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Discussion

More is not always better: a response to Roelofs, Meyer, and Levelt

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Abstract

In a series of papers we have argued that the distinction between lemma and lexeme levels of representation in lexical access may be unnecessary. We pointed out that the evidence cited in support of this view is not incompatible with alternative accounts that do not assume a lemma level of representation. Furthermore, we argued that there are neuropsychological observations and results from tip-of-the-tongue (TOT) experiments that appear to be problematic for the lemma/lexeme distinction. Roelofs et al. [Roelofs, A., Meyer, A.S., Levelt, W.J.M., 1998. A case for the lemma/lexeme distinction in models of speaking: comment on Caramazza and Miozzo (1997). *Cognition* 69, 219–230.] have challenged our conclusions by attempting to demonstrate that (1) a model that incorporates the lemma/lexeme distinction can account for the putatively problematic neuropsychological and TOT data; (2) there are other data that appear to be problematic for a type of model that does not include a lemma level of representation. In the present paper we respond to these criticisms by showing (1) that the neuropsychological and TOT data still represent a challenge for the lemma/lexeme distinction, and (2) that the other evidence cited by Roelofs et al. is not incompatible with lexical theories that assume only one lexical layer. © 1998 Elsevier Science B.V. All rights reserved

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Researchers working on problems of lexical access in language production agree that this process involves a stage where lexical representations are specified and a stage where their phonological or orthographic forms are specified. There is much less agreement on issues about the nature of such representations and the manner in which they are accessed. One area of disagreement concerns whether there are *two* lexical stages between the semantic representation of a word and its segmental content (phonological or orthographic) or whether there is *only* one such stage of lexical representation.

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The received view is that there are two lexical stages (e.g. Butterworth, 1989; Dell, 1990; Garrett, 1992; Levelt, 1989; Roelofs, 1992). Following a suggestion by Kempen and Huijbers (1983) the two types of representations have been labeled lemma and lexeme. The lemma level specifies the syntactic properties of the word: its grammatical class and various diacritics associated with that grammatical class (e.g. number and gender for nouns). This level of representation is assumed to be modality-neutral in the sense that it is common to both the spoken and the written forms of words. The lexeme level specifies the phonological and the orthographic contents of words. Lexemes are modality-specific since there are distinct representations for speaking and writing (see Fig. 1A). The types of evidence traditionally cited in favor of the lemma/lexeme distinction include the patterns of speech errors and the tip-of-the-tongue (TOT) phenomenon. More recently, the evidence from reaction time studies in picture naming tasks has also been cited as support for the lemma/lexeme distinction (see Levelt et al., 1998).

In several papers (Caramazza, 1997; Caramazza and Miozzo, 1997; Miozzo and Caramazza, 1997) we argued that although the evidence cited in ‘support’ of the lemma/lexeme distinction is indeed consistent with this hypothesis it is also compatible with the alternative hypothesis that there is only one level of lexical representation between a word’s meaning and its phonological (and orthographic)

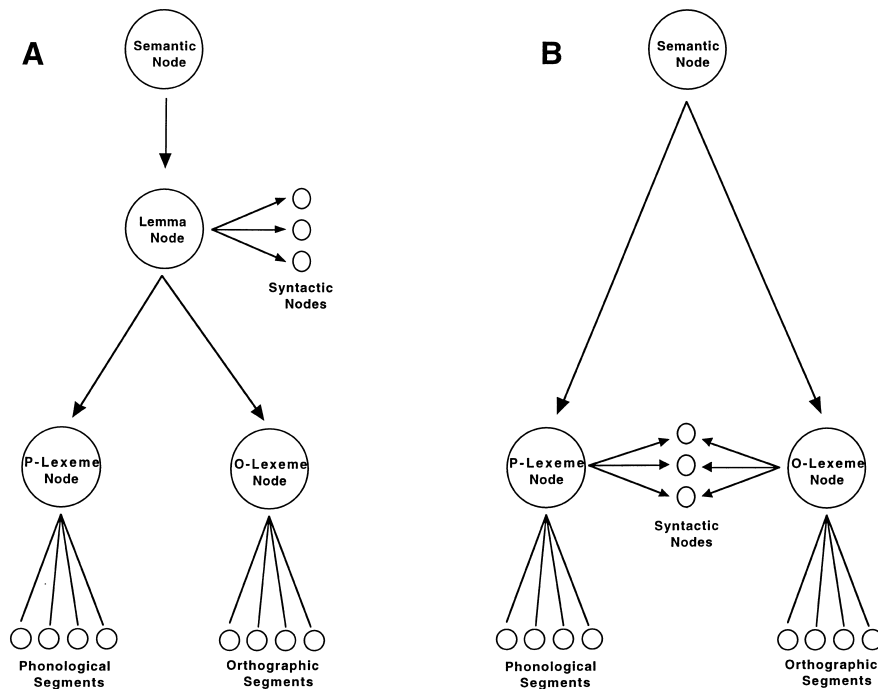


Fig. 1. (A) A schematic representation of the lemma/lexeme distinction hypothesis showing the relation among lemmas and P- and O-lexemes; (B) shows a model in which semantic representations are directly connected to P- and O-lexeme representations.

content. We also argued, however, that there are neuropsychological observations and recent results based on the TOT phenomenon that may be problematic for the lemma/lexeme distinction.

In our critique of the lemma/lexeme distinction we focused on two properties of a particular version of the lemma theory developed by Roelofs (1992, 1993, 1996, 1997; see also Levelt et al., 1998): the *lemma mediation assumption* and the syntactic mediation assumption. The lemma mediation assumption refers to the claim that a *single* lemma node mediates between the meaning of a word and its phonological and orthographic lexemes (henceforth P-lexeme and O-lexeme, respectively). This assumption is captured in Fig. 1A where a single lemma node connects to its P-lexeme and O-lexeme nodes. The *syntactic mediation assumption* refers to the claim that the syntactic features of a word's lemma are selected *before* its lexeme can be selected. We argued that both assumptions may be wrong. Thus, given that the evidence traditionally cited for the lemma/lexeme distinction fails to support this theory over alternative accounts that do not postulate such a distinction, and given that there may be neuropsychological and TOT results that are problematic for the standard lemma/lexeme distinction, we proposed that we adopt models of lexical processing that postulate only one level of lexical representation between meaning and form. A schematic comparison of the two hypotheses is shown in Fig. 1.

Roelofs et al. (1998) (RML) take issue with the interpretation of the evidence we discuss in our papers. They further claim that there are other types of data that are consistent with models that postulate the lemma/lexeme distinction but are problematic for models, such as the Independent Network model (Caramazza, 1997), that postulate only one lexical layer between a word's meaning and its phonological content. Here we briefly respond to their criticisms.

1. The neuropsychological evidence: the case against the lemma mediation hypothesis

We have reported the performance of a number of brain-damaged patients who show a striking dissociation between speaking and writing (for a review see Caramazza, 1997; Caramazza and Miozzo, 1997). Although several different patterns of deficits have been documented, here we focus on just one illustrative pattern.

There are brain-damaged patients who are selectively impaired in producing words of one grammatical class in only one modality of output. One pattern is exemplified by patient SJD (Caramazza and Hillis, 1991). She has difficulties producing verbs in writing but not in speaking, but can produce nouns equally well in speaking and in writing. Thus, she might fail to write the verb (to) 'watch' but would have no difficulty saying the verb (to) 'watch' and in saying and writing the noun (the) 'watch'. Furthermore, her errors in writing verbs consist of semantic substitutions (e.g. watch → 'see') or anomias (failures to respond). This pattern of performance allows several inferences in the context of the hypothesized lemma/lexeme distinction (see Fig. 1A). First, since the patient's difficulty is restricted to one

modality of output the locus of impairment cannot be at the semantic level. This inference is confirmed by the fact that she does not have word comprehension difficulties. Second, since the impairment is modality-specific the locus of the deficit cannot be in the connections between semantics and lemma representations or at the level of lemma representations themselves. For if either were the case, then, both speaking and writing would have been affected. Third, since SJD could write without difficulty the noun member of noun/verb homonym pairs (e.g. the watch/to watch), we can infer that the lexeme level of representation is intact.

This pattern of performance can be explained naturally by a model that assumes only one lexical layer between semantics and form content as in Fig. 1B. On this view, the presence of semantic errors in only one modality of output results from the damaged connection between the semantic system and one of the modality-specific lexical systems. The ‘grammatical class’ effect in these patients can be explained by assuming that the semantics of objects and actions involve distinct brain regions (for converging evidence for this claim see Martin et al., 1996). Brain damage causing a disconnection between one of the semantic subsystems and either the phonological lexicon or the orthographic lexicon will result in a modality-specific grammatical class effect. And as a consequence of the ‘noisy’ transmission between the semantic and the lexical system, a semantically related lexical node is selected.

The occurrence of semantic errors in only one modality of output for words of only one grammatical class poses an interesting challenge to models that postulate a lemma/lexeme distinction of the type shown in Fig. 1A. The reason is as follows. In this type of model, semantic representations connect directly to lemmas and not to lexemes. The selection of a lexeme depends on the prior selection of its corresponding lemma. In other words, the lemma/lexeme distinction effectively separates the semantic system from the modality-specific lexicons. In such models, we naturally expect semantic effects at the level of lemma selection but not in the selection of lexemes. However, as reviewed above, there are neuropsychological results which show that the semantic errors in only one modality of output produced by some aphasic patients must occur at a stage of processing after the correct selection of the target lemma, i.e. at a level of representation where we expect syntactic and phonological effects and not semantic effects. In other words, since a lemma must be selected before its lexical form, and since lemmas are correctly selected, it is not obvious how the lexeme of a semantically related word is selected in its stead. And it is even less clear how a post lemma selection deficit could result in *semantic* errors for words of only *one grammatical class*.

RML make three comments in response to our interpretation of the neuropsychological data and their implications for the lemma/lexeme distinction. They argue that (1) their model has not addressed the issue of written production and that, if necessary, (2) they could simply assume that there are separate lemmas for speaking and writing but that (3) there is no need for this since the results could be explained by assuming a disconnection deficit between lemmas and lexemes.

Although RML have not dealt explicitly with the problem of written word production they have clearly stated that orthographic and phonological lexemes converge on a single, modality-neutral lemma representation. In various papers where

RML have tried to explain the interference effects of written words on picture naming they have argued that orthographic lexemes converge on the same lemmas as those used in speaking (Levelt et al., 1998; Roelofs, 1992; see also Fig. 2, p. 248 in Roelofs et al., 1996). Their position is very clear in the following statement: ‘Because recognizing a word, whether spoken or written, involves accessing its syntactic potential, i.e. the perceptual equivalent of the lemma, we assume activation of the corresponding lemma-level node. In fact, we... [assume] that all production lemmas are perceptual lemmas; the perceptual and production networks coincide from the lemma level upward (p. 11, Levelt et al., 1998; emphasis in original). It seems highly implausible that RML would postulate a common lemma representation for oral production and for written word comprehension but not for oral and written production. Thus, we think that we are justified in assuming that the basic architecture of their model is as shown in Fig. 1A.

RML correctly note that to account for the neuropsychological results they could simply assume that there are distinct orthographic and phonological lemmas. The new theory would look as in Fig. 2. They could then explain the neuropsychological data as we have done: They could assume damage to the connections between a specific (actions vs. objects) semantic subsystem and a modality-specific (orthographic vs. phonological) lemma subsystem. However, such a move essentially

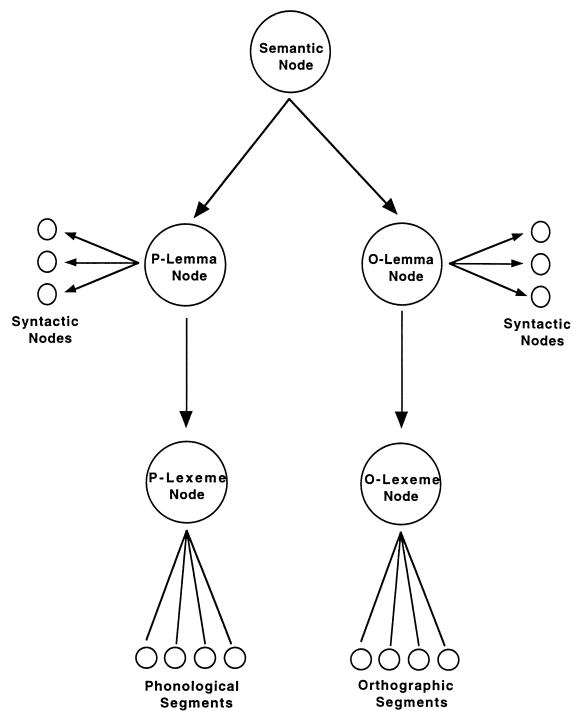


Fig. 2. A schematic representation of a model that postulates modality-specific lemma levels of representation.

entails the rejection of the notion of lemmas as modality-neutral representations (the ‘lemma mediation assumption’) which is a crucial feature of their current model¹. And we would, then, have to turn to other results in order to choose between theories of lexical access that assume one versus those that assume two lexical layers between the semantic and segmental structure of words².

The third response by RML is to argue that modality-specific semantic errors can result from lesions that disconnect lemmas from written or spoken forms. It is thus proposed that when lexeme selection fails, one of the semantically-defined cohort of partially activated lemmas is randomly selected and its corresponding form produced. This argument echoes a possibility we considered in our earlier papers. Our variant went as follows:

‘It could be argued that damage to the connections between lemma and lexemes in one modality leads to the re-selection of another lemma because of spreading activation within the conceptual system. The chain of events might be as follows: the correctly selected lexical concept activates the correct lemma, leading to its selection; the correctly selected lemma activates its associated P- and O-lexemes; if one of these lexemes cannot reach threshold because of damage within that level of representation, a different lexical-concept node is selected from among the set of nodes that have become activated by the spreading activation from the originally selected lexical-concept node; the newly selected lexical-concept will activate its associated lemma node, and so on. The way in which the abstract lemma hypothesis can motivate the re-selection of another lemma is by proposing that this process is undertaken whenever the appropriate lexeme node does not reach threshold.’

(p. 192–193, Caramazza, 1997).

However, it should be noted that the ‘solution’ proposed by RML, or the variant we discussed, requires assumptions that are not in the spirit of the theory. The proposed disconnection predicts the production of no-responses but not the production of semantic errors. To circumvent this problem, RML assume that the ‘patient’s need to communicate’ leads to the selection of an alternative lemma when no lexeme is selected in a naming trial. But is not clear how this need to communicate would lead to the selection of an obviously incorrect lemma in a normally-functioning lemma selection process. In RML’s theory there is a built-in verification process

¹Note that this new theory of the lexicon would essentially be the same as the Independent Network model (Caramazza, 1997) in that access of orthographic lexical representations would not be mediated by a modality-neutral lexical node. It differs from the IN model in that it has one additional lexical layer and is, therefore, much more powerful (and more difficult to falsify).

²If RML were to make this move, they would be faced with a new set of challenges. They would have to come up with a new account of the reaction time data obtained with the picture-word interference paradigm. These data were used to test the computational version of their theory and to set the critical parameters used in the simulations of various patterns of results (Roelofs, 1992, 1993, 1996, 1997; see Levelt et al., 1998 for a review). Whether a new theory of lexical access that contains distinct phonological and orthographic lemmas would be able to account for these data is an open question.

that is supposed to exclude errors. We know that this verification process must be functional, since it works in the modality in which the patient does not make semantic errors. Thus, it is unclear how such a process can be circumvented to allow the selection of a semantically related lemma.

But even if one were to ignore these problems, it is not clear how the RML proposal of a disconnection between lemmas and lexemes accounts for the fact that the modality-specific semantic errors are restricted to words of *one grammatical class*. Their claim that there is a disconnection between lemmas and either the phonological or orthographic lexicon fails to predict the observed grammatical class effect. According to this interpretation, syntactic information is correctly retrieved and it is unclear how it would play a critical role in the production of erroneous responses. The proposed disconnection deficit should thus result in semantic errors for words of all grammatical classes and not the observed phenomenon of errors restricted to words of only one grammatical class³.

2. The tot results: the case against the syntactic mediation hypothesis

The core motivation for distinguishing between lemmas and lexemes is to capture the distinction between words as syntactic objects and words as specific phonological (or orthographic) objects. Lexical access is seen as a sequential process in which the semantic content, then the syntactic properties, then the phonological form, and finally the phonological content of the word are specified. On this view, the selection of the lemma of a word is a necessary condition for the subsequent selection of its lexeme representation. That is, the selection of a word's lexeme is necessarily preceded by the selection of its syntactic content. We have called this property of models that distinguish between lemma and lexeme representations the syntactic mediation hypothesis.

Recently, we tested the syntactic mediation hypothesis by comparing the relative availability of phonological and syntactic information in TOT states (Caramazza and Miozzo, 1997; Miozzo and Caramazza, 1997). We reasoned as follows: If the TOT phenomenon represents a state in which subjects have accessed the lemma of a word but are unable to retrieve its lexeme representation, then, subjects should be able to correctly report lemma-level information even though they may be unable to retrieve the phonological content of the word. However, in several experiments we found that subjects in TOT states are no better at recalling the gender of a noun (a word-specific syntactic feature) than they are at recalling the word's initial phoneme, even though they could recall both at well above chance levels. Furthermore, subjects are no better at recalling gender information when they have correctly

³There is another interesting phenomenon from the neuropsychological literature that is problematic for the lemma/lexeme distinction. There are aphasic patients who make errors such as saying 'broomed' when trying to produce 'swept' (Miceli et al., 1984; Saffran et al., 1980). These errors cannot be explained by models that interpose a lemma layer between semantics and lexemes. Once the patient has accessed the lexeme for 'broom' it comes already with the syntactic feature 'noun' and, therefore, cannot take verbal affixes.

recalled the initial phoneme of a TOT word than when they fail⁴. In other words, correct retrieval of a word's initial phoneme does not depend on correct retrieval of the word's gender. These results would seem to disconfirm the syntactic mediation hypothesis and, more generally, to undermine the lemma/lexeme distinction.

RML have two responses to this conclusion. They argue (1) that gender selection in word production only occurs when needed by the context and (2) that off-line metalinguistic data such as those obtained in TOTs are not appropriate for evaluating the ordering of syntactic and phonological access in naming tasks. In other words, they argue that the TOT data we have reported do not undermine the lemma/lexeme distinction.

RML's observation that gender selection only occurs when needed by the context is not relevant here. It may be that RML are right and that, in fact, a noun's gender is only selected when needed to produce words such as Dutch or Italian articles whose form depends on gender⁵. However, the crucial issue here is not whether the selection of gender information is optional but whether it would be available once a word's lemma has been selected. And since TOT states supposedly represent cases where a word's lemma has been selected but its lexeme is inaccessible, the question is whether gender information should be available in such cases. Elsewhere, RML have given a clear answer to this question.

In a detailed defense of the lemma/lexeme distinction, Levelt et al. (1998) cite research on the TOT phenomenon as support for this distinction: '...Italian speakers in tip-of-the-tongue states most of the time know the grammatical gender of the word, a crucial syntactic property in the generation of utterances.... However, they know the form of the word only partially or not at all.... This shows that lemma access can succeed where form access fails' (p. 20; for a similar claim see also Bock and Levelt, 1994; Levelt, 1989). Thus, according to Levelt et al. (in press) TOT states represent cases where a word's lemma and its syntactic features, including gender, have been accessed but there has been a failure to access the word's phonological form⁶. By implication it follows that RML are on record as arguing that successful access to a word's lemma allows the selection of its gender feature whether or not the latter process is normally optional in speech production.

RML's second response to our TOT results, namely that 'off-line' data such as the

⁴This result was found in four experiments we carried out (Caramazza and Miozzo, 1997; Miozzo and Caramazza, 1997) and in a re-analysis of the results of a similar experiment by Vigliocco et al. (1997). Also, Vigliocco, Vinson, Martin, and Garrett (personal communication) have recently confirmed the absence of a correlation between phonological and syntactic properties in an experiment that considered the mass/count distinction instead of the gender feature.

⁵This assumption raises interesting problems for the lemma theory. How and which syntactic features are selected in word production? For example, is the property 'noun' selected in 'bare' picture naming even though it is not required by the context? What about the feature 'singular'? Does the 'optionality of selection' extend to all syntactic features of words?

⁶The evidence cited by Levelt et al. (1998) does not support the lemma/lexeme distinction. The authors cite a paper by Vigliocco et al. (1997) in which they report TOT results similar to ours: subjects in TOT states can retrieve both the gender and the phonological features of the target noun with better than chance accuracy. However, there is nothing in the results of Vigliocco et al. (1997) that would lead to the claim that a word's gender is more accurately retrieved than its phonological features.

TOT results may not be appropriate for evaluating the ordering of syntactic and phonological access, is strange. RML have repeatedly cited the evidence from the TOT phenomenon when it seemed to support the lemma/lexeme distinction (Levelt, 1989; Levelt et al., 1991, 1998; Bock and Levelt, 1994; Jescheniak and Levelt, 1994). It is unclear what justification there might be for excluding from consideration just the TOT results that are not consistent with their theory.

3. Other results: are they really only consistent with the lemma hypothesis?

RML cite other data that are supposedly consistent with the lemma/lexeme distinction but problematic for theories, such as the IN model (Caramazza, 1997), that do not make this distinction. They cite the results of van Turennout et al. (1998) which show that gender information may be available about 40 ms before phonological information. These are very interesting results, but they do not necessarily speak to the issue under consideration here. RML have conflated architectural with temporal aspects of the lexical access process. The results of van Turennout et al.'s research show that gender information is temporally available earlier than phonological information. The results do not show that the selection of phonological information depends on the retrieval of a lemma-type representation. The issue of the temporal dynamics of access of various sorts of information should not be conflated with the structural dependence of levels of representations. Models that do not postulate a structural dependence between syntactic and phonological features could nonetheless assume that syntactic information is selected *earlier* than phonological information.

RML also mention the homophone frequency effect observed by Jescheniak and Levelt (1994). These researchers found that the low-frequency members of homophone pairs behave as their high-frequency twins in speeded naming tasks. That is, subjects produced low-frequency homophones that have a high-frequency twin faster than frequency matched non-homophone words. For example, English speakers would be faster in naming the low-frequency word *thyme*, which has a high-frequency twin (*time*), than the non-homophonic low-frequency word *spine*. This result is not necessarily problematic for models with only one lexical layer which represent homophones as independent lexical entries (see Fig. 1 in Roelofs et al., 1998, this issue). Of crucial importance, are the processing assumptions of the model. For example, in a manner similar to Dell (1990), if interactivity were allowed between the lexical and segmental layers, the frequency effect observed with homophones could be explained by one-layer lexical models.

RML's final observation concerns the role of morphology in speech errors. They cite the case of errors such as 'how many *pies* does it take to make an *apple*?' to argue that some errors should be explained as lemma exchanges. They further argue that in the IN model the 'morphophonology and syntax should undergo the same fate' and that syntactic features cannot be stranded independently of their stems. This is simply wrong. There is nothing in the architecture of the IN model that precludes the independent movement of stems from their associated inflectional

syntax. Consequently, the stranding of the plural feature in a syntactic frame in which specific phonological material is inserted is perfectly compatible with IN-type architectures.

4. Conclusion

In various papers we have argued that the lemma/lexeme distinction may be unnecessary. We have developed this argument specifically in the context of the lexical access model proposed by the Nijmegen group. These researchers have proposed one of the most detailed models of lexical access. A great virtue of their model is its explicitness. Because of this, it can be subjected to empirical test. We have argued that two of its assumptions, the lemma mediation assumption and the syntactic mediation assumption, may be false. RML have challenged our conclusions and argue that there is nothing in the results we have marshaled against the lemma/lexeme distinction that requires them to reconsider their model. Here we have tried to show that our results may be more problematic for the lemma hypothesis than RML are willing to admit. We have also argued that models with only one lexical layer between a word's semantic and phonological content can account for the empirical facts typically cited in support of the lemma/lexeme distinction. Importantly, this latter type of model can naturally explain the results potentially problematic for the lemma/lexeme distinction.

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