



EDITED BY

THOMAS

HOFFMANN

GRAEME

TROUSDALE

≡ The Oxford Handbook *of*
CONSTRUCTION
GRAMMAR

CHAPTER 21

PSYCHOLINGUISTICS

GIULIA M. L. BENCINI

21.1. INTRODUCTION

Psycholinguistics traditionally covers three broad areas: production, comprehension, and acquisition. First (L1) and second (L2) language acquisition are treated separately in this volume in the chapters by Diessel (L1) and Ellis (L2). This chapter focuses on the psycholinguistics of language production, which is concerned with specifying the representations and processes required to turn features of thought or preverbal ‘messages’ into linguistic expressions that can be phonologically encoded and articulated. Historically, to the extent that linguistics has taken psycholinguistic data to constrain theory development, it has done so more from comprehension than production. There are good reasons, however, to examine production data and to seek integration with theories of language production. I follow Bock (1995), in listing why. First, there is an observation made by Garrett (1980: 216, quoted in Bock 1995: 205) that “[t]he production system must get the details of the form ‘right’ in every instance, whether those details are germane to sentence meaning or not.” Bock elaborates, “There can be no argument about whether syntax, for example is ‘important’ in production, because the speaker as a matter of course creates those features of utterances that we call their syntax” (1995: 205). Second, “although variation in a speaker’s use of structures is often ascribed to a concern for making comprehension easier, it is likely that some variations serve only to make production easier” (1995: 207).

21.2. LANGUAGE PRODUCTION

21.2.1 A Consensus Model

Since the seminal work of Garrett (1975), language production researchers have worked within an overall functional architecture which, following Ferreira and Slevc (2007) I refer to as the ‘consensus model’ for production. Earlier reviews can be found in Bock and Levelt (1994) and in the classic volume by Levelt (1989). ‘Consensus’ should not be taken to signify unanimous agreement on the model, and I will address some of the past and presently debated issues later in this chapter. Unlike other areas of language research, however, there appears to be greater agreement among researchers both on the explananda for a theory of language production as well as the overall architecture of the system. To illustrate the overall organization of the model I will use as an example the planning of the sentence *The girl is giving flowers to her teacher* (Figure 21.1). The model takes as its starting point a representation of an intention to communicate a meaning, called the ‘message,’ followed by several processes of ‘grammatical encoding,’ and ends with a phonetic code interfacing with motor plans for oral/manual articulation. The message specifies conceptual and semantic information about entities and events and includes perspective-taking and information structure. Little experimental research has examined the nature of the representations in the message, and assumptions about this level are often derived from linguistics. Bencini and Goldberg (2000; see also Gries and Wulff 2005) examined the nature of messages using a categorization task (see section 21.2.4.3). Based on these results, along with additional experimental findings reviewed later in the chapter, I will suggest a revision of the message level within the consensus model. I then propose an integration of the revised language production model with constructionist approaches in section 21.2.6.

Grammatical encoding is the ‘linguistic engine’ of language production and is thought to involve separate processes of ‘selection’ and ‘retrieval,’ referred to as ‘functional’ and ‘positional’ processes, respectively (Garrett 1975; Levelt 1989; Bock and Levelt 1994). Functional processes select linguistic representations underspecified for certain types of information (i.e., phonology, inflectional morphology, and linear order). Positional processes retrieve the selected representations ‘filling in’ the underspecified information. Both functional and positional processing contain mechanisms that deal with content (lexical processes) and mechanisms that deal with the ordering of content units at different levels of granularity (structural processes). The lexical processes at the functional level are the selection of abstract lexical entries called ‘lemmas,’ suitable for conveying lexical meanings. Lemmas contain semantic and syntactic information (but crucially no phonological information). The structural processes of the functional level assign lemmas to grammatical roles suitable to express the semantic and pragmatic distinctions specified in the message.

Function assignment is influenced by message level variables (conceptual, semantic/pragmatic) but also by production specific pressures related to the

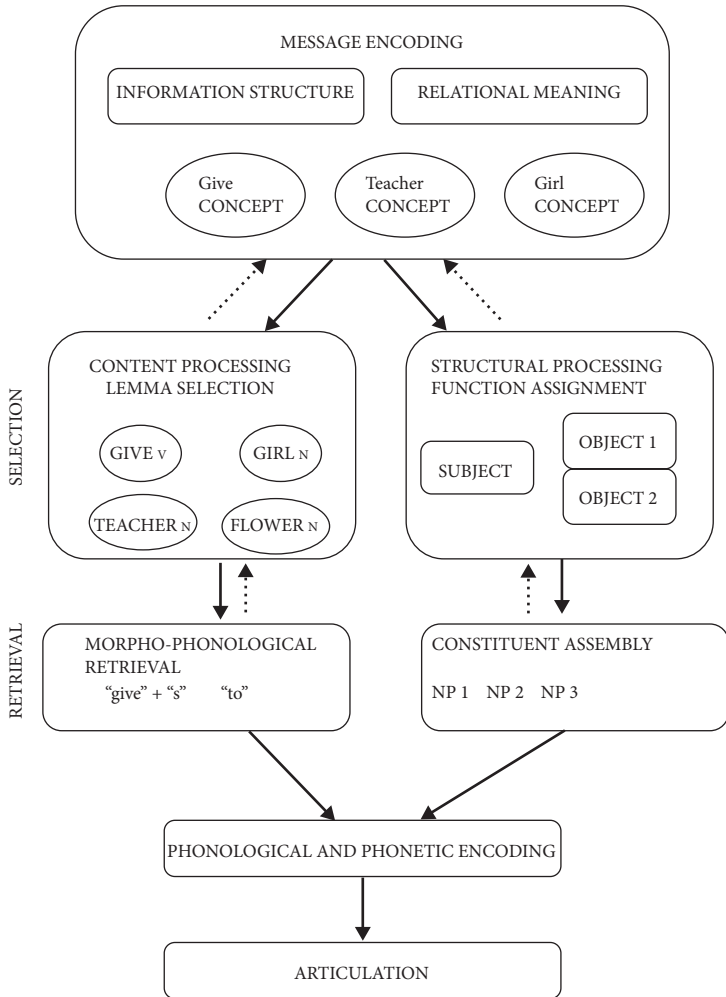


Figure 21.1. Schematic representation of consensus model for language production. Information flow through the system is indicated to be one way, from ‘top’ to ‘bottom’; but bidirectional flow, via feedback between levels, is possible (dotted arrows).

processing dynamics of language production, such as the ease with which referents are retrieved from memory (‘accessibility’). It is a contention of this chapter that, in addition to meaning and listener-oriented constraints, production constraints also provide a valuable window into understanding how processing/usage shapes grammars, for example, in the area of word-order phenomena. As we will see, production may in fact provide the functional motivation for the existence of constructions that allow for word order flexibility.

The lemma level is assumed to be an abstract, modality neutral level of representation, shared between the processes of comprehension and production, both written and spoken. In the example *The girl gives flowers to her teacher* the functional level would select lemmas for GIRL, TEACHER, FLOWER, GIVE, and TO and assign the Subject function to GIRL, the Direct Object function to FLOWER,

and Oblique to TEACHER. The next level is positional processing. Lexical processing at the positional level involves the retrieval of the abstract phonological codes of words called 'lexemes' containing an overall specification of a word's syllable structure and abstract segmental information (CV structure). Structural processes at the positional level create linearized sentence frames with open slots for closed class items such as inflections and determiners. The consensus model assumes that dominance relations are computed separately from linear order relations. It is only at the positional level that surface linearization of constituents (word order) is assumed to take place.

A long debated issue within the consensus model is how information is processed through the system, that is whether processing is 'serial' and 'discrete' (Levelt 1988; Levelt et al. 1999), or whether it is 'interactive' or 'cascading,' allowing for lexemes to be accessed before lemmas are fully selected. Some variants of the model also allow for information to flow backwards (via 'feedback') from the phonological level of the lexeme to the lemma level (Dell 1986; Cutting and Ferreira 1999; Rapp and Goldrick 2000). Although the issue of information flow through the system is important, it does not substantially change the overall architecture of the production system. More substantial challenges to the consensus model come from challenging the lemma/lexeme distinction and the existence of modality neutral lemmas in favor of modality specific representations that combine properties of lemmas and lexemes (see section 21.2.4.1).

21.2.2 Empirical Evidence for the Two-stage Model

Garrett proposed the two-stage architecture on the basis of speech error data (e.g., Garrett 1980). There are qualitatively two types of errors: those sensitive to the semantic and syntactic properties of words, and those sensitive to a word's phonological form. Subsequent evidence came from experiments such as sentence recall and priming. For example, Bock and Warren (1985) showed that 'conceptual accessibility' (the ease with which the referent of a Noun Phrase can be retrieved from memory) affects the functional level and not the positional level, hence providing experimental evidence for the distinction between these two levels. In a sentence recall paradigm, they manipulated conceptual accessibility by manipulating the imageability of the NP referents (high/low imageability) in active/passive, ditransitive/prepositional datives, and in active sentences containing an object conjunct clause (e.g., *The lost hiker fought time and winter*). Speakers placed accessible material in subject position for actives and passives and in direct object position for datives. Accessibility, however, did not affect the ordering of conjuncts. Bock and Warren (1985) deduced that conceptual variables affect the mapping from the message level to the abstract (unordered) grammatical level of function assignment, whereas phonological variables (e.g., length, phonological relatedness to a prime) affect linear ordering and phonological encoding at the positional level.

Bock (1986a) also provided evidence for the distinction between functional and positional processing using a lexical priming procedure. Speakers described pictures of transitive events (e.g., lightning striking a church). Before each picture, participants were primed with a word in one of four conditions obtained by crossing relatedness (semantic, phonological) and semantic role (agent, patient). So, for example, the word could be semantically related to the agent (*thunder*) and the patient (*worship*) or phonologically related to the agent (*frightening*) and the patient (*search*). Results showed that semantic, but not phonological priming increased the probability of assigning the lemma to subject role. More actives were produced after semantically priming the agent and more passives were produced after semantically priming the patient; crucially, phonological priming did not have this effect.

One problem with these early experimental studies on English, however, is that the effect of conceptual accessibility on function assignment always results in earlier placement of the NP in the sentence (e.g., as either the subject of an active or a passive sentence). It is thus difficult in English to disentangle whether accessibility affects NP placement in the sentence directly (at the positional level), or indirectly (at the functional level) by assigning the more accessible lemma to a grammatical function that then happens to occur earlier in the sentence. Language production researchers have increasingly added a crosslinguistic dimension to research, examining these questions in languages where grammatical function and linear order can be more easily decoupled than in English (see section 21.2.4.2).

21.2.3 Production Specific Influences on Grammar

In this section I present two highly studied production specific processing phenomena: (1) ‘incrementality’ and (2) ‘accessibility’ and I suggest that they have a role in shaping grammars. They also serve to illustrate how grammars can be the result of an interaction of different functional pressures from both comprehension and production, alongside structural/typological variation operating over diachronic time. I propose that word order variations corresponding to classic ‘alternations,’ in addition to being associated with subtle meaning differences (Goldberg 1995), are also motivated by the dynamics of lexical retrieval during on-line spoken production.

21.2.3.1 Incrementality

Early mention of referents in speaking is linked to the dynamics of language production, specifically to incrementality—the notion that grammatical encoding proceeds efficiently by processing material as it becomes available, thus reducing the amount of advanced planning required before articulation.

The extent to which production is incremental is an active topic of research, with some studies suggesting a higher degree of incrementality (Kempen and

Huijbers 1983; Ferreira 1996; Roelofs 1998; Ferreira and Dell 2000; Kempen and Harbush 2003) and others a greater degree of forward planning (Bock 1986a; Ferreira and Swets 2002; van Nice and Dietrich 2003). Incrementality may also be context dependent. For example, Ferreira and Swets (2002) found that speakers were more incremental when they were given a deadline to initiate production. The finding that incrementality may be context sensitive suggests that the language production system operates by optimizing its resources (Ferreira and Henderson 1998; Ferreira and Swets 2002). It also highlights the needs for studies in a variety of testing conditions, as well as more naturalistic contexts (Gries, this volume).

21.2.3.2 *Accessibility*

Accessibility is the ease with which representations are retrieved from memory. A large number of factors has been found to affect accessibility, including ‘imageability’ (Bock and Warren 1985), ‘animacy/humanness’ (Bock, Loebell, and Morey 1992; Prat-Sala and Branigan 2000), ‘prototypicality’ (Onishi et al. 2008), ‘previous mention/priming’ (Bock and Irwin 1980; Bock 1986a; MacWhinney and Bates 1978; Prat-Sala and Branigan 2000; Ferreira and Yoshita 2003), and ‘visual salience’ (Gleitman et al. 2007).

Accessibility and incrementality provide an additional motivation for the existence of word order variations, including classic grammatical ‘alternations.’ Word order variation allows speakers to be incremental and produce more accessible material earlier, increasing processing efficiency (Bock 1982; Ferreira and Dell 2000). It will be important to systematically examine the interaction between production tasks with different timing constraints (deadline/no deadline), complexity (e.g., Ferreira 1991), as well as communicative setting (isolated language production vs. dialogue). Whatever the findings, it is clear that production specific pressures have effects on grammar and thus need to be taken into consideration in addition to semantic-conceptual (message level) effects and listener-based, or ‘audience-design’ effects.

21.2.4 **Debates in Language Production**

21.2.4.1 *Are Lexical Representations Modality General or Modality Specific?*

In recent years the two-level architecture has been challenged both at the level of lexical and structural processing. Let us start with lexical processing. Recall that in the consensus model the lemma is a modality neutral semantic/syntactic representation and the lexeme is a modality specific representation (phonological, graphemic, gestural). Caramazza and colleagues, however, have rejected the lemma/lexeme distinction on neuropsychological and experimental grounds (see Caramazza 1997, for the initial challenge) arguing instead for a model that does away with the abstract amodal lemma in favor of a unique representation that,

in the case of language production, combines syntactic, semantic, and phonological information. In this approach, all of a word's properties—syntactic, semantic, and phonological—operate in parallel to determine its position in a linearized string (e.g., Alario and Caramazza 2002). Note that although this view may *prima facie* evoke the representations assumed in parallel architecture linguistic models (e.g., Jackendoff, this volume) this model actually denies the existence of amodal representations shared between the processing systems and argues for separate/separable entries for each input/output modality, including separate input representations for listening and reading, and separate output representations for speaking and writing.

Neuropsychological evidence for the modality specific nature of grammatical and phonological representations comes from brain-damaged individuals who exhibit modality by grammatical category dissociations. The most striking case is the existence of a double dissociation within a single subject who showed a noun/verb dissociation with more impaired naming for nouns than verbs in the spoken modality, and the opposite pattern in the written modality (Hillis and Caramazza 1995; Rapp and Caramazza 2002). There is also more recent experimental evidence for the interaction of grammatical category and phonological relatedness on the ordering of short multiword strings. Janssen and Caramazza (2009) found evidence that phonological relatedness differentially affected the time it took speakers to produce the first word in word sequences with words from same versus different grammatical classes (noun–noun, noun–adjective, adjective–noun, adjective–adjective–noun combinations).

The debate over whether the language processing systems operate on modality specific representations or whether there are instead (or in addition) modality general representations shared between the processing systems has consequences beyond psycholinguistics and the relationship between the processing systems. For example, it has consequences for acquisition, because it implies that learning in one modality (e.g., learning in comprehension) should not transfer directly into learning in the other modality (e.g., learning in production). Beyond psycholinguistics, it also has consequences for the relationship between linguistics and psycholinguistics. A strong version of the cognitively and neurally separate representations view would undermine the relevance of linguistic representations gleaned from judgments of acceptability/grammaticality (another form of computation/representation) to their involvement in understanding and producing language. I will return to the question of whether there is evidence for modality neutral sentence representations in section 21.2.4.4.

21.2.4.2 How Many Steps to Produce Words in Order?

With respect to structural processes, the distinction between the two levels of function assignment and linear ordering has also been challenged. Evidence against this distinction comes from a particularly powerful experimental technique that has been used extensively to examine the architecture and mechanisms

of language production: structural priming. Structural priming refers to the tendency of speakers to produce previously experienced sentence structures. In the classic demonstration by Bock (1986*b*), priming was found with Active/Passive and Ditransitive/Prepositional Dative constructions. Speakers were more likely to describe two-participant transitive events (e.g., a picture of a bee stinging a man) with a passive sentence if they previously heard and repeated a passive (e.g., *The 747 was alerted by the airport control tower*). As in other types of priming, if previous processing of a stimulus influences the processing of a subsequent stimulus, we can infer that the cognitive system is sensitive to the overlapping dimensions (e.g., structure, semantics, etc.) between the priming stimulus and the subsequent target stimulus. By varying the dimensions of overlap between priming sentence and target sentence (e.g., Bock 1986*b*, 1990; Bock and Loebell 1990; Pickering and Branigan 1998) priming has allowed researchers to study the linguistic representations involved in language production (Branigan et al. 1995). Using a structural priming paradigm, Pickering et al. (2002) argued for a single model of production in which dominance relations and linear order are computed simultaneously, based on the finding that dominance relations alone do not exhibit priming: “shifted” prepositional datives such as *The driver showed to the mechanic the overalls with the stains* do not prime nonshifted prepositional datives such as *The mechanic showed the injury to the doctor*.

In addition to evidence from structural priming, another approach to determine whether the language production system is staged with respect to the computation of dominance relations and linear ordering comes from studies on languages with more flexible word orders that allow linear order to be decoupled from grammatical roles. As we saw in section 21.2.3, the accessibility of a referent influences the assignment of the corresponding NP to subject position in English (Bock 1986*a*), in turn resulting in the placement of that lemma earlier in the sentence. This raises the question as to whether the accessibility of a lemma affects early mention of that lemma directly, or indirectly via assignment to subject—and subject happens to occur earlier in English. This question was examined recently in Japanese, which allows both subject–verb–object (SOV) and object–verb–subject (OVS) sentences in both active and passive forms (distinguished morphologically on the verb). Branigan et al. (2008) found that greater conceptual accessibility had an effect both on function assignment and on linear ordering. In a sentence recall paradigm, Japanese speakers assigned more conceptually accessible (animate entities) to subject function independent of word order, and conversely, they preferred to place more accessible entities earlier in sentences, independent of grammatical function. Based on these results, the authors argued that dominance and linear order are computed in one stage.

It is beyond the scope of this chapter (and perhaps too early) to resolve the issue of whether functional and positional processing should be separated. An answer may come from the convergence between functionally oriented linguistic typology and psycholinguistics. There is a growing body of crosslinguistic psycholinguistic research over a more typologically diverse empirical base than what dominated

the first thirty years of research. The picture that seems to emerge is one in which processing constraints (from production and comprehension) interact with the individual grammatical properties of different languages both in normal (Bates and Devoscovi 1989; Bates and McWhinney 1982; Yamashita and Chang 2001, 2006) and cognitively impaired speakers (e.g., see Bencini et al. 2011). Generally, it is becoming apparent that crosslinguistic psycholinguistics is needed in order to determine both which aspects of the processing systems may be universal and which ones result from the interaction between processing constraints and grammatical variation.

21.2.4.3 *Structural Influences in Sentence Production*

Within a larger debate in cognitive science (Rumelhardt and McClelland 1986; Fodor and Pylyshyn 1988), questions about the existence of abstract, structural representations and processes operating independently of specific content have dominated much research in all areas of psycholinguistics. The use of the term 'abstract,' however, needs to be qualified relative to the theory one assumes. In linguistics, what is 'abstract' in one framework may be too concrete in another theoretical approach. In psycholinguistics the terms 'structural' and 'abstract' representations, however, are to be understood in contrast to lexically specific representations, and more generally the associated view that the lexical requirements of specific words (typically, verbs) are the driving force in sentence comprehension (e.g., MacDonald et al. 1994), production (e.g., Bock and Levelt 1994), and acquisition (e.g., Tomasello 1992; 2000a). Within language production, the representations assumed are generally surface oriented, nonderivational (but see F. Ferreira 2000; Ferreira and Engelhardt 2006), and philosophically compatible with the types of representations assumed in the constructionist tradition (Goldberg 1995, 2006a; including Sign-Based Construction Grammar, see Michaelis, this volume; the parallel architecture model of Jackendoff 2002a, this volume) and in 'simpler syntax' approaches (Culicover and Jackendoff 2005). The structural view is neutral as to whether sentence structures are stored or whether they are assembled on-line (Jackendoff 2002a). The crucial point is whether the production of sentence form relies on the retrieval of specific words, or whether it is independent of it (Konopka and Bock 2008).

Clearly, producing well-formed sentences requires knowledge of individual words/lemmas and their semantic and syntactic properties. There is a large body of evidence pointing to the existence of lexically specific representations in psycholinguistics (Bock and Levelt 1994; McDonald et al. 1994; Lieven et al. 1997; Tomasello 2000a; 2000b, *inter alia*). At issue is the extent to which structural information (e.g., whether a speaker produces a ditransitive or prepositional dative sentence structure) necessarily requires prior selection of a lexical entry (e.g., a verb) or whether, alongside lexical representations/processes, there are lexically independent mappings from relational meanings in the message to grammatical encoding.

According to lexicalist views of sentence production (e.g., Bock and Levelt 1994; Ferreira 2000) the sentence level representations that organize speakers'

utterances are intrinsically bound to the verb lemmas that are assumed to license them. This view amounts to a projectionist view of the relationship between verb, sentence structure, and sentence meaning, a view that has dominated much of psycholinguistic research not just in production but also in comprehension and in acquisition. According to abstract, structural (or frame-based) views of sentence production (e.g., Wardlow Lane and Ferreira 2010; Konopka and Bock 2008; see Bencini and Goldberg 2000; Goldberg and Bencini 2005 for a constructionist perspective), sentence production operates on representations that segregate lexical and structural information. That is, lexical items and sentence structures are separately retrieved/assembled on the basis of message representations. In the example above, the ditransitive sentence frame is not activated solely by the selection of the verb *give*, rather it results from 'give' and an abstract (lexically independent) mapping from the speaker's intention to describe a three participant encoding of an event to an allowable sentence structure suitable to express the speaker's message.

The classic lexicalist/projectionist view of the relationship between verb, sentence structure, and sentence meaning is one that, starting with Goldberg's (1995) work in linguistics, was challenged both on theoretical and experimental grounds (Goldberg 1995; Bencini and Goldberg 2000; Goldberg and Bencini 2005). I refer the reader to Goldberg's seminal work for the linguistic arguments; here I briefly review some of the experimental evidence. Bencini and Goldberg (2000) used a categorization task in which they pitted verbs against constructions in determining overall sentence meaning. They found that native English speakers categorized sentences based on overall meaning by taking into account the overall argument structures of sentences, in addition to verbs. These results suggest a contribution of sentence structure to sentence meaning, independent of verb meaning. Returning to the consensus model of language production, these results shed light into the message level of encoding, under the assumption that the message is shared between the processing systems.

In language production research proper, there are three experimental sets of results that provide evidence for the existence of lexically independent structure building operations in language production in addition to lexical representations. I will start with the classic one, based on evidence from structural priming. The original structural priming studies by Bock and colleagues (e.g., Bock 1986*b*; Bock and Loebell 1990) demonstrated that speakers repeated sentence structures from priming sentence to target sentence even when the prime and the target did not use the same content words, and importantly for our purposes, did not share verbs. The existence of structural priming in the absence of shared lexical content indicates that the processor is sensitive to shared semantic/syntactic structures independent of lexical content. Pickering and Branigan (1998) extended these findings by manipulating the amount of lexical and morphological overlap between the verbs in the prime and in the target. They found an enhanced priming effect when the verb was repeated between the prime and the target, which is now referred to as the 'lexical boost' effect in structural priming. They also found that priming

was unaffected by whether tense, aspect, or number of the verb stayed the same or differed between prime and target.

Pickering and Branigan (1998) proposed a model of verb lemmas that includes links to a verb's multiple argument structures, called 'combinatorial nodes.' In this model, when *give* is used in a ditransitive construction the combinatorial nodes NP NP are activated. When *give* is used in the prepositional dative, the NP PP nodes are activated. Combinatorial information is not linked to a particular morphological instantiation of a verb form (its lexeme) but to the verb lemma, hence it can be activated cross-modally. Although this model accounts both for lexically independent priming and the lexical boost effect, it is still a lexically driven model of language production in that the verb lemma specifies the subcategorization preferences (combinatorial nodes) as part of its stored lexical representation.

A more recent experiment by Konopka and Bock (2009) also used a priming paradigm to pit lexical versus structural guidance views of sentence production. They examined priming between active transitive sentences containing idiomatic (i.e., semantically noncompositional) phrasal verbs (e.g., *pull off a robbery/pull a robbery off*) and nonidiomatic phrasal verbs (e.g., *flip over a pancake/flip a pancake over*). The question was whether particle placement could be primed in idioms and nonidioms alike. They also examined whether priming would be influenced by the degree of structural flexibility of the phrasal verb (e.g., frozen idioms like *Mary's grandpa finally gave up the ghost/*gave the ghost up* vs. flexible idioms like *The hikers broke their new boots in/broke in their new boots*; frozen nonidioms like *The new material gave off a weird smell/*gave a weird smell off* vs. flexible nonidioms like *Judy snapped on her earrings/snapped her earrings on*). On a lexicalist model of production, sentences with idiomatic particle verbs should be stored and retrieved as lexical entries (more akin to lexical access), and not produced via the regular route assumed for sentence generation (function assignment/constituent assembly). On a structural model, in contrast, the structure building mechanisms should operate for idiomatic and nonidiomatic phrasal verb constructions alike. On a lexical view, therefore, idiomatic primes are predicted to exhibit reduced priming effectiveness compared to nonidiomatic primes. On a structural view, priming is predicted to be qualitatively and quantitatively similar for idioms and nonidioms. Consistent with a structural view, the results showed identical priming patterns for idioms and nonidioms (both as primes and as targets). For both idioms and nonidioms alike, structural inflexibility reduced the effectiveness of priming. These results argue for a view of production in which the operations responsible for generating surface structure are lexically independent even for multiword expressions that are semantically noncompositional.

A third set of results bearing on the issue of lexically versus structurally guided sentence generation comes from an error-elicitation paradigm in which speakers are asked to rapidly repeat short sentences or phrases under conditions that make errors likely. Wardlow Lane and Ferreira (2010; see also Ferreira and Humphreys 2001) elicited so-called 'stem exchange' errors in which words of different syntactic categories exchange positions, often stranding an inflection. For example, a

speaker who erroneously utters *I roasted a cook* has exchanged an intended verb *cook* with a noun *roast*, producing what appears to be an ill-formed utterance with a noun erroneously produced where a verb was intended and vice versa. Ferreira and Humphreys (2001), however, noted that many stem exchange errors involve words that are formally ambiguous as to category membership, raising the possibility that, in fact, stem exchange errors are syntactically well-formed (i.e., that *roasted* is really a verb). Because the stems for the verb and noun forms for *cook* and *roast* are indistinguishable, Wardlow Lane and Ferreira selected noun and verb forms that differ in stress placement, or *stress-shifting* stems (the noun form *REcord*, vs. the verb form *reCORD*). If speakers can be induced to make stem exchange errors with stress-shifting stems, it is possible to determine the syntactic category of the stem. The authors elicited errors under two structural conditions: a syntactically constraining condition, which forced category membership, and a syntactically neutral condition that did not. Participants heard pairs of words (e.g., *REcord*, *hate*) and were instructed to produce the words in either one of two frames, prompted on the screen: either in a syntactically constraining transitive frame (Use: _____ the _____) or syntactically neutral conjunct clause (Use: _____ and _____). Participants were also instructed to either repeat the words in the sequence given, or to swap their position. Swapping was included to maximize the chances of producing errors, but it only occurred on filler trials, never experimental ones. The question was whether speakers would be more or less likely to produce errors as a function of the production template provided. On a structural view, speakers should be constrained by the transitive frame to produce a verb form in the first slot, and a noun form in the second slot. More errors should occur resulting in a stress-shifted stem with stress on the second syllable (i.e., resulting in a verb stem) in the syntactically constraining frame than in the syntactically neutral frame. On a lexical view, the rate of such errors should not differ across frames. Results confirmed the predictions of the structural view, suggesting that even in the generation of speech errors, constraints from lexically independent sentence templates operate in sentence production. Ferreira and Wardlow Lane make the interesting proposal that the morphological conversion mechanism that is required to account for these results (changing the noun stem into a verb stem) has a functionally based motivation within the processes of production. In order to maintain fluency and preserve well-formedness in the face of the challenges of lexical retrieval, speakers may exploit morphological conversion on the fly. A speaker who starts to say *I am waiting for the...* but erroneously retrieves the verb form *deliver*, rather than producing the ill-formed *I am waiting for the deliver* can resort to morphological conversion and produce *I am waiting for the delivery*. As in the case of word order flexibility, the existence of morphological relations and processes that provide the system with flexibility in lexical retrieval during sentence production will be advantageous to the cognitive system (Bock 1982; Ferreira and Dell 2000).

To summarize, three independent lines of experimental evidence in language production suggest that producing sentences involves both lexical representations and processes and lexically independent structural processes. This is in no way to

deny the importance of lexical processes in language use; examples of lexical effects abound in all three areas of psycholinguistics. In language production, lexical and structural processing must converge to produce well-formed utterances; but crucially, structural processes do not rest upon prior lexical access and retrieval.

The evidence points to the existence in language production of structurally mediated mappings from message level relational representations (e.g., ‘Two participant event structure,’ ‘Three participant event structure’) to structural representations. As I understand them, these mappings correspond to the abstract Argument Structure constructions as developed in Goldberg (1995; 2006a).

21.2.4.4 The PC Problems: Performance/Competence and Production/Comprehension. Are There Shared Structural Representations?

Linguistics is a theory of the knowledge that native speakers have of their language. A contentious, yet foundational question is whether the representations discovered by linguists are also *directly* engaged in the processes of understanding and producing language. The answer is ‘yes’ according to the Strong Competence Hypothesis (Bresnan and Kaplan 1984) and ‘no’ according to what Bock et al. (2007) call the Weak Competence Hypothesis. Linguists, irrespective of theoretical inclination, fall on both sides of the debate—expression of a commitment to convergence with psycholinguistics can be found both in exponents of mainstream generative linguists (e.g., Marantz 2006), as well as within constructionist and usage-based approaches such as those represented by many of the chapters in this volume. A related question is whether production and comprehension engage one unique representational system, or whether linguistic representations are split along performance lines: the representations for comprehension not needing to be identical to those required for production (Clark and Malt 1984). The weak competence view finds more adherents within psychology and neuropsychology than in linguistics; it seems safe to say that linguists, irrespective of theoretical inclination, view linguistic knowledge as a unique system of representations. Evidence for separate knowledge representations underlying performance in different modalities comes from intuitive observations, such as the fact that one’s comprehension of different linguistic variants and dialects typically surpasses one’s production abilities (Clark and Malt 1984). Neuropsychological evidence (see section 21.2.4.1) also provides support for the view that different knowledge representations for lexical items underlie comprehending, reading, speaking, and writing.

The first question (Performance/Competence) may be more epistemological in nature; whether the representations posited with traditional linguist methods converge with those of psycho/neurolinguistics will be a matter of scientific success of the theories that cover the largest number of phenomena (Marantz 2006). The second question, whether production and comprehension share the same amodal sentence representations, has recently been investigated directly, using a spoken comprehension to spoken production structural priming technique (Bock et al. 2007). Speakers described pictures after having been exposed to spoken sentences in different

structures (active/passive; ditransitive/prepositional dative), which crucially, they did not repeat. Because priming involves the reusing of previous representations/processes, Weak Competence predicts that processing a prime sentence through the comprehension system alone (listening without repeating), should not engage the same representations/processes as does actually producing the primes (listening and repeating), and hence comprehension to production priming should not mirror production to production priming. Strong Competence, on the other hand, predicts similar amounts of priming across modality. Consistent with the predictions of Strong Competence, results showed remarkably similar cross-modal priming, both in terms of magnitude and temporal duration, to previous within-modality priming results (Bock and Griffin 2000). These findings argue strongly for the existence of modality general shared sentence level representations between comprehension and production. Because priming was not contingent on lexical overlap, the representations are also structural and abstract. Similar cross-modal priming results also can be found for spoken to written priming (Pickering and Branigan 1998), arguing for shared representations irrespective of output modality (speaking/writing).

The mechanism that ties representations in one modality to other modalities is not yet understood. One possibility is that the links are tied to the mechanisms of language acquisition (F. Chang 2002; F. Chang et al. 2006). In this view, structural priming (whether within or across modality) supports learning and generalization in language production by creating new utterances from old structures. Cross-modal priming takes this further, and allows generalized and abstract enough language learning to occur from listening to speaking. Evidence that abstract (verb independent) structural priming occurs in very young children can be found in Bencini and Valian (2008) and will be reviewed in section 21.2.5. Shimpi et al. (2007) also found cross-modal abstract priming, in slightly older children. These findings corroborate the function of priming as a mechanism for language learning.

Another intriguing possibility is that cross-modal priming is tied to perception/action coupling as part of a general tendency for representational alignment during dialogue, with structural priming being the most abstract form of alignment to date (Pickering and Garrod 2004). This places structural priming within the realm of social imitation and more speculatively mirror systems (Gallese et al. 1996). It is an open question as to whether these two options are independent, whether the comprehension/production link exploits pre-existing mirror circuitry, or whether the existence of within-system modality general representations linking an individual's processing systems affords social imitation. Either way, both mirror systems and within individual perception/action links require that the system have the representational vocabulary in abstract enough format to allow generalization over event participants/semantic roles, in the case of mirror systems, and generalization over event participants and predicates, in the case of structural priming. In all of these cases, the representational vocabulary in Construction Grammar, with slots for participants and predicates (e.g., Goldberg 1995) is both the necessary and sufficient amount of abstraction to allow for learning and generalization in language (F. Chang 2002; Dominey and Hoen 2006).

21.2.5 The Developing Language Production System

In this section, I examine language acquisition from a processing perspective choosing to focus on the development of the language production system, and a question that has been at the center of recent debates in the acquisition literature. I refer the reader to the chapters by Diessel and Ellis (this volume) for a more extensive treatment of language acquisition. The question is whether children's early multiword utterances rely on an abstract vocabulary with generalizations over classes of words (e.g., N, V, NP, VP) and generalizations over argument structures, such as Active, Passive (Early Abstraction Hypothesis), or whether they are more concretely organized around lexical knowledge (Lexical Specificity Hypothesis).

Until recently, comprehension and production data in child language pointed to a 'paradox' in which children appeared to rely on abstract representations in comprehension (Naigles 1990; Fisher et al. 1994; Naigles et al. 2005; Gertner et al. 2006), and lexically dependent ones in production (Lieven et al. 1997; Childers and Tomasello 2001; see Tomasello 2000*b*, for a review). Here I review evidence for abstract (verb-independent) representations in young children's language production. The evidence once again comes from structural priming. Bencini and Valian (2008) examined priming in young 3-year-olds (age range 2;11–3;6) in the absence of verb overlap and controlling for animacy (see Huttenlocher et al. 2004 for similar findings with older children; Shimpi et al. 2007; and Savage et al. 2003, for contrasting results). Because lexical retrieval is a computationally demanding production operation (Bock 1982), reasonably all the more so for young children, the priming phase was preceded by a lexical warm-up phase for nouns and verbs. Verbs were presented in the gerund (e.g., "look, here is stirring"). During priming, the experimenter described a picture (e.g., *the milk is stirred by the spoon*) and then the child repeated. This was followed by a 'Your Turn' trial, in which the child described a target picture (e.g., a picture of a hammer cracking an egg). Using stricter criteria for what counted as a passive than typical in child studies, the results showed abstract priming of passive sentences. This finding supports the existence of abstract (verb-independent) representations in young 3-year-olds' language systems. Shimpi et al. (2007) found similar results (with the caveat that animacy was not properly controlled, and scoring criteria were laxer) with active/passive and ditransitive/prepositional datives. They also found that abstract priming operated cross-modally (from comprehension to production) for 4- and 5-year-olds, but not for 3-year-olds. The reason for this is yet unknown, but important to pursue. One series of issues is whether it is a consequence of the learning mechanism: does production to some extent proceed separately from comprehension? Or do representations have to be strong enough to be activated cross-modally?

Many questions remain to be answered about the nature of priming in acquisition, for example, whether, as suggested for adults (Chang et al. 2006), it is a form of implicit learning (Savage et al. 2006). Bencini and Valian (2008) found evidence for learning over trials when scoring criteria were relaxed and learning

occurred rapidly, over a total of 8 trials. Priming has proved successful in answering basic questions in acquisition whose relevance extends beyond acquisition to models of language production (Chang et al. 2006) and to linguistics. Importantly for constructionist approaches, they seem to offer the 'right' level of generalization to describe young children's sentence production. Constructions may play an important role in language learning as they provide a means for children to generalize beyond the input. On the other hand, this level of generalization is not so abstract that it cannot be learned from the input via general learning mechanisms (e.g., Goldberg 2006b).

21.2.6 Integrating Constructions into a Theory of Sentence Production

The evidence reviewed in the previous sections supports the existence of lexically independent, modality independent structural representations represented in the message (Bencini and Goldberg 2000) and used during sentence production (e.g., Wardlow Lane and Ferreira 2010). The acquisition studies show these representations are developed early (e.g., Bencini and Valian 2008).

In this section, I offer a natural integration of these results with the model proposed in Goldberg (1995) on the basis of linguistic data. Two different scenarios can occur in production. The first involves the integration of a construction (ditransitive) with a predicate whose number of participant roles is equal to the number of argument roles required by the construction, using as an example the sentence *The girl gives her teacher flowers*. The revised representation is shown in Figure 21.2.

The message level represents a generalized trivalent relation between an agent, a recipient, and a theme (I leave it as an open question as to what exactly the representation contains; the important point is that the relation be not tied to a particular predicate). In grammatical encoding, the relational meaning maps directly onto the appropriate syntactic relational structure (functional representation) <subject, object₁, object₂>. The message also contains lexically specific information, in this example tied to *give*. The message specifies a link between the three predicate participant roles <giver, givee, given> and the three ditransitive argument roles <agent, recipient, patient>. Functional processing links these general roles to the three functional roles <subject, object₁, object₂> in grammatical encoding. A second possibility (to my knowledge not addressed in any psycholinguistic model) is one in which a construction integrates with a predicate whose number of participant roles is a subset of the number of argument roles, as in the 'classic' sentence *She sneezed the foam off the cappuccino* (Ahrens 1995; Goldberg 1995). In this case the construction contributes the two additional argument roles and the overall cause-to-recipient interpretation, while the predicate contributes the means component of the event (Figure 21.3).

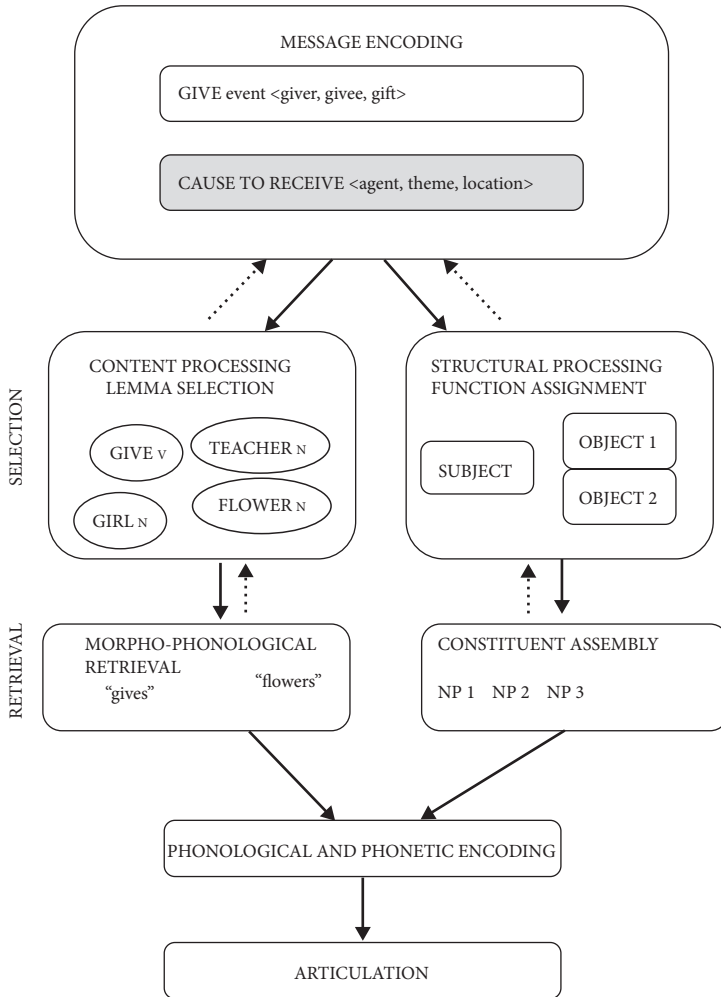


Figure 21.2 Constructions in the production model. The message level includes verb independent constructional meaning, in addition to verb meaning. The construction and the verb specify the same number of participant roles.

The combination of verbs and constructions is by no means an unregulated relationship (Goldberg 1995, 1997). This topic is not addressed here, but I refer the reader to the chapters by Gries (this volume) and Stefanowitsch (this volume) for a survey of studies and methods examining the interaction of constructions with particular lexical items. There is no research in language production examining whether the production of verbs in sentence structures they do or do not subcategorize for is qualitatively similar. Both structural (Konopka and Bock 2008; Wardlow Lane and Ferreira 2010) and constructionist views predict that it should not differ and one way to examine this would be in a priming paradigm as in Konopka and Bock (2008).

To conclude, I take it as a success for research in language representation and use that two very independent lines of research within disparate disciplines and theoretical traditions have converged on positing remarkably similar representations.

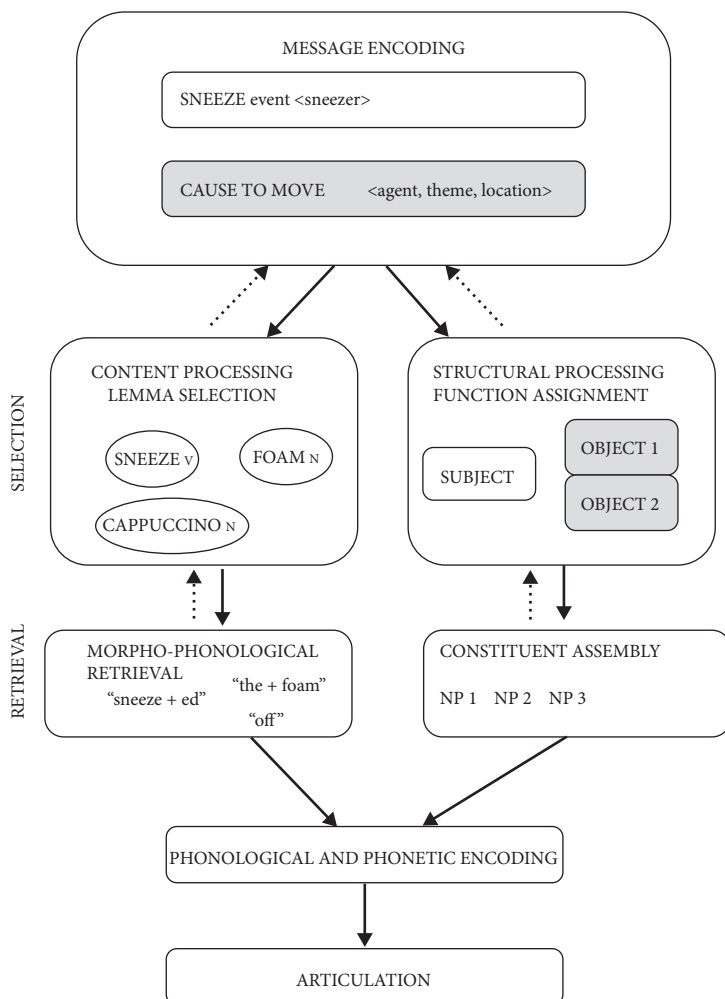


Figure 21.3 Constructions in the production model. The message level includes verb independent constructional meaning, in addition to verb meaning. The construction specifies a different number of roles than the participant roles specified by the verb. In grammatical encoding, the construction assigns the two additional roles to grammatical functions (shaded roles/functions).

21.5. CONCLUSION

This chapter provided a review of some current issues in psycholinguistics focusing on language production. Much research in language production has converged with representations that appear constructional in spirit, that is, surface generalizations with a sufficient degree of abstraction to capture linguistic creativity in the mapping from ‘thought’ to ‘talk.’ Additional findings in language acquisition with regards to the development of the language production system corroborate the utility of a constructionist framework to explain language representation and processing, from acquisition to adult language.