

# Retrieval of Lexical–Syntactic Features in Tip-of-the-Tongue States

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Italian speakers who signaled that they were in a tip-of-the-tongue (TOT) state were asked to recognize the grammatical gender and the initial and the final phonemes of the unavailable word. The proportions of gender and phoneme hits that occurred with “don’t know” (DK) responses were adopted as baselines for chance-level performance. Participants were more accurate in recognizing the grammatical gender and the initial but not the final phoneme of target words when they were in TOT than in DK states. The availability of gender in TOT states suggests the independence of syntactic from phonological information in lexical access. However, the retrieval of gender was far from perfect for TOT words, and it was no better than recognition of the initial phoneme. These results are problematic for the notion that the selection of a lemma is synonymous with the retrieval of the word’s syntactic features. The implications of these results for the distinction between lemma and lexeme levels of representation in lexical access are discussed.

Current models of speech production typically assume that the selection of a word involves two stages: In Stage 1, a semantically and syntactically specified representation is accessed; in Stage 2, a phonological representation is accessed (e.g., Bock, 1982; Burke, MacKay, Worthley, & Wade, 1991; Butterworth, 1989; Dell, 1990; Fromkin, 1971; Garrett, 1975, 1976; Levelt, 1989; Martin, Weisberg, & Saffran, 1989). These representations are often referred to as *lemma* and *lexeme*, respectively (Kempen & Huijbers, 1983). The nature of lexical–phonological representations, or lexemes, and the process by which they are accessed have recently been the focus of extensive empirical investigation and theoretical analysis. Although major disagreements remain, highly articulated claims have been made both about the structure and content of lexemes and about their associated access mechanisms (see, e.g., Dell & O’Seaghdha, 1991; Levelt et al., 1991). By contrast, far less articulated proposals have been made about the content and the mechanisms of access to lemma-level representations (but see Roelofs, 1992). In particular, it is far from understood how a word’s grammatical features are processed. The principal objective of this article is to articulate and evaluate a specific proposal concerning the representation and the retrieval of lexical–grammatical information. For this purpose, we investigated the retrieval of gender information in Italian participants who were in a tip-of-the-tongue (TOT) state.

Two-stage models of lexical access assume that the selection of a lexeme is dependent on the activation of the semantically and grammatically specified representation of the word. This view is common to both serial and interactive lexical models, even though they differ radically in other respects. In serial-access models, the retrieval of lemmas and the retrieval of lexemes constitute nonoverlapping stages of processing (Butterworth, 1989; Fay & Cutler, 1977; Garrett, 1980, 1988; Kempen & Huijbers, 1983; Levelt et al., 1991; Schriefers, Meyer, & Levelt, 1990). That is, the semantically and grammatically specified representation of the word is retrieved first, followed by access to the lexical–phonological representation of the word. In this class of models, the activation of lexemes is not initiated until lemmas have been completely retrieved. In the interactive-activation models, the lexicon is composed of layers of interconnected units. Typically three layers are displayed: One layer of units encodes semantic properties, another represents lexical nodes, and the third layer consists of units that encode the phonological representation of the words (Dell, 1986, 1988; Dell & O’Seaghdha, 1991, 1992; Harley, 1984; MacKay, 1987; Martin, Dell, Saffran, & Schwartz, 1994; Stemberger, 1985). A major characteristic of these interactive models is the bidirectional spreading of activation between lexical and phonological levels. Both forward activation (lexical units → phonological units) and backward activation (phonological units → lexical units) are allowed in this type of architecture.<sup>1</sup> Thus, for instance, following the initial excitation of the lexical node *cat*

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The research reported here was supported in part by National Institutes of Health Grant NS22201. We thank George Wolford for advice concerning statistical matters and Kathryn Link and Jennifer Shelton for their helpful comments on an earlier version of this article.

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<sup>1</sup> There is some uncertainty about the number of levels of representation that are considered necessary in interactive network models. The number and nature of these levels have evolved over the years. Thus, for example, although the most common schematic representation of Dell’s (Dell & O’Seaghdha, 1991, 1992) model depicts three levels—semantic features, lexical nodes, and phonological segment nodes—in other cases, a further distinction is made between lemmas and lexemes, thereby adding a fourth level of representation (Dell, 1990).

corresponding to the concept of *cat*, the phoneme nodes /k/, /æ/, and /t/ are activated. The activated phoneme nodes respond by spreading their activation backward to lexical units associated with those phoneme nodes. In this way, the level of activation of the lexical node *cat* is increased, allowing this node to exert an even stronger activation of its corresponding phonological units. Despite the fact that serial and interactive models of lexical access differ in the manner in which semantic and phonological information are represented and accessed, they appear to agree on one crucial issue for present purposes: Grammatical information is specified at the level of lemmas—a level of representation between semantic and lexeme units.

The most clearly articulated proposal concerning the representation of grammatical information in the lexicon has been made in the context of serial-processing models (Bock & Levelt, 1994; Jescheniak & Levelt, 1994; Roelofs, 1992). According to this view, conceptual information activates an abstract lexical node—a lemma—which is connected to syntactic nodes specifying the word's grammatical category and gender. Activation of the lemma node spreads automatically and immediately to its grammatical nodes. The lemma, in turn, activates its corresponding lexeme, which specifies the morphological and phonological properties of the word. This proposal assumes that grammatical information is represented independently of semantic and phonological information, and that it is represented at a level intermediate to these two levels of representation. In other words, the order of activation of lexical information proceeds from semantic to syntactic to phonological (and/or to orthographic) levels. Figure 1 presents a schematic representation of this model. There is a growing body of evidence that is consistent with some aspects of this proposal.

Evidence that grammatical information plays a crucial role in lexical organization comes from neuropsychological investigations of language production. It has been amply documented that brain-damaged patients can be selectively impaired in processing words of a particular grammatical class. One such category-specific deficit is that affecting function (closed class) words in the face of relatively normal production of content words (e.g., Andreevsky & Seron, 1975; Caramazza, Berndt, & Hart, 1981; Gardner & Zurif, 1975; Rapp & Caramazza, 1997). The other major grammatical class dissociation that has been reported is that between nouns and verbs, where it has been found that some brain-damaged participants are impaired in producing nouns in the face of spared ability to produce verbs, whereas others show the opposite pattern of impaired and spared abilities (e.g., Caramazza & Hillis, 1991; Damasio & Tranel, 1993; De Renzi & di Pellegrino, 1995; Hillis & Caramazza, 1995; McCarthy & Warrington, 1985; Miceli, Silveri, Villa, & Caramazza, 1984; Zingeser & Berndt, 1988). In addition, recent functional neuroimaging studies using event-related potentials and PET (positron emission tomography) have shown that different anatomical sites are involved in processing words of different grammatical classes (Dehaene, 1995; Neville, Mills, & Lawson, 1992; Pulvermüller, Lutzenberger, & Birmauer, 1995; Warburton et al., 1996). The evidence from language deficits and functional imaging

clearly indicates that grammatical class information plays a crucial role in the organization of lexical knowledge in the brain.

A more subtle demonstration of the independence of grammatical information from lexical-phonological knowledge is provided by the performance of anomic participants who are able to provide information about grammatical features of a word form they are unable to retrieve. Thus, for example, Henaff Gonon, Bruckert, and Michel (1989) and Badecker, Miozzo, and Zanuttini (1995) reported a French anomic patient and an Italian anomic patient, respectively, who could correctly provide the grammatical gender of nouns they were unable to produce. A similar dissociation has been demonstrated with a grammatical feature of Italian verbs—the aspectual auxiliary—which does not correlate with verb meaning (see Burzio, 1986). Miozzo and Caramazza (1997) reported the case of an Italian anomic participant who could almost invariably provide the correct auxiliary form of a verb (*be* or *have*) that he was unable to retrieve. These results support the hypothesis that grammatical information is represented independently of lexical-phonological forms, and they are consistent with those models of sentence production that hypothesize two separate stages of lexical access—a stage in which a syntactically specified representation is accessed and a subsequent stage in which the phonological form of the word is accessed (e.g., Bock, 1982; Dell, 1986; Garrett, 1975; Levelt, 1989).

The TOT phenomenon is often cited as evidence in support of the two-stage retrieval of lemmas and lexemes (e.g., Bock & Levelt, 1994; Dell, 1990; Garrett, 1992; Levelt, 1989). TOT states constitute a momentary inability to utter an intended word, accompanied by the feeling that the target word is known and that it is on the verge of being available. In their phenomenology, TOT states would seem to demonstrate that the meaning of a word can be retrieved independently of its form. Evidence that the phenomenological experience reported by participants in TOT states accurately describes a distinction between accessibility of meaning and word form is provided by experimental investigations of the phenomenon. That is, the participants' experience that they know the word they are unable to produce has been confirmed by having them guess specific features of the target response, such as the initial phoneme or phonemic cluster, the number of syllables, and the position of stress. In a pioneering study, R. Brown and McNeill (1966) showed that participants in TOT states were frequently correct in recalling specific phonological features of a word they were unable to recall correctly; in other words, the reported "feeling of knowing" was accurate. These results have since been replicated in several studies (e.g., Burke et al., 1991; Jones & Langford, 1987; Koriat & Lieblich, 1974; Lovelace, 1987; Meyer & Bock, 1992; Perfect & Hanley, 1992; Rubin, 1975; for reviews, see A. S. Brown, 1991; Levelt, 1989; Smith, 1994).

It could be argued that there are some indications that morphosyntactic information associated with a specific lemma is available during TOT states when the corresponding lexeme is not available. The simple fact that alternate words retrieved in TOTs are of the same grammatical class

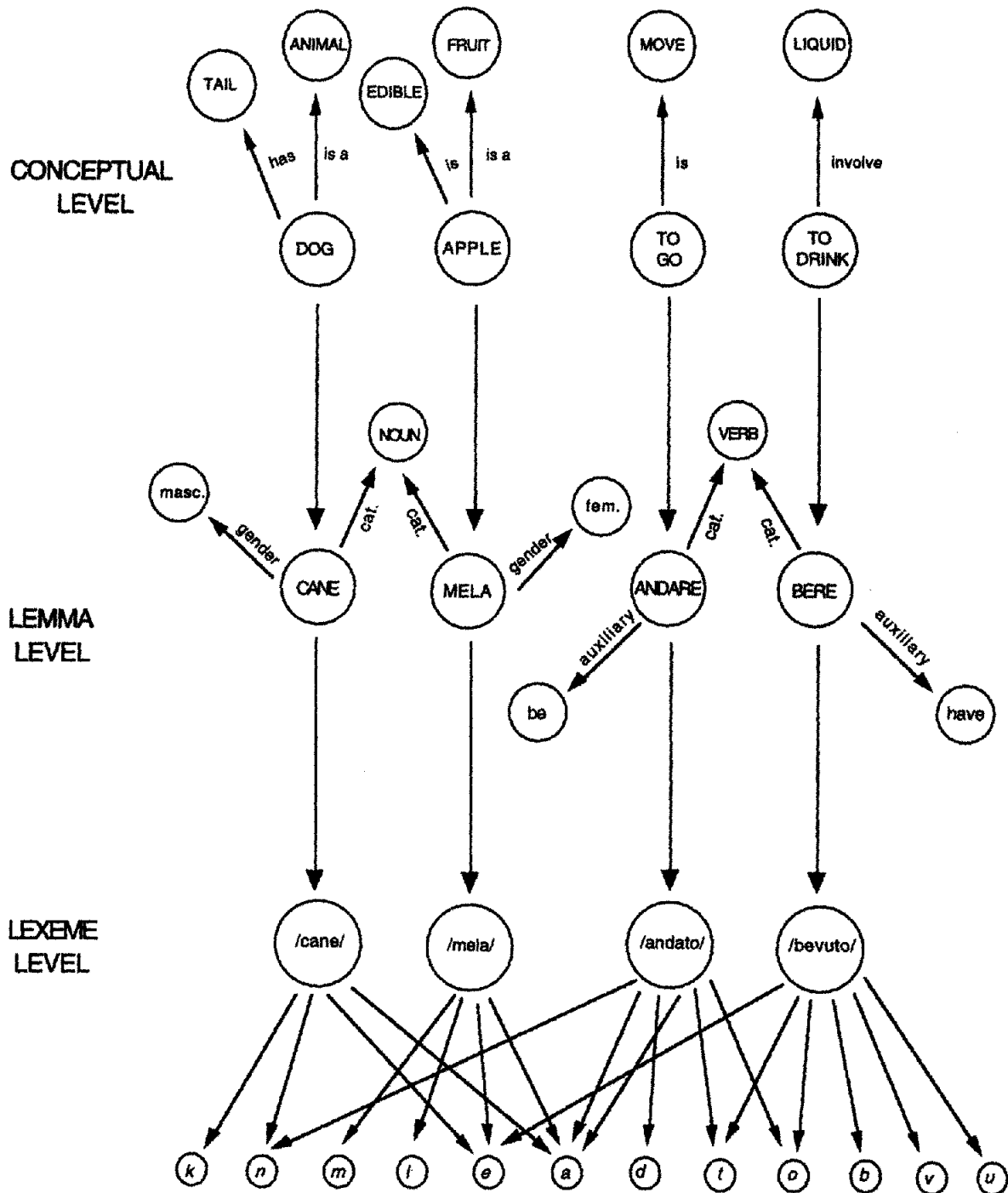


Figure 1. Schematic representation of a fragment of the lexical network. cat. = grammatical category; masc. = masculine; fem. = feminine. From "Word Frequency Effects in Speech Production: Retrieval of Syntactic Information and of Phonological Form" by J. D. Jescheniak and W. J. M. Levelt, 1994, *Journal of Experimental Psychology: Learning, Memory, and Cognition*, p. 826. Copyright by the American Psychological Association. Adapted with permission.

as the target word (e.g., Burke et al., 1991) indicates that the target's grammatical category is recoverable. The same argument could be advanced for other syntactic or morphological features, such as number or verb tense. It must be

noted, however, that participants' knowledge that the target word is, for example, a noun and singular, cannot be unambiguously interpreted as evidence that syntactic information is independently available at the lemma level during

TOT states. In experimental conditions, TOTs are obtained by having participants produce target words in response to definitions of infrequent words (e.g., R. Brown & McNeill, 1966). Characteristics of the words' grammatical class or number can be easily derived from information provided by the definition. Similarly, with TOTs experienced in daily life, the syntactic and semantic context provided by the sentence is sufficient to derive several syntactic properties of the omitted word. What has to be demonstrated, therefore, is that during TOTs, participants are able to report syntactic features that are not encoded in, or directly derivable from, the meaning of the word. Grammatical gender is a morpho-syntactic feature that satisfies this requirement.

In languages like Italian, French, Spanish, German, or Dutch, gender can be assigned, with the exception of a very small number of cases (e.g., *man*, *girl*, *rooster*), independently of the semantics of the noun. Thus, for example, *flower* is masculine in Italian (*fiore*) but feminine in French (*fleur*), and there are no semantic properties that would seem to dictate why the Italian noun *tavolo*, "table," is masculine, whereas the noun *sedia*, "chair," is feminine. In addition, the Italian gender assignment system presents another interesting property: Although gender types are statistically associated with specific word endings (i.e., *-a* for feminine singular and *-o* for masculine singular), the correlation is far from perfect, and there are very many nouns whose gender cannot be determined from their phonological structure alone (e.g., *mano*, "hand," feminine singular; *poeta*, "poet," masculine singular; *canè*, "dog," masculine singular; *merce*, "merchandise," feminine singular; *dialisi*, "dialysis," feminine singular; *bisturi*, "scalpel," masculine singular). In short, the fact that the semantics and phonology of Italian names do not unequivocally predict gender makes the investigation of the retrieval of gender information during TOT states particularly appropriate for shedding light onto the structure of lemmas.

The question of the availability of grammatical gender in TOT states was recently addressed by Vigliocco, Antonini, and Garrett (1997), who found that Italian speakers in a TOT state could successfully report the gender of the target word in a considerable proportion of times (84%). The possibility that participants guessed gender on the basis of word ending does not seem to be a viable explanation of these data because participants were equally good in reporting the gender of the words whose endings did not correlate with gender. Thus, if word ending were indeed critical for deriving gender, participants should not have reported gender correctly when this feature did not correlate with the end of the word. More generally, Vigliocco et al. found that the availability of gender information is not related to the availability of phonological features of the word, such as number of syllables and phoneme identity. They found that the probability of correctly recalling gender was the same for cases in which the participants did not provide correct phonological information and cases in which they correctly reported phonological information. This latter result is consistent with current two-stage models of lexical access, which assume that because the activation of lemmas precedes the access of lexemes, the retrieval of syntactic

features is not affected by the selection of phonological information.

Critical for the interpretation of the results of TOT experiments is establishing that participants are searching for the word expected by the experimenter. Obviously, the possibility that some participants might be searching for a word other than the one intended by the experimenter introduces an unknown level of noise in interpreting performance in TOT states. Suppose, for example, that instead of attempting to produce the Italian noun *lince* ("lynx," feminine), a participant who was in a TOT state was actually trying to retrieve the word *tigre* ("tiger," feminine). If the gender of the noun *tigre* were available, the response "feminine" would be mistakenly scored as correct given that the target and the alternative word have the same gender. On the other hand, if the initial phoneme of the noun *tigre* could be successfully retrieved, the selected first phoneme /t/ would be mistakenly scored as incorrect. In Vigliocco et al.'s (1997) study, the probability that a participant in a TOT state was searching for the wrong target word was quite high, at least as estimated from the number of nontarget naming responses (i.e., responses other than the one expected by the experimenter) produced by the participants. Of the total number of naming responses, 41% were words different from those expected by the experimenters. Thus, we can estimate that in roughly 40% of the TOT states, participants had in mind a word different from the expected target response.

To alleviate the interpretive problems raised by the uncertainty of whether participants in a TOT state are searching for the desired target, many investigations of the TOT phenomenon (see, e.g., R. Brown & McNeill, 1966; Burke et al., 1991), including that of Vigliocco et al. (1997), have used a post-TOT recognition test designed to assess the proportion of cases in which participants were seeking the wrong word. The typical form of this test is to present the target word to the participants after they have responded to queries about the phonological features of the TOT word and to ask participants to decide whether the word is the same as the one for which they were searching. On the basis of participants' responses to this test, TOT states are then divided into two groups: positive TOTs, where the word sought by the participant matches the word selected by the experimenter, and negative TOTs, where there is a mismatch between the word sought by the participant and the word selected by the experimenter. When TOTs were distinguished in this way, Vigliocco et al. found that grammatical gender was correctly retrieved far more frequently for positive TOTs (84%) than for negative TOTs (53%).

The post-TOT recognition task is a far from optimal assurance that the word sought by a participant in a TOT state matches the experimenter's target word. There is the possibility that the presentation of the target word might bias participants' recognition performance. That is, participants might have a greater tendency to identify a word as the target of their TOT search if they have correctly retrieved some information related to that particular word. In contrast, in the case of failed retrieval of word-feature information, participants might be more willing to assume that their search was

oriented toward a different word. A bias of this sort would have an important consequence: If only positive TOT states are considered to be true TOT states, the availability of word features, such as gender information or number of syllables, might be overestimated. Unfortunately, it is difficult to control for such a bias, and Vigliocco et al. (1997) did not attempt to determine whether participants' recognition of the target words in their study was influenced by the successful retrieval of word features (e.g., by introducing catch trials). Nonetheless, there may be some indication in their data that participants did not base their recognition responses only on their feeling of knowing the TOT target. If we were to assume that the distribution of target and nontarget name responses represents a fair estimate of the probability of searching for target and nontarget words in TOT states, then the expected ratio of positive to negative TOTs should correspond to the ratio of target to nontarget name responses. However, whereas the proportion of nontarget name responses was .41 of the total number of responses, the proportion of negative TOTs was .70 of the total number of TOT states.<sup>2</sup>

One of the aims of the present study was to establish more firmly, with a different methodology, whether Italian speakers know the gender of a word they cannot produce in a naming task. Another objective of the study was to compare more directly the relationship between the gender and the phonological information retrieved in TOT states. For these purposes, we used a two-alternative forced-choice procedure both in evaluating participants' knowledge of gender and in evaluating their knowledge of phonological features. Specifically, we asked participants in TOT states to guess the gender of the word (masculine or feminine, in Italian) and to choose between two phonemes for the initial and for the final phonemes of the target word. Thus, our experimental design differs significantly from the one used by Vigliocco et al. (1997), who evaluated knowledge of the phonological features of a target word by having participants guess the number of syllables and as many phonemes as possible. The procedure used by Vigliocco et al. makes it difficult to directly compare performance in the gender and the phonological tasks because of the different baseline levels of performance in the two tasks. By contrast, the use of a two-alternative forced-choice procedure in evaluating the availability of both gender and phonological information allows a more direct comparison of their relative availability in TOT states.

A strict assessment of the amount of phonological information that is retrieved in TOT states is crucial for two reasons. First, it is needed to rule out the possibility that correct performance in retrieving the gender of a word is dependent on knowledge of the final phoneme, which in Italian can be used to (statistically) predict gender. Second, evidence concerning the availability of phonological information is relevant in evaluating an important aspect of two-stage lexical-access models: that the correct selection of the grammatical features of a word is a necessary precondition for the correct selection of phonological information. According to this view, the correct retrieval of phonological features in TOTs should occur only when grammatical information is

correctly accessed. A detailed discussion of this issue is deferred until the General Discussion section.

In summary, then, the objective is to clarify how grammatical features are encoded and how the retrieval of these features interacts with the retrieval of phonological forms. We report two experiments in which we analyzed Italian speakers' ability to correctly recognize the grammatical gender and phonological features of words they could not produce, but which they felt were at the tips of their tongues. The aims of Experiment 1 were, first, to develop a set of words and a procedure for assessing the relative availability of gender and phonological information in TOT states and, second, to replicate the finding that grammatical features of a word can be reported despite the momentary inability to retrieve the word's phonology. In Experiment 2, we introduced a procedure for controlling for chance in the recognition of the features queried in TOT states.

### Experiment 1

Certain precautions must be followed in interpreting gender-retrieval performance in TOT states. In Italian, a noun's gender is moderately correlated with the word's phonology. In general, a noun ending with the vowel /o/ or a consonant is masculine and singular (e.g., *arco*, "bow"; *computer*, "computer"), whereas a noun ending with the vowel /a/ is feminine and singular (e.g., *arca*, "ark"). Although these correspondences can account for the majority of nouns in the language, there are numerous exceptions. In fact, we encounter nouns that end in /o/ that are feminine and singular, and nouns that end in /a/ that are masculine and singular. In addition, nouns that end with the vowels /e/, /i/, or /u/ are either masculine or feminine, as exemplified by the word pair *ponte* ("bridge," masculine) and *fonte* ("source," feminine). Bates, Devescovi, Pizzamiglio, D'Amico, and Hernandez (1995) demonstrated that the phonological characteristics of Italian nouns affect participants' responses in a gender-decision task (for further evidence of phonological influence on gender processing, see Brooks, Braine, Catalano, Brody, & Sudhalter, 1993; Grosjean, Dommergues, Cornu, Guillelmon, & Besson, 1994; Tucker, Lambert, Rigault, & Segalowitz, 1968; for a more general discussion of this issue, see Corbett, 1991). As a consequence of these facts, to conclude that gender is a feature that can be retrieved at the lemma level in TOT states, we first had to demonstrate that gender is not derived from the phonological characteristics of the noun. In our experiment, we

<sup>2</sup> Alternatively, it could be argued that the probability that the attempt to retrieve a word would result in a TOT state is not equally distributed between those words that lead to target and nontarget responses. Perhaps the test items that more frequently lead to nontarget name responses are also more likely to result in TOT states. In the latter case, the proportion of negative TOTs would not be expected to mirror the proportion of nontarget name responses. Be this as it may, until adequate experimental controls are introduced to directly assess the potential biasing effect on recognition induced by knowledge of the correctness of prior responses about a word's features, we must be very cautious in interpreting results based on the post-TOT recognition procedure.

controlled for this possibility by evaluating whether retrieval of gender information was correlated with retrieval of the final vowel. If gender is recovered through phonology, the two features should be highly correlated.

### Method

**Participants.** Sixteen native Italian speakers (staff and students of the University of Padua) were recruited for the experiment. Each participant was tested individually. Participants were told that they were participating in an experiment to investigate the TOT phenomenon. The tester was not informed about the purposes of the study.

**Materials.** A total of 160 uncommon Italian nouns (80 masculine and 80 feminine) were selected for a naming task. The words *biga* ("chariot"), *curaro* ("curare"), and *alibi* ("alibi") are examples of target nouns. All targets were singular words that ended with a vowel. Furthermore, none of the selected words had an affix that correlated with natural gender (e.g., *professoressa*, "female teacher"), nor did the words refer to the masculine or feminine exemplars of a concept (e.g., *ragazzo*, "boy" and *ragazza*, "girl"). Both regular and irregular gender nouns were selected. Regular nouns ended with gender-specific vowels (i.e., the vowel *-o* for masculine nouns and the vowel *-a* for feminine nouns). Irregular words ended with a different vowel than that of the regular nouns. Specifically, irregular masculine nouns could end with the vowels *-e*, *-a*, or *-i*, whereas feminine nouns could end with the vowels *-e*, *-o*, or *-i*. For both masculine and feminine words, there were 43 regular and 37 irregular nouns each. The mean frequency of the target nouns was 5.7 (range = 0–162; Istituto di Linguistica Computazionale, in press). There were no frequency differences between masculine and feminine nouns ( $M = 4.2$  and  $7.2$ , respectively),  $t(158) = 1.34$ ,  $p > .05$ , or between regular and irregular nouns ( $M = 5.3$  and  $6.2$ , respectively),  $t(158) > 1$ .

A picture-naming task, a definition-naming task, or both were used to induce participants into TOT states. Pictures were copied from various picture dictionaries. Whenever a picture was considered to be insufficient for inducing the production of a specific noun, the picture was accompanied by a short definition. For instance, to elicit the noun *cornamusa*, "bagpipe," instead of *zampogna*, "reed pipe," the picture of a bagpipe with the description *It is typical of Scotland* was provided. For nouns that could not be easily depicted, only a verbal description was presented. The three types of stimuli were distributed as follows: 38 pictures, 88 verbal descriptions, and 34 pictures and descriptions. Stimuli were presented individually on sheets of paper that also contained the alternative responses for gender and the final vowel. Alternative choices for the initial phoneme were shown on a separate page. The latter procedure was adopted as a precaution against prematurely providing a cue for the retrieval of the target word.

**Procedure.** Stimuli were presented in a pseudorandom order. On trials in which definitions were presented, they were read aloud by the experimenter. A stimulus remained in view until the end of the trial. Participants were required to name the stimulus within 15 s from the presentation of the picture or the end of the reading of the definition. When unable to name an item within 15 s, they were asked to decide whether or not they knew the target name. They were instructed to respond "don't know" if they did not recognize the picture or the definition, or if they thought that they had never known the appropriate name of that concept. However, if they felt that they knew the word and that they had the feeling that the word was about to come, they were instructed to report being in a TOT state. Immediately after reporting that they were in a TOT state,

participants were asked to retrieve, in order, the following features of the unavailable noun: grammatical gender, the final vowel, and the initial phoneme. For each type of information, a forced-choice decision was required. Each pair of alternative responses was visually presented and read aloud by the experimenter. No time constraints were imposed for the response. In the case of grammatical gender, the alternatives were "masculine" and "feminine." For the final vowel, the alternatives were represented by a regular final vowel (*-o* for masculine and *-a* for feminine nouns) and an irregular final vowel (*-e* or *-i*). Each target noun was associated with two pairs of vowels: one pair if the masculine gender was selected and another pair if the feminine gender was selected. Participants were instructed to choose between the pair of letters (phonemes) consistent with the selected gender. Thus, for example, with the feminine noun *cornamusa*, "bagpipe," the pairs of vowels *-a* and *-e* for feminine gender and *-o* and *-i* for masculine gender were presented. If, in response to the gender query, participants responded "feminine," they were required to choose between the pair of vowels *-a* and *-e*, and if they responded "masculine," they were required to choose between the pair *-o* and *-i*.

The identity of the initial phoneme was queried last. The consonant-vowel status of the initial phoneme of the target word constrained the selection of false alternatives. If the initial phoneme of the target word was a vowel, the pair of alternatives consisted of two vowels. Similarly, a choice between two consonants was offered when the initial phoneme of the target word was a consonant. For both initial- and final-phoneme choices, a specific phoneme occurred approximately an equal number of times as a correct and as a false response. Within the constraints discussed above, a phoneme was randomly assigned to be the false initial phoneme or the false final phoneme of a target noun.

Whenever the participants were able to retrieve the target name while searching for the grammatical gender or the final letter ("recovered TOTs"), their responses were considered correct naming responses, and the item was not retained for further analysis.

### Results and Discussion

Participants produced a name that they considered adequate for the stimulus on 77.8% of the naming trials, including 39 recovered TOTs—cases in which participants initially signaled that they were in a TOT state but then were able to correctly retrieve the word before being queried with the initial phoneme. Most of the recovered TOTs (30 out of 39) occurred after the search for gender. The vast majority of the names produced by participants (93.7%) conformed to those designated by the experimenter. Of the alternative names produced by participants, 76 out of 125 (60.8%) could be considered as appropriate alternative responses to those designated by the experimenter (e.g., *cambusa*, "galley" → *stiva*, "hold," for the definition *the place in the ship where food is stored*); the remaining cases (49 out of 125) were frank incorrect responses (e.g., *sestante*, "sextant" → *goniometro*, "protractor"). The alternative names were unevenly distributed across the stimuli: They were mostly concentrated in a very small number of stimuli (see Experiment 2). A total of 263 "don't know" responses ( $M$  per participant = 16.4, range = 3–43) and 304 TOT responses were also produced ( $M$  per participant = 19.0, range = 3–37). The remaining analyses focused on partici-

pants' recognition of the queried word features in TOT states.

The proportions of correct recognition for each of the word features queried in TOTs were the following: 218 out of 304 (71.7%) for grammatical gender, 233 out of 304 (76.6%) for the initial phoneme, and 136 out of 218 (62.4%) for the final phoneme. A one-way analysis of variance (ANOVA), with target feature (gender, initial phoneme, and final phoneme) as the independent variable, was performed on participants' proportions of correct recognition. A significant effect of word feature was found,  $F(2, 15) = 7.40$ ,  $MSE = 138.556$ ,  $p < .01$ . As revealed by post hoc analyses, this latter result was due to participants' less accurate performance in recognizing the final phoneme than in recognizing gender,  $t(15) = 2.59$ ,  $p = .02$ , or the initial phoneme,  $t(15) = 4.64$ ,  $p < .0001$ .<sup>3</sup> No difference emerged when correct responses for gender and for the initial phoneme were compared,  $t(15) < 1$ . Analysis of the data with items as a random variable was complicated by the fact that some stimuli did not induce any TOT states. Consequently, only stimuli that generated TOT responses were retained for the following analyses by items. In a one-way ANOVA, in which the entire corpus of TOTs was considered, the proportions of correct responses with gender and the initial phoneme were contrasted. No difference was found in this comparison,  $F(1, 115) < 1$ . Thus, an identical pattern of results emerged from the analyses by subjects and by items: Participants in TOT states could retrieve gender and the initial phoneme equally well.

Figure 2 depicts the distribution of correct gender performance for masculine and feminine nouns and for nouns with regular and irregular endings. Separate analyses were carried out to determine whether type of gender (masculine vs.

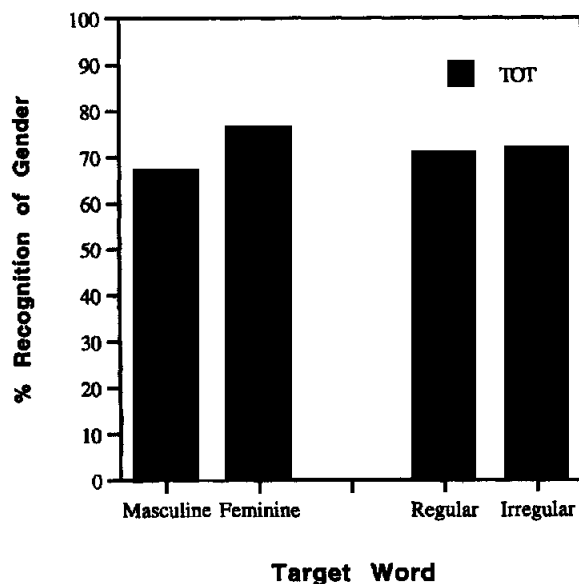


Figure 2. Percentage of correct recognitions of grammatical gender in "tip-of-the-tongue" (TOT) responses for masculine and feminine nouns and for regular and irregular nouns (Experiment 1).

feminine) and regularity (regular vs. irregular ending) affected participants' performance. A marginally significant effect of type of gender was obtained: Performance was slightly better with feminine (110 out of 143, 76.6%) than masculine nouns (108 out of 161, 67.1%),  $t(114) = 1.95$ ,  $p = .054$ . Noun regularity did not affect gender recognition (correct responses: regular nouns = 130 out of 182, 71.4%; irregular nouns = 88 out of 122, 72.1%),  $t(114) < 1$ . This result was obtained even though participants tended to select the regular ending more frequently than the irregular ones (correct responses: regular nouns = 94 out of 130, 72.3%; irregular nouns = 42 out of 88, 47.7%),  $t(104) = 4.26$ ,  $p < .0001$ . This latter asymmetry reflects the distribution of Italian nouns—among the first 3,000 most frequent Italian words (De Mauro, Mancini, Vedovelli, & Voghera, 1993), 66% of the nouns have a regular gender ending.

The most important result in this experiment concerns performance in retrieving gender information during TOT states. It would seem that participants in TOT states are able to correctly choose the gender of a noun in a considerable proportion of trials (71.7%) despite their inability to produce the target word. Two other results strengthen the conclusion that gender can be correctly selected despite participants' inability to retrieve relevant phonological information about the target word. Performance in choosing gender was significantly better than in choosing the final phoneme (62.4%), and gender regularity did not affect the probability of correctly choosing gender (70.9% and 79.5%, for regular and irregular gender, respectively). These results indicate that participants did not choose the gender of a word on the basis of their ability to retrieve the final phoneme of the target word—the part of a word that could potentially help in retrieving gender information. However, the lack of an estimate of the chance level of accuracy limits the interpretation of the data reported in this experiment. In Experiment 2, we introduced a procedure for assessing chance performance. However, before proceeding to the next experiment, we consider two other results that are relevant to the theoretical and methodological issues raised in the introduction.

An important and intriguing result concerns the relative level of accuracy in choosing the initial phoneme of words in TOTs. In this experiment, participants were able to correctly choose the initial phoneme 76.6% of the time. This level of accuracy is not different from performance in choosing gender (71.7%). This result is intriguing because there is one version of the two-stage model of lexical access—the discrete stage model of lexical access (e.g., Levelt et al., 1991)—that would predict better performance in the retrieval of grammatical information than phonological information in TOT states. In this model, grammatical but not phonological information is supposed to be available at the level of lemma—the level of information that is accessed in

<sup>3</sup> The results of all the  $t$  tests presented in this article remain significant when a Bonferroni correction of the alpha level is applied.

TOT states.<sup>4</sup> We return to this issue in the General Discussion.

Finally, it is important to note that the ratio of target to nontarget name responses in this experiment was very high—14.9:1 (93.7% target vs. 6.3% nontarget responses). The very high ratio of target to nontarget responses in our experiment indicates that participants in TOT states were very likely to be searching for the desired target response. Of course, this ratio provides only an estimate of the actual distribution of target to nontarget searches in TOT states. Nonetheless, it provides one means of assessing the extent of uncertainty associated with knowing whether or not participants in TOT states were searching for the designated target. In Experiment 2, we attempted to further reduce this uncertainty by using just those word stimuli that are known to generate high agreement in naming responses.

### Experiment 2

To demonstrate that some specific feature of the target word is available in TOT states, it must be shown that the same information is not recalled by chance. This requires establishing the chance level of accuracy that would be expected in the case of complete unavailability of such information. In a two-alternative forced-choice task, if responses are randomly selected and the two events are assumed to be equally probable, a .5 level of accuracy is expected. A different pattern of chance-level accuracy would be expected if other assumptions were to govern participants' decisions. Thus, for example, if masculine words were more frequent in the language than feminine words and if participants were sensitive to these distributional properties, chance level should differ from .5 and, consequently, more (correct) "masculine" than (correct) "feminine" responses would be expected. One way to correct for such biasing factors is to adopt as a baseline for chance-level performance the proportion of hits obtained with "don't know" (DK) responses (Koriat & Lieblich, 1974)—that is, responses where participants claim not to know what the intended target word is as opposed to TOTs where they know the intended target but are not able to retrieve the appropriate word form. In this way, if a feature of the target word is successfully accessed in TOT, the probability of correctly reporting this feature should be greater in TOT than in DK states.

The introduction of the DK condition, in addition to a refined selection of the stimulus materials, allowed us to better characterize the kind of information that is available for words that are on the tip of the tongue.

### Method

**Participants.** Thirty-two native Italian speakers (staff and students of the University of Padua) participated in the experiment. None of the participants in this experiment took part in the previous experiment. The tester was not informed about the objectives of the experiment.

**Materials.** The naming responses from Experiment 1 served as the basis for selecting the materials used in this experiment. By

adopting a criterion of at least 80% responses consistent with the name designated by the experimenter, 12 stimuli were discarded. To counterbalance the variables of gender and regularity, 4 new stimuli were added (for these new stimuli, name agreement was controlled through informal testing). The final list of stimuli consisted of 152 uncommon Italian nouns. Half of the words were masculine, the other half feminine; for each gender, there were 40 regular- and 36 irregular-gender nouns. The mean frequency of the target nouns was 4.6 (range = 0–34; Istituto di Linguistica Computazionale, in press). Masculine and feminine nouns did not differ in frequency ( $M = 4.4$  and  $4.7$ , respectively),  $t(150) > 1$ . Irregular gender nouns tended to be more frequent than regular ones (mean frequency: regular = 3.4, irregular = 6.0),  $t(150) = 2.60$ ,  $p = .01$ , a fact that would eventually result in an increased incidence of TOTs with regular gender nouns. As in Experiment 1, definitions and pictures were used for the naming task. Stimuli were distributed as follows: 35 pictures, 81 verbal descriptions, and 36 pictures plus descriptions.

**Procedure.** The procedure was the same as that described in the previous experiment, with the exception that when participants declared not to know the name, they were asked to choose the gender and the initial and final phoneme of the supposedly unknown target word. In this way, participants were asked to make the same choices for TOT and DK words.

### Results and Discussion

On 79.3% of the trials, participants produced a name that was considered adequate for the presented stimulus. This number includes 157 occasions (4.1%) in which the participants had initially signaled that they were in a TOT state but were subsequently able to name the stimulus while searching for the gender or the final phoneme of the word. On average, there were 4.9 resolved TOTs per participant (range = 0–12). Most of the resolved TOTs occurred just after the search for gender (152 times). In 80 cases (equal to 2.1% of the trials in which a name was produced), participants labeled the stimuli with a different word from that expected by the experimenter. Fifty-four (67%) of these responses could be classified as errors (e.g., *lince*, "lynx" → *tigre*, "tiger"); the remaining 26 cases were plausible alternative responses (e.g., *cariatide*, "caryatid" → *colonna*, "pillar"). Given the very high concordance (98%) between the nouns produced by the participants and those expected by the experimenter, we can be confident that participants in TOT states were, in the vast majority of cases, searching for the expected target forms. The stimuli induced a total of 527 DK and 479 TOT responses; the mean numbers of DK and TOT responses per participant were 16.4 (range = 1–45) and 15.1 (range = 1–42), respectively.

The percentages of correct recognition of grammatical gender and of the initial and the final phonemes for TOT and DK responses are presented in Table 1. In the case of DK

<sup>4</sup> We hesitate to discuss these data in greater detail here because there is the possibility that the level of performance for the initial phoneme was affected by the two-alternative forced-choice procedure used in this experiment. That is, it could be argued that providing the participant with two phonemes to choose from served as a cue to the retrieval of the target noun. We discuss these issues later in the article.

Table 1  
*Correct Recognitions of Target Words in the Tip-of-the-Tongue (TOT) State and the "Don't Know" (DK) State in Experiment 2*

Feature	TOT			DK		
	Correct recognitions	Total responses	% correct	Correct recognitions	Total responses	% correct
Gender	338	479	70.6	247	527	46.9
Initial phoneme	344	479	71.8	306	527	58.1
Final letter <sup>a</sup>	198	338	58.6	130	247	52.6

<sup>a</sup>In this condition, the total number of responses is represented by the number of correct responses with grammatical gender.

responses, participants' correct performance was around 50% correct for each of the queried features (47%–58%). With TOTs, a high proportion of correct responses was obtained for grammatical gender and for the initial phoneme (70.6% and 71.8%, respectively), but not for the final phoneme (58.6%). Participants' proportions of correct responses were analyzed in a two-way ANOVA with target retrieval status (TOT vs. DK) and target feature (gender, final vowel, and initial phoneme) as main variables. The analysis revealed that participants were more accurate in recognizing target features with TOT responses than with DK responses,  $F(1, 31) = 19.28$ ,  $MSE = 0.055$ ,  $p < .0001$ , although as indicated by a main effect of target features, the queried properties were recognized with different probabilities,  $F(2, 62) = 5.67$ ,  $MSE = 0.048$ ,  $p < .01$ . The interaction was also significant,  $F(2, 62) = 4.30$ ,  $MSE = 0.026$ ,  $p = .018$ , a result due to participants' more accurate performance with TOT compared with DK responses in recognizing the grammatical gender and the initial but not the final phoneme. Planned comparisons confirmed the discrepancy between DK and TOT responses in responding to grammatical gender,  $t(31) = 5.77$ ,  $p < .0001$ , and the initial phoneme,  $t(31) = 4.58$ ,  $p < .0001$ ; no difference was found for the final phoneme,  $t(31) < 1$ .

Because some stimuli did not induce TOT or DK responses, an analysis with items as a random variable is problematic. To circumvent these difficulties in an item analysis, only stimuli that induced both TOT and DK responses were retained for analysis; this procedure was used in all analyses by items. Two analyses were carried out: one for gender and initial phoneme and one for final phoneme. The reason for carrying out a separate analysis for the final-phoneme data is that as discussed in the *Materials* section of Experiment 1, only those trials in which gender was correctly recognized could be included in the analysis. Thus, (interpretable) final-phoneme data are available only for trials in which gender responses were correct, making an overall analysis by items impossible.

A two-way ANOVA was performed with type of response (TOT vs. DK) and target feature (gender vs. initial phoneme) as main variables for gender and initial phoneme. This analysis was carried out on 392 TOT responses and on 514 DK responses, corresponding to 81.8% and 97.5% of the entire corpus of TOT and DK responses, respectively. There

was a main effect of type of response,  $F(1, 98) = 16.18$ ,  $MSE = 0.092$ ,  $p < .0001$ , but no significant effect of target feature,  $F(1, 98) = 1.56$ ,  $MSE = 0.162$ ,  $p > .05$ , nor was there an interaction between these two variables,  $F(1, 98) = 0.45$ ,  $MSE = 0.084$ ,  $p > .05$ . A separate analysis was carried out for the final phoneme. Because of the design of the experiment (see above), only a relatively small subset of responses could be analyzed: Only trials in which gender was correctly identified were retained for a one-way ANOVA with type of response (TOT vs. DK) as the independent variable. In this way, 68% ( $N = 326$ ) of the entire corpus of TOT responses and 71% ( $N = 372$ ) of the total corpus of DK responses were retained for analysis. No difference between TOT and DK responses emerged,  $F(1, 72) = 2.13$ ,  $MSE = 0.121$ ,  $p > .05$ . In short, identical results emerged from the analyses by subjects and by items: The probability of recognizing grammatical gender and the initial phoneme was higher when participants signaled that they were in a TOT state than in a DK state; no such difference was found for the final phoneme.

The distribution of TOT and DK responses for masculine and feminine and for regular and irregular gender nouns over all items is presented in Figure 3. An analysis of whether the probability of correctly recognizing grammatical gender was affected by a target's gender or by a target's gender regularity was performed on the subset of items that induced both TOT and DK responses. In the case of DK responses, masculine gender was more frequently selected than feminine gender (63.9% and 36.4%, respectively),  $t(101) = 4.61$ ,  $p < .0001$ . Participants' bias in responding "masculine" is consistent with the distributional characteristics of gender in Italian. In the corpus of the 3,000 most common words listed in a frequency dictionary (De Mauro et al., 1993), we counted more masculine (63%) than feminine nouns. Furthermore, the probability of correctly recognizing the gender of DK nouns was higher for irregular than for regular nouns (60.7% vs. 43.8%),  $t(101) = 2.64$ ,  $p < .01$ . The basis for this response bias is not clear. However, none of the asymmetries found for gender selection of DK nouns emerged when participants declared that they were in a TOT state. In fact, there was a comparable level of accuracy in indicating the gender of masculine nouns (72.4%) and feminine nouns (62.3%),  $t(123) = 1.58$ ,  $p > .05$ , and gender information was equally available for

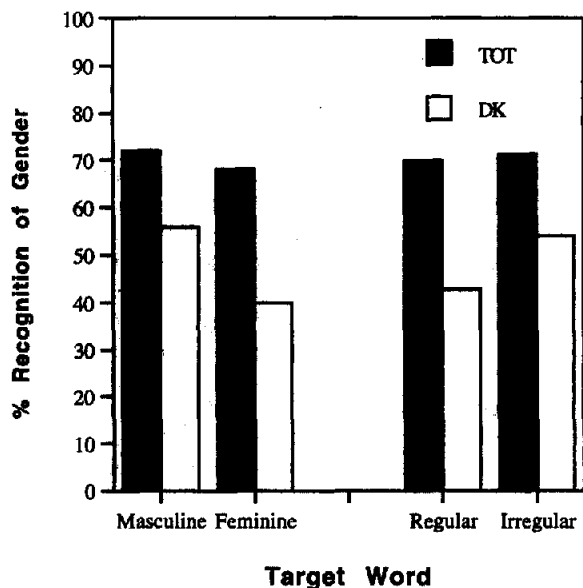


Figure 3. Percentage of correct recognitions of grammatical gender in "tip-of-the-tongue" (TOT) and "don't know" (DK) responses for masculine and feminine nouns and for regular and irregular nouns (Experiment 2).

regular and irregular nouns (69.3% and 65.3%, respectively),  $t(123) < 1$ .<sup>5</sup>

A gender-regularity effect was observed for final-phoneme responses: Regular gender vowels were more frequently selected. This asymmetry emerged with both TOT and DK responses (see Figure 4)—a result further suggesting that the same principles governed the choice of

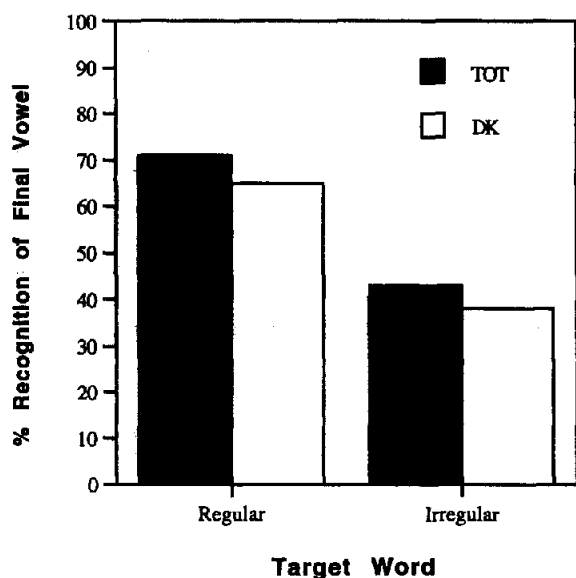


Figure 4. Percentage of correct recognitions of the final vowel in "tip-of-the-tongue" (TOT) and "don't know" (DK) responses for regular and irregular nouns (Experiment 2).

the final phoneme in both types of responses. A comparison performed on the subset of stimuli for which gender was correctly recognized confirmed this regularity effect, both with TOT responses (regular = 73.4%, irregular = 43.1%),  $t(93) = 4.37$ ,  $p < .0001$ , and with DK responses (regular = 63.5%, irregular = 33.1%),  $t(88) = 3.89$ ,  $p < .0001$ . This asymmetry is consistent with the distribution of the regular and irregular word endings in Italian nouns (see Experiment 1).

On 24.2% of the trials in which participants signaled that they were in a TOT state, the presentation of the initial letter cued the retrieval of the correct response. Thus, for example, a participant who might have been trying to produce the word *biga*, "chariot," and was presented with the alternatives /p/ and /b/ was able to respond *biga* after having chosen the phoneme /b/. However, there was no relation between the effects of cuing and the recognition of gender: The probability of recognizing gender in the resolved (72.4%) and unresolved (70.0%) trials did not differ significantly,  $t(25) = 1.08$ ,  $p > .05$  (this comparison was restricted to the group of participants who produced resolved responses). This latter result is important because it shows that the ability to correctly retrieve phonological information was not affected by the prior response about gender.

### General Discussion

In the introduction we noted that there is virtually universal agreement among theorists of speech production that lexical access involves at least two distinct stages of lexically specific processing: a stage of processing in which a semantically and syntactically specified representation is accessed and a stage of processing in which the corresponding lexical-phonological representation is accessed (Bock, 1982; Butterworth, 1989; Dell, 1990; Fromkin, 1971; Garrett, 1975; Levelt, 1989). But, this is where the agreement stops, for there is no agreement on such fundamental issues as the overall number of levels of representation (see footnote 1), and the nature and organization of the information represented at those levels. Thus, for example, one model assumes a componential theory of meaning (Dell, 1986), whereas another assumes a holistic theory of meaning (Bock & Levelt, 1994), and one model assumes morphological composition (Levelt, 1989), whereas another assumes whole-word representations (Butterworth, 1992). There is also, as already noted, disagreement on the specific nature of the access process: Some models assume discrete stages of processing (e.g., Butterworth, 1992; Levelt, 1989); others assume interactive stages of processing (e.g., Dell, 1986; Stemmer, 1985). Thus, the fact that there is widespread agreement on the general distinction between lemmas and lexemes may be less compelling than it would at first appear, because the very notions of lemma and lexeme

<sup>5</sup> In the subset of TOTs considered in these analyses, participants correctly recognized grammatical gender about 67% of the time, a figure that is slightly lower than when the entire corpus of TOTs is considered (see Figure 3).

may be fundamentally different across models. This is especially true for the concept of lemma, which remains poorly specified in terms of both its content and its role. Nonetheless, the results reported here, together with other recent experimental and neuropsychological evidence, provide an increasingly strong set of constraints concerning the relation among grammatical, semantic, and phonological information in lexical access.

In this study, we investigated whether grammatical gender—a word-specific syntactic feature of Italian—could be retrieved by participants in a TOT state. Adopting the proportion of hits with DK responses as a baseline, we found that participants' probability of correctly recognizing the grammatical gender of target words in TOT states was significantly higher than it was for words in DK states. In none of the nouns used in the experiment could gender have been inferred from the semantic characteristics of the concept. Similarly, the correlation between gender and the final phoneme in Italian could not account for the correct identification of gender because the availability of the latter feature was demonstrated even with nouns for which there was no correspondence between gender and phonology. The results of the present research allow us to characterize TOT as a condition in which, despite the unavailability of the word form, the syntactic (and some phonological) features of the target noun can be retrieved. In this respect, we replicated and further extended the results of a previous investigation of the availability of grammatical gender in TOTs (Vigliocco et al., 1997). These results are consistent with the finding that the alternate words that come to mind in participants in TOT states are almost always of the same grammatical class as the target response—a finding that led Burke et al. (1991) to argue that grammatical features of words are available in TOT states. Thus, together with the results showing that amnic patients can retrieve the gender of the nouns (Badecker et al., 1995; Henaff Gonon et al., 1989) and the verb auxiliary of the verbs (Miozzo & Caramazza, 1997) that they are unable to produce, the results reported here provide strong support for the two-stage lexical-access hypothesis.

Two other results of our research are worth noting. First, in our experiments the probability of correctly recognizing gender was lower than that reported by Vigliocco et al. (1997)—.71 vs. .84, respectively. The discrepancy may have been due to one of three factors or to their combination. One possibility for the lower level of correct performance in our experiments is that our data included an unknown mixture of positive and negative TOTs. The inclusion of negative TOTs has the effect of lowering the overall level of correct gender recognition. Although we cannot provide a precise estimate of the proportion of negative TOTs in our experiments, it is likely to have been quite small, as indicated by the minuscule proportion of nontarget name responses in Experiment 2: Only 2% of the responses in which participants produced a name were different from the target designated by the experimenter. Alternatively, the higher proportion of correct gender recognition in Vigliocco et al.'s study may have been due to the fact that the post-TOT recognition procedure they

used for distinguishing positive from negative TOTs induced a bias in recognizing those words whose features were previously recognized correctly. As discussed in the introduction, there are indications in their data of just this type of bias, with the consequence that it would lead to an overestimation of the availability of gender information in TOTs, and of course, it could be that both factors discussed here contributed to the observed discrepancy in the rate of correct gender recognition in TOTs. Further research is needed to resolve this issue. However, for present purposes we note that any bias in our estimation of correct gender retrieval would apply equally to the estimation of correct retrieval of phonological information. Furthermore, any such bias would have the effect of reducing the level of correct gender (and initial-phoneme) recognition. Thus, the presence of such a bias in our data would not undermine the conclusion that grammatical information about a word is available even when its word form cannot be accessed. Finally, the discrepancy in results may have been due to the different criteria used in the two studies for inclusion of a trial in the pool of TOTs used for analysis. In this study, we did not count as TOTs 157 cases in which participants initially signaled that they were in a TOT state but were able to retrieve the name immediately after the search for gender ( $n = 152$ ) or after the search for the final phoneme, but before the initial-phoneme query. If these cases were to be included in the pool of TOTs, the percentage of correct gender responses would be 77.8%—a level of performance not too dissimilar from that obtained by Vigliocco et al.<sup>6</sup>

Another aspect of the results worth noting concerns the fact that participants in TOT states did not recall the final phoneme better than would be expected by chance and the fact that comparable levels of accuracy were obtained for the final phoneme with TOT and DK responses (for similar results, see also Kohn et al., 1987; Koriat & Lieblich, 1974). These results rule out the possibility that the superior performance for gender information was the result of inferences based on knowledge of word-end phonology, which in Italian can statistically predict gender.

Finally, the fact that in TOTs the retrieval of gender was not better than recognition of the initial phoneme raises important questions concerning how grammatical features are selected and how they are related to semantic and phonological information. As noted in the introduction, two-stage models of lexical access would seem to predict that the recognition of gender in TOT states should be better than the recognition of the initial phoneme. This follows

<sup>6</sup> Note that the inclusion of the 157 resolved TOTs in the analysis does not change the relative levels of correct gender and initial-phoneme recognition. Because the resolved TOTs involved not only the correct retrieval of gender but also the correct retrieval of the word's phonology, the two proportions remain unchanged relative to each other. Thus, correct gender recognition goes from 70.6% to 77.8%, and correct initial-phoneme recognition goes from 71.8% to 78.8%. In other words, the level of performance of gender recognition is still not different from the level of initial-phoneme recognition.

directly from the assumption that the selection of grammatical information, which is associated with the lemma level, precedes the selection of phonological information at the lexeme level, and if TOTs represent cases of access of lemma representations with failure to retrieve their associated lexemes, then the expectation ought to be that gender recognition should be better than initial-phoneme recognition. However, we did not obtain this result in either of the two experiments reported here. In both cases, the level of correct recognition of gender was the same as the level of correct recognition of the initial phoneme. Two implications follow from these results. One implication is that being in a TOT state (assuming that this subjective state indicates lemma access) is not equivalent to successful retrieval of the grammatical features of a word. The other, more interesting implication is that it sets boundary conditions on the relation between access to grammatical and access to phonological information. More specifically, the results are consistent with models of lexical access in which selection of a lemma node sends activation in parallel to both grammatical and phonological information, but the results are problematic for models in which selection of the lemma is synonymous with the selection of the grammatical features of a word. The former, but not the latter, models allow for patterns of results in which gender and initial-phoneme recognition are equivalent and even allow for the case in which recognition of the initial phoneme is superior to recognition of gender. Additional evidence relevant to the issues raised here may be garnered from other sources.

An inspection of the TOT data reported by Vigliocco et al. (1997) reveals that the probability of correctly reporting phonological features (i.e., number of syllables and phoneme identity) when gender is not recalled is higher for positive than for negative TOTs. Specifically, participants were nearly twice as likely to correctly report phonological features of positive than of negative TOTs (60% vs. 34%, respectively). This result suggests that access to phonological information may not strictly depend on the successful retrieval of (some) grammatical features of a word.<sup>7</sup>

Data pointing to the same conclusion came from a reaction-time study designed to address the issue of word frequency in speech production (Jescheniak & Levelt, 1994). Jescheniak and Levelt (1994) had Dutch participants report the grammatical gender of the names of pictured objects. The gender-decision task was preceded by a naming task with the same objects. Some participants were required to produce the names of the pictures, whereas others had to produce the full noun phrases (article + noun). It was reasoned that because, in Dutch, nouns are marked for gender, a naming task that demands the retrieval of the article necessarily involves accessing the noun's gender. In the gender-decision task, a facilitatory effect on reaction times was found when the naming task involved production of the article. No facilitatory effect emerged in the condition in which participants produced only the name of the pictured objects. These results suggest that phonological information can be accessed independently of grammatical information.

Finally, evidence consistent with the latter conclusion,

albeit of a rather anecdotal sort, is provided by the spontaneous speech of a brain-damaged Italian speaker, F.S. (Miceli & Caramazza, 1988). This aphasic participant produced lexical substitution errors in repetition of single words. For instance, asked to repeat the Italian word *grossa* ("big," feminine singular), he responded *grosso* ("big," masculine singular), and he produced *finestra* ("window," singular) instead of *finestre* ("windows," plural) suggesting a deficit in processing inflectional morphology. More relevant to the present context, in spontaneous speech, F.S. produced utterances such as the following: *Poi io ascolto il* (masculine singular) *televisione* (feminine singular), "then I listen the television"; ... *perché il* (masculine singular) *giornate* (feminine plural) ... *lungo* (masculine singular) "... because the days are long." In these examples, F.S. correctly retrieved the lexemes *televisione* and *giornate* but not the gender information needed to select the correct article (*la* and *le*, respectively) or the proper inflection on the adjective (*lunghe*, in this case). As another example, he produced the utterance ... *c'è la* (feminine singular) *mia* (feminine singular) *studia ancora aperto* ... "there is my office still open," where he produced the neologism *studia* (instead of *studio*, masculine singular)<sup>8</sup> and the incorrect gender features for the article (*la* instead of *il*) and for the possessive pronoun (*mia* instead of *mio*). These examples illustrate the possibility of selective disruption of syntactic information that leaves the retrieval of lexical-phonological forms unaffected.

The pattern of results in our experiments, along with other results reviewed here (e.g., Jescheniak & Levelt, 1994; Miceli & Caramazza, 1988; Vigliocco et al., 1997), allows three conclusions: (a) Grammatical information is specified and accessed independently of semantic and phonological information; (b) selection of a lexical-semantic representation does not guarantee access to its grammatical features; and (c) access to phonological features of a word may not strictly depend on access to its grammatical features. These conclusions are consistent with some aspects of two-stage models of lexical access that assume that semantic, syntactic, and phonological features are independently represented but are connected through an abstract lexical node—the lemma (see Figure 1). This feature of the model is consistent with the results we have reported. However, our results are problematic for other aspects of this model. First, as already noted, the results undermine the hypothesis that access to a word's lemma leads automatically to access to its syntactic features. Second, and more important, the results challenge the hypothesis of a strict dependence between the retrieval of grammatical and phonological information, inviting the

<sup>7</sup> It is an open question whether all syntactic features of a word are represented at the same level of processing and, thus, are available at the same time. Thus, for example, were the features "noun," "count noun," and "masculine" represented at the same level of processing? If they were, then the results with gender would also apply to other syntactic features.

<sup>8</sup> Actually, *studia* is an Italian word meaning "he, she studies." However, when used as a noun, it is a neologism.

inference that access to the phonological content of a word is not mediated by access to its full syntactic representation (see Caramazza, 1997, for further discussion of this issue).

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Received February 22, 1996

Revision received March 17, 1997

Accepted April 23, 1997 ■