let me unpack their argument.

First, Branigan and Pickering claimed that syntactic priming is an implicit effect, but acceptability judgment tasks involve explicit decision-making processes. The syntactic priming effect can indeed be obtained without speakers' awareness (for the clearest demonstration, see V. S. Ferreira et al. (2008)) and it is indeed the case that acceptability judgment tasks require explicit decision making. However, it is not clear how and why implicit methods are better than explicit methods in investigating syntactic representations. Branigan and Pickering noted that the potential decision-making bias might contaminate acceptability judgment results. However, it remains unclear which specific decision-making bias affects the result of which specific acceptability judgment, in a way that is problematic for data interpretation. Of course, if researchers themselves are giving an acceptability judgment, it is important to be aware of potential confirmation bias, but this issue is entirely independent from whether acceptability judgment task should be used (see Chapters 1 and 4 for discussion).

Second, Branigan and Pickering argued that acceptability judgment tasks invoke what they call the source ambiguity problem, that is, acceptability degradation/improvement can be attributed to some factors other than the grammaticality of sentences. They implied that syntactic priming does not suffer from the same problem. However, the syntactic priming effect, or any other effects on complex behaviors for that matter, do suffer from the same problem. When studying a complex system like human language, it is rarely the case that an experimental effect can be attributed unambiguously to a single cause. As I reviewed above, it is far from clear what causes the syntactic priming effect. It may be due to the repeated

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thematic role–linear order correspondence (Bock et al. 1990; Chang et al. 2003), repeated linear order of words and constituents (Hartsuiker & Kolk 1998), or a repeated phrase structure sequence (Bock et al. 1990). It is important to be aware that the term syntactic priming as it is often used in the literature refers to a behavioral effect, not a cognitive mechanism. Thus, it is dangerous to make an inference about syntactic representation just because one observes an effect that can be described as "syntactic priming."

Finally, Branigan and Pickering argued that the acceptability judgment task only allows researchers to test whether a sentence belongs to a set of grammatical sentences in a language. That is, they argued that acceptability judgment tasks are a method that determines weak generative capacity. In comparison, they claim that syntactic priming can assess the representations directly, so it is a method that can determine strong generative capacity. This claim is simply false. As pointed out by Gaston, Huang, and Phillips (2017), acceptability judgment tasks are routinely used in assessing representational similarity (ellipsis, coordination), hierarchical relation (binding), and structural locality (*wh*-movement, relativization, topicalization, scrambling, among others).

In sum, syntactic priming can provide an additional source of data for syntactic theories, but it is not clear why syntactic priming should be viewed as a privileged source of data for syntactic theories. A reasonable view, in my opinion, is that which methodology is more suitable depends on what specific question a researcher is trying to answer. Syntactic priming is a good tool for detecting some similarities between two structures (e.g. see the discussion of Kim (2006) above). But it is not a particularly good tool for detecting differences between two structures, because the fact that two sentences prime each other does not mean that they are identical (see the discussion of Bock and Loebell (1990) above). Also, the failure to obtain a syntactic priming effect does not necessarily suggest that two structures are syntactically dissimilar, because syntactic priming is not necessarily sensitive to all aspects of syntactic representations and because there could be various reasons why a syntactic priming effect fails to be observed.

26.4.3.2 Breaking Circularity

Acceptability of sentences can be influenced by a variety of factors, including grammaticality, pragmatic naturalness, complexity, and frequency of constructions, among other factors. A critical task for researchers using acceptability judgments is to identify the source(s) of acceptability degradation/improvement. When researchers hypothesize that an acceptability judgment difference is not due to grammatical status, they need to offer an alternative explanation for the acceptability difference. One potential source of acceptability difference is the difference in the frequency of constructions (Greenbaum 1977, 1980; see

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Schütze (2016) and Chapters 1, 4 and 25 for discussion). However, the problem is that any frequency explanations of acceptability difference are circular and thus carry little explanatory force, because frequency explanations of acceptability difference need to explain why a certain structure is (in-)frequent to begin with. The same problem holds for frequency explanations of processing difficulties in comprehension. To break this circularity, there needs to be an independent explanation of why certain structures are less frequent than others. Such an explanation necessarily involves theories of speaking. Thus, studies of production can be useful in making a non-circular argument in syntax (and also in sentence comprehension research; see, e.g., MacDonald (2013) for an excellent example in comprehension research).

26.5 Conclusion

Theories of speaking seek to capture how speakers use syntactic knowledge during speaking. Thus, understanding the nature of syntactic knowledge is a central part of understanding speaking. In turn, speaking reflects, though imperfectly, the structure of their syntactic knowledge. Thus, production data can be used to test behavioral predictions of syntactic theories, when combined with articulated linking hypotheses that connect representations and behaviors. With the caveats and limitations discussed above, studies of speaking and studies of syntax can be mutually informative.

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