Chapter 7
Speaking and Misspeaking

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Several years ago, U.S. President Gerald Ford toasted Egyptian President Anwar Sadat and "the great people of Israel—Egypt, excuse me." Later this incident was reported to me by a friend like this: "I heard Freud made a Fordian slip... [laughs] wait..." Whether we like it or not, slips of the tongue are a fact of life. For normal speakers of English, one or two errors occur on average about every thousand words (Garnham et al. 1981; Hotopf 1983) and, as far as we can tell, all speakers of all languages make them. Analogous errors occur in sign languages and in writing and typing—basically in all media in which language is produced.

Besides providing a source of amusement, embarrassment, and armchair psychoanalysis, speech errors are an excellent source of data for understanding the nature of language and how it is produced. It is useful to think of slips as data for language in the same way that collisions of atoms and subatomic particles provide data for physics. Consider the slip of saying "darn bore" for "barn door." It is as if the words *barn* and *door* "collided" and broke apart into pieces that then recombined to make new words. By studying word collisions such as these, we can determine the nature of the pieces of language and the laws that govern their combinations. In the case of "darn bore" for "barn door" we might characterize the slip as the *exchange* of /b/ and /d/, thus providing evidence that things such as /d/ and /b/, *phonemes*, are building blocks of speech. We might furthermore hypothesize from the fact that the /d/ from *door* moved to a word-initial position to make *darn* and that the /b/ from *barn* moved to a word-initial position to make *bore* that the phonemes are coded for position. In general, by looking at many such errors, one can formulate and test hypotheses about language production. In this chapter we will examine both how researchers use speech errors as data in cognitive science and some of their conclusions.

7.1 Studying Slips of the Tongue

How do you get a sizable number of slips to study? The easiest thing to do is to collect them from natural speech. Often, researchers attempt to

write down all of the slips that they hear. This is what Meringer and Mayer (1895), the first to systematically study speech errors, did. It was soon recognized, though, that trying to listen for and write down all slips conflicts with normal living and, hence, creates a sample biased toward errors that are most noticeable—often the bizarre or funny slips, such as the two "Fordian" slips presented above. Consequently, many collectors listen for slips only during short periods of time when they are able to attend to error monitoring. Even though this method can miss and miscode errors (Ferber 1993), trained collectors who work only at specific times have gathered large and valuable collections. The most accurate way to build a collection, however, is to tape-record speech samples and then to study the recording carefully for errors. This time-consuming work, however, rarely gets enough errors for quantitative tests of hypotheses. For example, Garnham et al. (1981) went through a sample of around 200,000 words and came up with fewer than 200 slips.

Because of the limitations associated with collections of natural slips, some investigators try to bring the phenomenon into the laboratory by creating slips in controlled experiments. For example, Baars, Motley, and MacKay (1975) presented subjects with written word pairs, at a rate of about one pair per second. After some pairs a tone sounded, directing the subject to say the most recent pair as quickly as possible. By cleverly setting up the word pair sequence, these researchers were able to induce phoneme exchanges in about 10 percent of the trials. In fact, their experiment made a significant discovery, namely, that exchanges such as "beal dack" for "deal back," in which the spoken output consists of nonwords, are about three times less likely than exchanges that create words, such as "bean dad" for "dean bad." This conclusion was possible because their experiment controlled for other possible factors by comparing the slip rate to pairs such as "deal back," whose initial consonants exchange to produce nonwords, with an equal number of similar pairs such as "dean bad," which exchange to produce words. This ability to test specific hypotheses, while controlling for extraneous factors, is an advantage of the experimental approach over natural error collection. Furthermore, experiments allow for accurate recordings. Of course, one must acknowledge the disadvantages as well: By creating artificial slips, the experimenter may be altering the processes of speech production to such an extent that the artificial slips are not indicative of natural production. In general, one hopes that conclusions from experimental and natural data agree because each method compensates for shortcomings in the other. To a large extent, such agreement is the case (Stemberger 1992).

7.2 The Freudian Approach

Most people associate the study of speech errors with Freud and with the claim that slips result from a conflict between what one plans to say and some unconscious intention. Often, the slip will reveal the repressed intention, according to this view; for example, Freud (1901/1958) interpreted an error from a patient who replaced the German word *schwer* ("heavy") with *Schwest* (first syllable of "sister") as evidence for the speaker's unconscious concern about his sister. Notice that the tendency for phonological exchanges to create words over nonwords discovered in the 1975 Baars experiment can be seen as support for the claim that slips reveal thoughts other than intended ones. It is, however, a big jump to conclude next that the revealed unintended thoughts were *repressed* and that the slip actually has the *function* of giving that thought expression. In fact, the orthodox Freudian view of speech errors has at least three problems. First, the approach is characterized by interpretation of slips *after the fact*. So, if a host introduces a guest like this: "It is my great pleasure to prevent... I mean, present ...," one could speculate that this introduction is not being made with the greatest of pleasure, at least unconsciously. But how are we to verify that this is the case? The way to validate a scientific statement is to derive and test predictions from it. Although one could imagine trying to predict future slips that this host might make from some hypothesized unconscious attitude toward the guest, in practice such predictions would be nearly impossible to derive. Consequently, empirical tests of Freudian after-the-fact interpretations of slips are lacking. (For a review of such attempts see Baars 1992). The second problem is that, when one looks informally for psychodynamic influences in slips that are collected from unbiased sources such as tape recordings, one is hard-pressed to find them, (Ellis 1980). So, Freudian interpretations may be hard to come up with for most real slips, even when one tries after the fact.[1] Finally, even if we grant that slips are psychodynamically caused, we are going to have to acknowledge that this perspective offers little insight into the complexity of the data. As we will show, speech errors come in all shapes and sizes, but we can make sense of this complexity only by adopting an alternative perspective, one that focuses on the structure of language and its use.

1. Of course, one can always counter this objection by saying that interpreting an error requires more knowledge than is typically available. If so, though, we are back to the difficulty of the testability of the theory.

7.3 A Cognitive Science Approach

The alternative to the Freudian view that this chapter develops is that the characteristics of slips are the result of the information-processing requirements of producing language. We will thus try to explain why someone says "prevent" instead of "present," not by discovering their repressed wishes but by explicating the *task* of utterance generation.

It may seem odd to refer to everyday talking as a task, because our impression is that it does not require a great deal of mental computation. This impression is wrong. First of all, an utterance is a very complex thing. As other chapters in this volume show, utterances can be described in several different ways. More precisely, each sentence is associated with distinct representations for each type of linguistic knowledge. These types of knowledge, or *levels*, include *semantics*, which represents the meaning of the utterance; *syntax*, which specifies the words and their arrangement; and *phonology*, which deals with the sounds of the words. Each level's representation focuses on different facts about the utterance; for example, the syntactic representation of "pass the salt" would, among other things, indicate that "pass" is the main verb, and that "the salt" is a noun phrase and direct object of "pass." The phonological representation would specify the sounds that make up each syllable, for example, that *the* is pronounced as "thuh" rather than "thee" in this context. To construct a sentence such as "pass the salt," one must mentally represent its meaning, choose words and determine their arrangement, and specify the sounds of the words; that is, one must build semantic, syntactic, and phonological representations of the utterance. Moreover, at each level there are rules to be followed; for instance, the direct object "the salt" must follow, not precede, the verb. Or, the word *the* must be pronounced "thuh" if it is before a word beginning with a consonant. In short, utterances are associated with rules and representations at more than one linguistic level, and the language production system must deal with this complexity.

The fact that utterances are constructed at different levels is closely related to another property of language, its *creativity*. A great many of the sentences that we utter are being spoken for the first time. Our ability to combine words in new ways can be thought of as syntactic creativity. Other levels of representation are also associated with creativity of a sort. We have the ability to produce and recognize novel words made up of existing morphemes, as in the sentence "My musical tastes are pre-Bachian." The term "pre-Bachian" illustrates *morphological* creativity, morphology being a linguistic level concerned with word building that is sometimes distinguished from syntax and phonology. There is even a form of phonological creativity associated with the fact that we see some novel combinations of speech sounds as potential words (for example, *snurk*),

while others (like *nsukf*) could never be considered words because they are not pronounceable. In sum, language allows for creativity in the way that words—and to a lesser extent, morphemes and sounds—are combined. The language production system must reflect this fact.

A final aspect of language production is that the relevant decisions have to be made fast. A speaker produces more than three words per second, each word having been chosen from a vocabulary of more than forty thousand words. What is more, most of these words consist of several speech sounds, each of which must be produced in correct sequence. These temporal constraints contribute greatly to the task of production.

Thus, we see that our impression of the effortlessness of talking is misleading. Generating an utterance requires the rapid building of novel combinations of linguistic units, a process that must go on at several linguistic levels and, hence, must be sensitive to a variety of rules—rules about word order, word building, and word pronunciation. Given all these complications, one should not be surprised that errors occur. However, the hypothesis that cognitive science offers about speech errors is more specific than just saying that slips occur because talking is hard. I will show, rather, that the characteristics of slips are derivable from what is known about language and language production. In particular I offer the hypothesis that slips occur and have the properties that they do because of the need for creativity at each linguistic level. To defend this idea, we first need to look more closely at the data.

7.4 Kinds of Slips

One of the most noticeable things about speech errors is that different-sized linguistic units can slip. The *Egypt-Israel* example involves the substitution of one word for another, while the *barn door–darn bore* slip was characterized as the exchange of phonemes. Linguistic theory proposes the existence of a variety of linguistic units smaller than a sentence: clause, phrase, word, morpheme, syllable, syllable part (such as the VC part of a CVC syllable), consonant cluster, phoneme, phonological feature. For each of these unit sizes, there seem to be slips.[2] The examples (1)–(6) below illustrate some of the types. In all cases the target utterance is "I wanted to read the letter to my grandmother."[3]

2. Of course, there is variation depending on the language being spoken; for example, if a language has no consonant clusters, then there can be no consonant cluster slips. The data presented in this chapter come from English, but the conclusions that we offer are hypothesized to be true for other languages. In general, though, there is a need for the study of slips in languages other than English and German.

3. Unlike the other examples given, these were not actually occurring slips.

(1) phrase (exchange)—"I wanted to read *my grandmother* to *the letter*."

(2) word (noncontextual substitution)—"I wanted to read the *envelope* to my grandmother."

(3) inflectional morpheme (shift)—"I want to read*ed* the letter to my grandmother."

(4) stem morpheme (exchange)—"I *read*ed to *want* the letter to my grandmother."

(5) consonant cluster (anticipation)—"I wanted to read the *gr*etter to my grandmother."

(6) phonological feature (anticipation or perseveration)—"I wanted to read the letter to my *b*randmother."

Notice that each slip is categorized with regard to both the size of the slipping unit and the nature of the disturbance. We have already seen examples of exchanges before, such as "Freud made a Fordian slip," where two parts of the speech stream exchange places, leaving something between them undisturbed. In the phrasal exchange (1), the noun phrases exchange, leaving the "to" in place. Error (4) involves the exchange of the stem morphemes "want" and "read," leaving in place the "ed" and "to." *Anticipations* and *perseverations* are closely related to exchanges. In (5), the consonant cluster /gr/ is anticipated; that is, it comes out earlier than it should and replaces some other material—the sound /l/ in this case. Notice that had the slip been "...*gr*etter to my *l*andmother," we would call it an exchange. A perseveration is the reverse of an anticipation, for example, "a letter to my *l*andmother." Sometimes, we cannot tell whether a substitution is an anticipation or perseveration. In (6) the sound /g/ is replaced with /b/. Where did the /b/ come from? One possibility is that this is a phonological feature error. If the sound /g/, which contains the *velar* feature (for a back place of articulation), acquires the *bilabial* feature (front place of articulation) of the sound /m/, the resulting sound is a /b/. However, there are two /m/'s that could have supplied the bilabial feature, one in "my" and one in "grandmother." Hence, we cannot say whether this feature was anticipated or perseverated or, for that matter, whether both /m/'s together caused the error to occur. *Shift* errors, like exchanges, anticipations, and perseverations, involve the movement of some linguistic unit, such as the past tense morpheme *ed* in error (3). The difference is that, in a shift, the moving unit does not replace anything; it just jumps from its correct spot to an earlier or later location. Error (2) is an example of a *noncontextual* slip. These occur when a linguistic unit from outside of the intended utterance is spoken. In the noncontextual word substitution (2), "envelope" replaces "letter," likely because of its similarity in meaning.

There are four points I would like to make about these error types. First, it should be clear that speech can go wrong in many different ways. This by itself shows something of the complexity of language production. Second, slips are not just a random scrambling of sounds; rather, there are strong constraints on how things go awry. For example, when a unit participates in an exchange, it likely exchanges with another of more or less the same size and kind (such as the two noun phrases in (1)). Similarly, when the *ed* shifted positions in (3), it moved to the end of another word, as is fitting for a suffix. The third point is that interference can come both from within the utterance as in examples (1) and (3–6) and from outside the utterance as in example (2). It appears that, when we are attempting to produce a particular word or sound, other linguistic material has the potential to be spoken: material from upcoming words, from previously spoken words, and from items that are not intended anywhere in the utterance. Another way to say this is that when we should be *activating* a particular unit, other units are partially activated as well.

Finally, it should be pointed out that it is not easy to categorize slips. For instance, we could not tell if error (6) was an anticipation or a perseveration. In fact, error categorization is always a theory-laden decision. For example, a theory that explains error (6) as the movement of a particular token of a linguistic unit from one place to another would require that the error be called either a perseveration or an anticipation, but not both. An alternate theory might allow that the error is both at once, for instance, because the theory thinks of anticipatory and perseveratory influences as sources of excitation that can sum together. Consider another example of ambiguity, the "Freud made a Fordian slip" case. Normally, this would be called an exchange of stem morphemes, *Freud* and *Ford*. But it also could be categorized as the exchange of the /roy/ and /or/ sound sequences. Here is where theory comes in. It so happens that the /roy/ and /or/ parts of *Freud* and *Ford*, respectively, are not considered to be single linguistic units in theories of phonological structure. It is simpler, therefore, to hypothesize that whole morphemes exchanged, rather than to say that it so happened that the particular phoneme sequences /roy/ and /or/ exchanged. In fact, some additional support for saying that the slip is really an exchange of meaningful units, rather than particular sounds, comes from the fact that the two morphemes are both proper names. In general, though, one cannot be sure about what unit or units are slipping. Particular categorization decisions are always going to be theory-laden. This fact, in turn, means that one must be careful when interpreting error patterns as support for theory, notably when the theory was assumed beforehand in the categorization.

Despite the ambiguities in categorization, there appear to be some solid facts regarding the size of the linguistic units that slip. Figure 7.1 (adapted

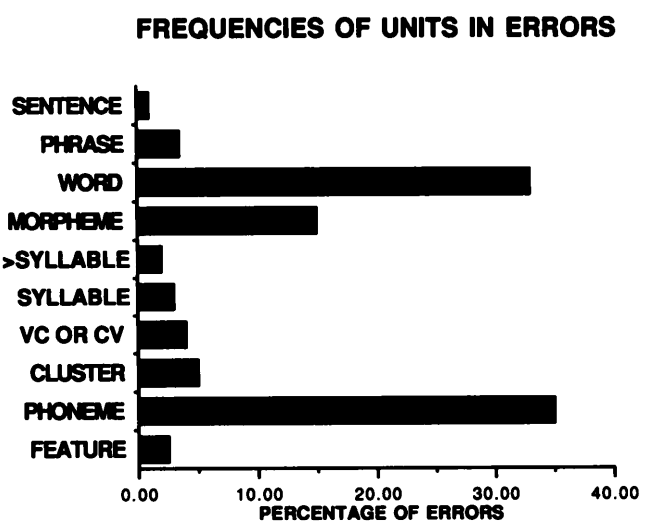

Figure 7.1
Rough estimate of the frequencies of linguistic units in exchange errors. Figure is from Bock 1991.

from Bock 1991) shows the relative rates at which the units participate in exchanges (based on error rates from English natural collections, cited by Stemberger 1982; Garrett 1975; and Shattuck-Hufnagel 1983). I have chosen to focus on exchanges here because these errors are more easily noticed and are, consequently, less likely to be missed by collectors. Although all the various-sized linguistic units do participate in exchanges, some units are much more vulnerable than others. There are two large bumps in the graph, and one medium-sized bump. The large bumps are at the level of the word and the level of the single phoneme. The medium bump is at the level of the morpheme. Why these units? Researchers suggest that the most slippable units are the most basic units in language production, and that each of these—the word, the morpheme, and the phoneme—is the building block for a particular linguistic level. The word is the basic unit for the syntactic level, and the phoneme is the basic unit of the phonological level. The fact that there is a medium-sized bump at the morpheme suggests that we may also wish to consider the possibility of a separate morphological level. In sum, the distribution of the frequency of slip sizes corresponds roughly with the levels of language that linguists have derived for independent reasons.

Why is each linguistic level associated with slips that are predominantly of a particular size? I believe that one must take the "building block" analogy very seriously. The claim is that, when one produces a sentence,

one first *builds* a syntactic structure whose elementary units are words. Then one *builds* any morphologically complex words out of existing morphemes. Finally, one *builds* the sound structure of individual words out of phonemes. Now, the alternative to building a representation is to have it prefabricated, stored, and called into action when it is needed. Let us call this alternative to building a representation, *retrieving* a representation. So, the claim is that, to the extent that a representation is built rather than retrieved, you can get slips, predominantly those involving the building blocks of that representation. Slips arise where there is some creativity in the production process—where the system actually builds rather than retrieves. This seems intuitively correct because slips are, themselves, creative combinations of units. When one says "I have to fill up my gas with car," one has produced a novel combination of words. Or in the error "In concludement ..." (for *conclusion*), the speaker has built a new "word" out of old morphemes. Finally, when one says "thollow hud" (for *hollow thud*), one has creatively arranged phonemes to make new pronounceable strings. Let us consider the relation between slips and linguistic creativity in more detail by considering, first, word errors and their relation to syntactic processes, and then errors involving individual speech sounds and phonological processes.

7.5 Word Errors and the Building of Sentences

One of the most striking facts about word slips, such as exchanges, anticipations, perseverations, and noncontextual substitutions, is that they obey a *syntactic category rule*. When one word erroneously replaces another, most of the time the target and substituting word are of the same syntactic category.[4] Nouns slip with nouns, verbs with verbs, and so on. Consider the examples that we've seen thus far. *Egypt*, a proper noun, was replaced by *Israel*, another proper noun; *gas* and *car*, both nouns, exchanged places. Other examples include the exchange of verbs in "Once I *stop*, I can't *start*," or prepositions in "Every time I put one of these buttons *off*, another one comes *on*." One way to account for these facts is to assume that these errors occur during the construction of a syntactic representation of the utterance. More specifically, it has been suggested that the processing goes like this: Based on the intended meaning of the utterance (the semantic representation), words are retrieved from the mental lexicon, the store of words that we already know. For example, if one wished to state the universal proposition that DOGS CHASE CATS, the nouns *dog* and *cat*

4. For word substitutions, the effect is very strong, 95 percent of the time (Fay and Cutler 1977). For exchanges, the effect is also very strong, provided that the exchanged words are far apart (Garrett 1975).

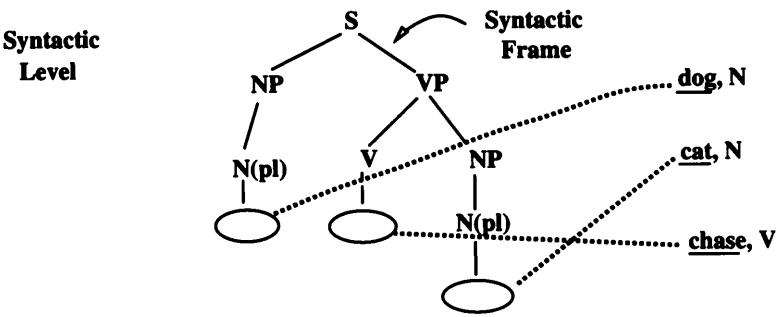

Figure 7.2
A syntactic frame for "dogs chase cats

and the verb *chase* might be retrieved. Furthermore, a syntactic *frame* is constructed that indicates the potential structure of the sentence. This frame, an example of which is shown in figure 7.2, can be thought of as a tree that indicates the grammatical relations among the words in the sentence. The frame by itself, however, does not initially contain any words; it has empty *slots* for the words to go into, slots that are assumed to be labeled for syntactic category. In our example the frame might specify that there is to be a noun phrase, consisting of a plural noun that is the subject of the sentence followed by a main verb in the present tense and another plural noun that is the direct object. Now, to actually complete the representation, the words retrieved from the lexicon have to be inserted into the frame slots. How is it known which words go in which slots? The labels on the slots are assumed to guide insertion. *Chase*, being a verb, will go only in the verb slot, and *dog* and *cat* will go only in noun slots. But what determines which noun goes where? Presumably, the semantic representation distinguishes between the chaser, or *agent*, and the chased, or *patient*; and there is a rule for this frame that the agent goes in the first, or subject, noun phrase. If there is some difficulty in making use of the semantic representation, then one might expect errors of insertion, such as the exchange "Cats chase dogs." But, even though the insertion went wrong in this example, it was nonetheless correct in that nouns went into noun slots.

Word errors that obey the syntactic category rule, particularly exchanges, provide good evidence for the idea that sentences are built by placing (and sometimes misplacing) word units in labeled slots in syntactic frames. This suggests that the errors ultimately arise because of the need

for the syntactic level to be creative. A system that knows the nouns *cat* and *dog*, the verb *chase*, and the structural frame shown in figure 7.2 not only is capable of building "Dogs chase cats" but can also make "Cats chase dogs." This is possible because the system separates syntactic patterns (the frame) from the words, with the result that the system implies the existence of sentences other than those that may have already been produced. So, because the system must be capable of producing "Cats chase dogs" when it wants to, it may also produce "Cats chase dogs" when it does not want to.

The proposal that word slips result from the system's creativity is consistent with other facts. For instance, sometimes one's utterances are not novel. How many times have you said "What time is it?" or "Excuse me, please"? It has been suggested that producing nonnovel utterances may involve retrieval of a prefabricated representation, rather than the building of a representation by actively inserting words into frame slots (for example, MacKay 1982). If this is so, one would expect fewer slips in nonnovel utterances. Experiments that have examined the effects of practicing particular utterances have shown that this expectation is true (Schwartz et al. 1994). Another example of the influence of the system's creativity concerns syntactic flexibility. Often, the same semantic representation can be associated with more than one syntactic representation. Consider the fact that "Dogs chase cats" means roughly the same thing as "Cats are chased by dogs." Hence, when one wishes to make a statement about dogs as chasers and cats as chasees, one must choose between a frame for the active voice or the passive voice. It has been suggested by Ferriera (1994) that this flexibility could contribute to error. Suppose that the active voice frame is eventually chosen but that the passive frame was a strong contender, losing out only at the end. It may then happen that the rule for assigning *dog* and *cat* to noun positions appropriate for the passive—namely, assign the patient to the subject position—may be erroneously called upon. The result of the passive assignment rule and the active frame is the error "Cats chase dogs." An actual error that suggests the influence of syntactic flexibility is "I'm mailing a *mother* to my *letter*." This could have resulted from a mix of the frame for "I'm mailing a letter to my mother" and the assignment of nouns suitable for "I'm mailing my mother a letter."

7.6 Semantic and Phonological Relations in Word Errors

Thus far, we have said that word errors obey a syntactic category rule: A word is erroneously replaced with another of the same category. In fact, this rule is the main reason that word errors are said to be associated with

the construction of a syntactic representation. This raises the question: Do the other properties of words—their semantic and phonological properties, for instance—also play a role in word errors? The answer is that they do play a role, but a different and arguably less central role. Consider semantic relations. It is common for one kind of word error, noncontextual word substitutions, to involve a semantically similar error word replacing the target word. For example, *knee* might replace *elbow*, or *black* might replace *white*. *Israel* for *Eygpt* is another clear example. For other kinds of word errors, such as exchanges, anticipations, and perseverations, semantic similarity between the interacting words is less evident; for instance, "I'm writing a *mother* to my *letter*." In addition to semantic similarity between the error and target words, one can see more complex relations due to meaning. When a speaker says "Lizst's second Hungarian *restaurant*," where "Hungarian *rhapsody*" was intended, the replacing and replaced words are themselves not semantically related. It seems, however that both words are associated to *Hungarian*, suggesting that the intention to say *Hungarian* brought along the associated *restaurant*.

What about phonological relations in word errors? Is there any tendency for words related in sound to replace one another in slips? If you have been trying to analyze the word slips presented thus far, you may already have an opinion on this matter. In *restaurant* for *rhapsody*, both words begin with /r/ and are three syllables long with first-syllable stress. Another example that we gave involved an exchange of *start* and *stop*, both beginning with /st/. It certainly looks as if the interacting words in word slips sometimes are phonologically related. In fact, there are many slips in which the only similarity between the words is phonological, aside from the words' similarity in syntactic category, for instance, *prevent* for *present* (the verb preSENT). But we must be careful when drawing conclusions about the effect of phonological relations or, for that matter, about any kind of similarity between error and target words. This is because, thus far, we have been doing the same thing that Freud did—we have been interpreting slips after the fact. When we see a slip of *prevent* for *present*, we say, "I bet this one occurred because of the phonological similarity." The problem is that the similarity may have arisen by chance. How, then, can you tell whether phonological similarity matters? Well, for a single error, you cannot. But it can be shown that there is a tendency for error and target words to be phonologically similar by assessing the degree to which a representative sample of word errors exhibits the similarity and by comparing that degree with what would be expected if words randomly replaced one another. There are a number of predictions that can be tested. For example, do the target and error words share their initial sounds more often than chance, or their main vowels, or their stress patterns? In general, tests of these and related predictions show that phono-

logical relations are quite strong in word substitution errors and seem to be present in other word errors such as exchanges (Dell and Reich 1981; Harley 1984). For example, substituted words in English share the initial sound with their corresponding target words around 35 percent of the time. By chance, you would expect this to happen only around 5 percent of the time.

When we speak of the semantic, syntactic, and phonological similarity between slipping words, we are dealing with information that is associated with different linguistic levels. How is it that all these different levels are involved in word errors? We have said that the word substitution errors may *happen* at the syntactic level, and our main reason for this was that the interacting words in substitutions, exchanges, and other word errors are constrained to be in the same syntactic category. The effect is so strong that we called it the *syntactic category rule*. There is no such "rule" with regard to semantic or phonological similarity; rather, semantic and phonological effects are best described as tendencies or influences. Hence, we can say that when one word replaces another, they are *required* to be of the same major syntactic category and will *tend* to show other aspects of similarity.

We have suggested that the similarity of syntactic category arises because word errors occur when the wrong words are inserted into syntactically labeled slots in syntactic frames. How, then, do semantic and phonological similarity work? It is reasonable to suppose that semantically and phonologically similar words become activated in the process of retrieving a target word; thus, these have some chance of erroneously replacing the target. The case of semantic similarity is more straightforward and so we consider it first. The semantic representation contains *concepts*, such as the concepts of GIRL, DOG, BIG, and so on. These are associated with one another so that when one processes a particular concept, related concepts become activated. Often, the concepts are described as existing in a *semantic network*, with related concepts connecting to one another, and with each concept connecting to the word(s) that encode(s) it (see, for example, Roelofs 1992). Retrieval processes involve the *spreading of activation*. Concepts in the semantic representation are activated and this activation spreads to associated words and concepts, with the result that, normally, the correct words are strongly activated. It is these strongly activated words that are given the opportunity to be inserted into slots in the syntactic representation. Because semantically related concepts are connected to one another, however, words that are semantically related to target words become active as well, thus increasing the chance that they will be erroneously inserted into slots. For example, when *girl* is a target, *boy*, *woman*, and other words will have some activation. This will be particularly true if any of these words was previously spoken or was about

to be spoken. So, *boy* might have a small chance of replacing *girl* as a noncontextual substitution error ("The boy... er... girl is on the swing"), but a greater chance of replacing *boy* an anticipation ("The boy... er... girl is next to the boy").

It makes sense that speakers err by sometimes replacing a target word with a semantically related word because they are supposed to choose words based on meaning. How is it, then, that word slips can also involve phonological relations? We certainly do not deliberately choose words because of their sounds, unless we are punning or making poetry. My view is that phonological effects on word slips reflect the spreading of activation from a target word to the target word's phonemes, and from there to other nontarget words that share those sounds. Let me be more concrete by using figure 7.3. Consider how the verb *prevent* might replace the verb *present*. First, the concept of *present* is activated and activation spreads to the word unit for *present*. This word unit stands for the word-*as-a-whole*, and it is what we assume is inserted into slots in the syntactic representation. However, when the word unit for *present* is activated, the activation continues to spread to its associated sounds. Notice how the semantic network has grown. It no longer has just concepts and words but also contains units for individual speech sounds. Instead of calling it a semantic network, then, it might be best to call it a *lexical network* to reflect the fact that it contains all the relevant information about words: their associated concepts, their syntactic properties, and their sounds. Now, to return to the example, as the sounds of *present* become activated, their activation continues to spread, and some of it can spread "upwards" to words that possess these sounds, such as *prevent*. Because *prevent* is also a verb, it may end up going in the verb slot that *present* was supposed to go in, thus creating the slip.

One explanation for why there are phonological influences in word errors is, therefore, that the retrieval of target words also activates phonologically related words through activation spreading down to sounds and back up to words. But why would we want to propose that activation moves from sounds to words during language production? Isn't the whole idea to go from meaning to words to sounds? Yes, it is. But we must remember that our lexical knowledge is not just used for talking. It is also used for listening. It may be the case that the lexical network allows activation to spread in both directions because it is used for both production and comprehension.

The proposal that phonological influences on word errors are caused by activation spreading down to sounds and back up to words is controversial. Many researchers claim that, when processes are at the syntactic level, information associated with later levels, such as phonological information, should not be active. This claim, known as the *modularity hypothesis*,

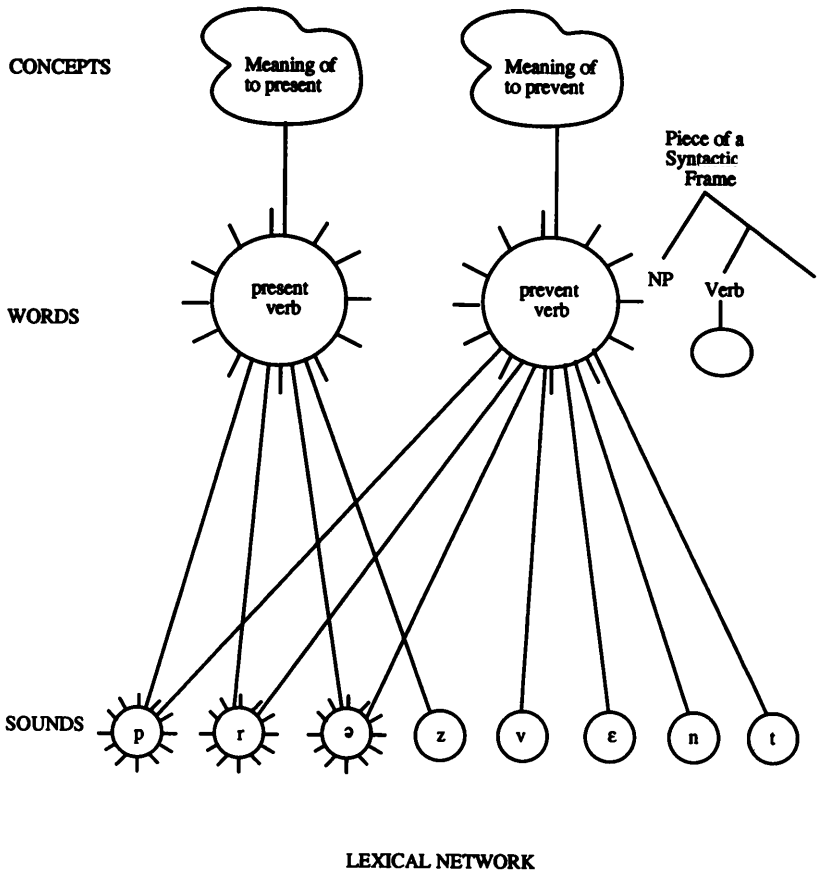

Figure 7.3
A piece of the lexical network showing how "present" might slip to "prevent" from the spreading of activation.

derives from the fact that the rules at each linguistic level are, for the most part, stated only in terms of information that is properly part of that level. For instance, it is generally true that syntactic rules do not refer to phonological information. You never see syntactic rules like this: If an adjective begins with a vowel, then it follows the noun it modifies; otherwise, it precedes the noun. If syntactic rules do not refer to phonological information, then the language production system does not need to activate the sounds of words when it is building the syntactic representation of the utterance. So, according to the modularity hypothesis, when words are being retrieved for slots in the syntactic representation, one might expect semantically related competing words to be active—because words

should be retrieved based on meaning—but not phonologically related words. But how does the modularity hypothesis explain the fact that word substitution errors often do exhibit phonological relations? It is assumed that errors such as *prevent* for *present* occur at some later stage in production, after words are retrieved based on meaning and inserted into slots in the syntactic representation. In fact, phonologically related word substitution errors are often categorized as a different kind of error, called *malapropisms*. If malapropisms occur at a postsyntactic linguistic level, the influence of sound similarity on them is not so unexpected.

Which is correct, then, the modularity hypothesis or the spreading activation view? Both ideas have an account of the semantic and phonological influences on word errors. The modularity hypothesis, however, predicts that the semantic and phonological influences should be separate. An error will be caused either semantically or phonologically, but not by both relations at once. Of course, it may happen that a particular error will look as though both influences are at work, but this would be a fortuitous occurrence. In contrast, the spreading activation view predicts that semantic and phonological influences can *combine* to increase the chance of the slip. For example, consider the slip of *stop* for *start*, which is called a *mixed error*. According to the spreading activation view, when one is retrieving the word unit for *start*, some activation spreads to *stop* directly because it is related in meaning to *start*; and some activation also gets to it via the shared phonemes /st/. The two sources of activation converge on *stop*, greatly increasing its chances of being selected. According to the modularity hypothesis, the mixed error would be either a semantic slip that happened by chance to be phonologically similar, or a malapropism that happened to be semantically similar. Clearly, the two hypotheses make different predictions about the likelihood of these mixed errors. It turns out that errors that look to be both semantic and phonological are unexpectedly common in speech error collections. Specifically, if one identifies a set of word substitutions that have strong semantic relations, one finds that the phonological similarity between the error and target in this set is greater than what would be expected by chance (del Viso et al. 1991; Dell and Reich 1981; Harley 1984). This supports the spreading activation view over the modularity view.[5]

In summary, one can profitably view word slips as reflecting the syntactic creativity of language and a process of lexical retrieval that is sensitive to meaning and sound. The syntactic class rule suggests that the errors occur during the construction of a syntactic representation. Retrieving

5. The modularity view can still be maintained with additional assumptions (see Levelt et al. 1991).

words for this representation, however, allows for both semantic and phonological information to play a role in word errors.

7.7 Phonological Errors

Thus far, we've been talking mostly about errors in which whole words or morphemes slip. As figure 7.1 shows, it is quite common for meaningless parts of words to slip as well. These slips, called *phonological* or *sound errors*, are assumed to arise during the construction of the phonological representation.

Just as with the word errors, sound errors may reflect creative processes in speaking. That is, when one says "thollow hud" for "hollow thud," one is creating two new "words." Now, it may seem odd to associate phonological errors with creativity because one does not seem to create words out of phonemes in the same way that one creates sentences out of words. We do not have all possible sentences stored in our heads; hence, we must build rather than retrieve them. In contrast, the sound sequences that make up words are, for the most part, stored in memory. One would think that constructing a phonological representation of a word is more an act of retrieval than an act of building. However, I claim that phonological errors tell us that there is a sense in which we actually build words out of sounds—they are not just prefabricated entities.

Let us look at some of the properties of phonological errors. Here are some examples taken from Fromkin (1973):

(7) "a reading list" spoken as "a leading list" (phoneme anticipation)

(8) "an early period" spoken as "a pearly period" (anticipatory addition of a phoneme)

(9) "black boxes" spoken as "back bloxes" (phoneme shift)

(10) "beef noodle" spoken as "beef needle" (phoneme perseveration)

(11) "heap of junk" spoken as "hunk of jeep" (rhyme exchange)

(12) "squeaky floor" spoken as "fleaky squoor" (consonant cluster exchange)

The first thing to notice about these slips is that they involve a slip of a single phoneme or, less likely, a group of phonemes. When the slip is more than a single phoneme, it is usually either a consonant cluster, such as /skw/ or /fl/ as in example (12); or it is a part of the syllable known as the *rhyme*, the part that remains when its initial consonants are removed ("unk" and "eep" from example (11)). The fact that multiphoneme sound

errors often correspond to clusters and rhymes is quite interesting, because phonologists have proposed the existence of these groupings of phonemes for independent reasons. For example, rules about which syllables are stressed refer to the rhyme part of the syllable. From the phonologist's perspective, words are composed of a hierarchical grouping of sounds, in the same way that sentences are a hierarchical grouping of words.

A second important aspect of sound errors is that there are strong constraints about what sounds can replace what sounds. Specifically, consonants replace consonants, and vowels replace vowels (see MacKay 1970); in fact, this property of sound errors is so strong that it can be characterized as a rule. The likelihood of an error such as "ant" being spoken as "ano" (replacing the consonant /t/ with the vowel /ow/) seems to be close to zero. This *consonant-vowel rule* is very much analogous to the syntactic category rule that we applied to word errors. Phonemes of the same type (vowels, consonants) replace one another in the same way that words of the same type (nouns, verbs, and so on) replace one another.

A third property of sound errors is that the slips are just about always well formed or pronounceable. They obey the *phonological rules* of the language (Fromkin 1971; Wells 1951). Even though some of the slips above were nonwords, such as "fleaky" and "bloxes," these are potential words because they exhibit the basic patterns of English words. Strings of sounds not exhibiting these patterns, like "lfeak" or "ngofg," simply do not show up in speech error collections. This finding, moreover, is not entirely due to error collectors' inabilities to hear ill-formed strings, because slips that are recorded in laboratory experiments also seem to have a strong tendency to be well formed. Another kind of rule that sound errors obey is illustrated by example (8). When the /p/ from *period* added itself on to *early*, the intended word *an* became *a*. The error was thus not only well formed in the sense that "pearly" is a pronounceable string of English, but also in that the error adhered to the rule that the form of *a/an* depends on whether the following word begins with a vowel or a consonant.

In general, sound errors are quite well behaved. They respect the hierarchical structure of the syllable, the vowel and consonant categories, and the rules that specify how sounds are put together. Because slips respect these properties, they create either actual words, such as "leading list," or, more interestingly, potential words—strings of sounds that adhere to the sound patterns of the language being spoken. This brings us to the link between slips and creativity. Just as the syntactic system must be creative to make novel sentences, the phonological system should have the potential to recognize and to produce novel words. No speaker of a language has a completely fixed vocabulary because, nearly every day, one is exposed to new words. Perhaps, for example, you experienced the words

malapropism and *velar* for the first time when reading this chapter. And even if you do not remember what they mean, you would be perfectly capable of pronouncing them. This ability to deal with novel words suggests that phonological representations are not always retrieved ready-made from the set of words that we know. Instead, we can create new phonological representations when we need to. I suggest that we also create new phonological representations when we don't want to. These are what sound errors are.

Because of the need for the phonological system to be creative, researchers have proposed that the phonological representation is constructed in much the same way as the syntactic representation—linguistic units are inserted into slots in a structural frame. In the case of the phonological representation, the frame looks something like that in figure 7.4. The frame corresponds roughly to a word, specifying the number of syllables in the word and subsyllabic structure. At the bottom are slots that are labeled for consonant or vowel. So, whereas the syntactic frame slots hold words and are labeled for syntactic category, the phonological frame slots contain individual phonemes and are labeled for type of phoneme.

Let's consider how the phonological representation of the word *read* (/rid/) is built. We will assume the same kind of spreading activational processes that we proposed for the building of syntactic representations. First, a frame is assembled specifying that the word has one syllable and that this syllable has slots for three phonemes, labeled consonant, vowel, and consonant. At the same time the phonemes of the word are being retrieved by the spreading of activation in the lexical network. Activation spreads down from the verb *read* to its phonemes. These activated phonemes are then inserted into the slots. The vowel /i/ goes in the vowel slot and the consonants /r/ and /d/ go in consonant slots. How do the

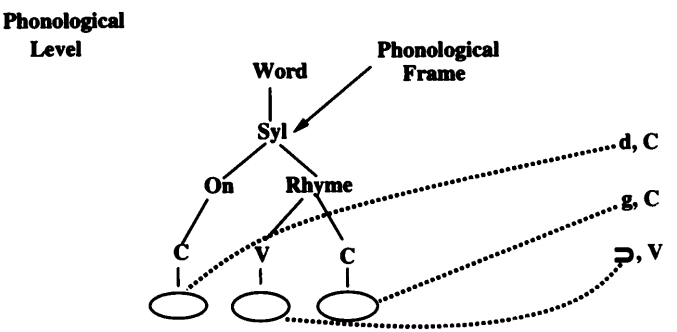

Figure 7.4
A phonological frame for the word "dog."

consonants know which slot to go to? That is, what makes "read" as opposed to "dear" happen? There are two possibilities. One is that the order of the consonants is specified by how activated they are; so, /r/ is more activated than /d/, and this causes /r/ to go in the first available consonant slot. The other possibility is that the activated phonemes and the slots are labeled as to whether they are syllable-initial or syllable-final. Hence the retrieved /r/ is a special syllable-initial /r/, and the /d/ is a syllable-final one. At present, some researchers believe that the consonants are labeled for position (for example, MacKay 1987), while others hold that position is represented just by the order in which they are activated (Meyer 1991). In either case, though, there is some mechanism that keeps initial and final consonants out of one another's slots. Whatever this mechanism is, though, it is a very powerful one because we do not see speech errors in which the initial and final consonants of a word are exchanged. "Read" never slips to "dear."

Words such as *read* do often participate in slips where intruding sounds come from nearby words such as "leading list" for "reading list." How does this happen? In general, a slip occurs when the wrong phoneme goes in a slot, or when a slot fails to get a phoneme, or when a slot is incorrectly added to a frame. In the "leading list" case the problem is one of the wrong phoneme in a slot. When the phonological representation for *reading* is being built, the syntactic level has probably already built the noun phrase *reading list*; that is, in the syntactic representation, the word units for *reading* and *list* have already been inserted into syntactic slots. Consequently, when one is trying to specify the phonemes of *reading*, the word *list* has already been selected. This means that the word unit for *list* may possess some activation, which could spread down to its phonemes. Thus there is some chance that /l/ will be activated enough to replace a consonant in *reading*, creating the slip "leading." The fact that /l/, the initial consonant of *list*, replaces the initial consonant /r/ can be taken as evidence that the slots may be labeled for syllable or word position. Other factors that could be at work in this slip are the similarity in sound between /r/ and /l/ and the fact that *leading* is a real word (see Stemberger 1992, for a review of factors involved in sound errors).

One of the most important properties of sound errors is that they occur only rarely on short, common words known as *function words*. Function words are articles, prepositions, pronouns, auxiliary verbs, and conjunctions. Instead, sound errors occur predominantly on nouns, verbs, and adjectives, or *content words*. For example, phoneme exchanges between an adjective and a noun, such as "heft hemisphere" for "left hemisphere" are common; but an exchange involving an article and a noun, such as "kuh that" for "the cat," would happen only rarely. In fact, I have not come

across a single sound error involving the word *the*, even though *the* occurs once every fifteen words in English, on average.

Why are sound errors largely confined to content words? One very interesting hypothesis is that function words are treated differently from content words during the construction of the phonological representation. Function words belong to syntactic categories that are *closed*; that is, the set of articles, prepositions, pronouns, and so on that you know is fixed and does not change. The content word categories, however, are *open*. We are constantly learning new nouns, verbs, and adjectives. Hence, we really need creativity in the phonological representation for only the content words. Once we have acquired our native language, we have no need to create new function words. The lack of sound errors in function words can thus be taken as evidence for the proposal that slips happen most often where the system must allow for the production of new combinations. Perhaps the process of actively inserting phonemes into slots in phonological frames does not take place for function words (see Garrett 1975). Alternately, function words' sounds tend not to slip because these words are quite common and hence benefit from frequent practice (see MacKay 1987).

7.8 Word and Sound Errors and Linguistic Creativity

To conclude the discussion of error data, let us compare the creativity of the phonological and syntactic systems. Clearly, the speaker's ability to combine words to make new sentences is called upon much more often than the ability to combine sounds to make new words. Most of the sentences we utter are new, whereas nearly every one of the words that we produce is familiar. Given this, it seems incongruous that figure 7.1 shows phoneme exchanges as occurring about as often as word exchanges. In fact, it may be that phoneme errors are even *more* likely than word errors because phoneme slips are harder for error collectors to catch. Why, then, are phoneme errors as common as (or more common than) word errors, given our view that the errors occur most where there is the greatest need for creativity? The answer may lie in the fact that speakers must produce more phonemes than words. The last sentence ("The answer may lie ...") takes around five seconds to say and contains fifteen words and around fifty-six phonemes. The greater rate at which decisions must be made at the phonological level (around eleven phonemes per second), in comparison with the syntactic level (around three words per second), may thus account for the unexpectedly high rate of sound errors. Some support for this claim comes from experiments that I have been doing in which speakers produce tongue twisters at different speech rates. Speech

rate has a large effect on the chance of making a sound error. When one speaks at a rate of around fifteen phonemes per second, sound errors are quite common, about one slip every ten words; however, when the speech rate is extremely slow, four phonemes per second, there are virtually no slips. Perhaps, then, the degree to which the phonological level is error-prone may reflect both its capacity for creativity (which is less than that of the syntactic level) and the speed with which its basic units must be selected (which is more than that of the syntactic level).

In summary, we have seen that slips can occur at different linguistic levels and that they seem to reflect the fact that language allows for the creative combination of linguistic units at these levels. Furthermore, we have suggested that at the syntactic and phonological levels, a hierarchical frame is constructed; the slots in that frame are filled with the appropriate linguistic units—words at the syntactic level and phonemes at the phonological level. By using frames in this way, the system is capable of producing novel but rule-governed combinations of units. Finally, it was hypothesized that linguistic units are retrieved by spreading activation through a network of units standing for concepts, words, and sounds. Slips are simply the natural consequences of all of these processes. When the system attempts to retrieve some particular linguistic unit, others become activated as well and, hence, it will sometimes happen that the wrong units are inserted into the slots. Luckily for us, this doesn't happen too often.

7.9 Conclusions—Slips and Cognitive Science

We began this chapter by promising to take a cognitive science approach to speech errors rather than a Freudian one. We sought explanation for the properties of slips by looking at the nature of language and how it is produced, rather than by looking at repressed memories. There is another important aspect of modern research on speech errors that is consistent with cognitive science. This is the use of computational models. By translating one's theory into a computer program, one can see whether the theory in fact behaves the way one expects it to. This translation has been particularly important for accounting for speech error data because there are so many factors at work in producing errors. For example, when one is selecting a particular target word for a slot in the syntactic representation, one must consider the semantic, syntactic, and phonological properties of all the surrounding words in the utterance, plus the relation of the target word to other similar words that might not be in the utterance. To explore the consequences of these factors, many researchers have found it worthwhile to build computational models. In essence, they make models that can "talk" and examine the "slips" that the models make. To the extent

that a model slips in the same way that people do, the theory that inspired the model gains support. It turns out that the particular approach to language production presented here—an approach based on spreading activation—has often been translated into computational terms. As it is beyond the scope of this chapter to present the characteristics of particular models, the interested reader should consult the following references: Berg 1988; Dell 1986, 1988; Harley 1993; Houghton 1990; MacKay 1987; Martin et al. 1994; Roelofs 1992; Schade and Berg 1992; and Stemberger 1985.

In conclusion, the study of speech errors is a good example of the interdisciplinary nature of cognitive science. Linguistics provides theories about the nature of language—its levels, units, and rules. Psychology provides hypothesized processing mechanisms, such as memory retrieval being carried out by spreading activation. And, finally, the consequences of wedding linguistic theory and psychological processing mechanisms can be made concrete by employing computational models.

Suggestions for Further Reading

Freud 1901/58 is the principal statement of the hypothesis that slips are related to repressed intentions. Fromkin 1971, Garrett 1975, and MacKay 1970 outline approaches based on linguistic and psycholinguistic theory. Garrett and Fromkin, in particular, show how errors are associated with different linguistic levels. Shattuck-Hufnagel 1979 shows how the variety of phonological errors can be accounted for by assuming breakdowns in the way that phonemes are inserted into slots in phonological frames. Dell 1986, Stemberger 1985, and MacKay 1987 present broad spreading activation theories of production that deal with speech errors. Levelt 1989 is a general text on language production and shows how speech error data fit with other psycholinguistic and linguistic data. Dell, Juliano, and Govindjee 1993 is an example of a recent neural network model of speech errors. Bock and Levelt 1994 provide a review of modern theories of syntactic encoding in production.

Problems

7.1 Categorize these errors with respect to the size of the slipping unit and the nature of the disruption.

a. petty cash → ketty pash
b. cup of coffee → cuff of coffee
c. Class will be about discussing the test → ... discussing the class
d. pass the pepper → pass the salt
e. spill beer → speer bill
f. Eerie stamp → steerie stamp
g. The squeaky wheel gets the grease → The skreeky gwease gets the wheel

7.2 Here is a type of error that we didn't discuss, called a blend. Instead of saying a "tennis athlete" or "tennis player," a person says "tennis athler." Explain how this might happen, according to the theory of production presented in the chapter.

7.3 The "tip-of-the-tongue" phenomenon is reasonably common. Here's an example: "That guy is amazing. He's so ... I can't think of the word. It's long and begins with *o* or *b* or something, it's not 'bodacious' ... obnoxious!... that's the word I wanted."

Using the theory of production outlined in the chapter, identify the point in the production process where the tip-of-the-tongue state is occurring.

7.4 Phonological slips happen only rarely in function words. The chapter gave two possible reasons—function words are members of closed categories, and function words are highly frequent. Try to think of other reasons why function words are relatively immune to their sounds slipping.

Question for Further Thought

7.1 Collect speech errors for around two hours sometime when you are hearing spontaneous speech (as in class or at a party). Note any problems you had in detecting and accurately recording slips.

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