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Semantic Transparency in the Processing of Compounds: Consequences for Representation, Processing, and Impairment

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The role of semantic transparency in morphological processing in general and in compound processing in particular is examined. It is argued that the notion of semantic transparency is crucial to an account of how compounds are represented and processed in the mind. A sketch of a model is proposed in which compound processing is described in terms of stimulus properties, lexical properties, and conceptual properties. The model represents the notion of semantic transparency in terms of a four-way classification of the semantic relationship between a compound's constituents and the corresponding independent morphemes. It also distinguishes between semantically componential and noncomponential compounds. It is proposed that the model offers a framework within which experimental psycholinguistic findings can be understood and within which aphasic deficits associated with compound processing can be characterized. As an example of this, the paper presents a reanalysis of an aphasic patient who exhibits the tendency to interpret semantically opaque compounds as though they were transparent and to interpret opaque compounds in terms of a blend of constituent and whole-word meaning. It is argued that the underlying deficit in this patient is the failure for inhibition to result from the competition among stimuli at the conceptual level of representation. © 1998 Academic Press

For over 20 years the study of the mental lexicon has occupied a position of prominence in the psycholinguistic literature. Part of this prominence is due to the widely accepted view that our ability to mentally represent and access a large store of words is central to the human ability for language. Another reason is that the study of the mental lexicon allows us to explore fundamental issues in language processing with relatively simple stimuli in relatively well-controlled laboratory settings. One of these fundamental issues has been the trade-off between storage and computation in the representation and processing of multimorphemic words. These are words such as

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FRIENDLY and BLACKBOARD which are units of meaning that themselves contain smaller meaning units. It has been argued that if the human language system were constructed so that it would be preferable to maximize storage efficiency at the cost of computational efficiency, multimorphemic words would not be stored as composite wholes but rather in terms of their constituent morphemes. Because there will always be fewer elements than combinations of those elements, representing only constituents in the mental lexicon would result in considerable storage efficiency. Of course, this would create a comparably larger computational burden on the system. Incoming multimorphemic strings would have to be decomposed into their constituents through a morphological parsing procedure, and the constituent representations in the mental lexicon would have to be linked in complex ways. The reverse trade-off, in which computational efficiency is favored over storage efficiency, has similar advantages and limitations. If multimorphemic words were all represented in their full forms, the size of the mental lexicon would be greatly increased, but no computational parsing mechanism would be required.

The psycholinguistic literature on the representation and processing of multimorphemic words has been characterized by the advocacy of both these alternatives. Taft (1981) has argued that the recognition of multimorphemic forms routinely involves morphological decomposition. Butterworth (1983), on the other hand, has claimed that the morphological decomposition procedure is a backup mechanism that is used only in cases of extremely rare or unknown words. As might be imagined, neither of these extreme positions have received unequivocal experimental support. The most probable reason for this is that the manner in which multimorphemic words are represented and processed depends on a variety of lexical factors. These include frequency, lexical category (noun, verb, etc.), morphological type (derived, inflected, compounded), and the semantic relationships between the multimorphemic forms and their constituents.

The interplay of these lexical properties has been a central characteristic of the models of morphological processing that have emerged in the past few years (e.g., Laudana & Burani, 1995; Marslen-Wilson, Tyler, Waksler, & Older, 1994; Schreuder & Baayen, 1995). The last two models, in particular, place great emphasis on the role of semantic transparency in the determination of whether a multimorphemic word is processed through its constituents. Under this view, the constituents of a semantically transparent word such as FRIENDLY would be routinely activated during word recognition. The processing of a semantically opaque word (e.g., DEPARTMENT), would not involve such constituent activation.

Another important theme in the very recent approaches is the view that models appropriate to one morphological type (e.g., prefixed words) may not be applicable to other morphological types (e.g., derived suffixed words). In this paper I will claim that this is particularly the case for compounds.

Because compounds are composed of multiple roots rather than a single root and multiple affixes, the characterization of compounds requires models appropriate to their specific morphological properties.

My goal here is to sketch a model of compound representation and processing that is consonant with the key findings in the experimental literature and is also able to provide a framework for the understanding of aphasic impairments in compound production, recognition, and interpretation. The notion of semantic transparency plays a large role in the proposed model and I will argue that it is crucial to the organization of compounds in the mental lexicon. In the following sections, therefore, I examine some recent studies that also center on semantic transparency as well as recent studies that indicate its importance in the processing of compounds. This will be followed by a sketch of the model and a discussion of its application to a case study that I reported in Libben (1993) in which a patient exhibited a pattern of compound misinterpretation that was related to the semantic transparency of compound stimuli.

SEMANTIC TRANSPARENCY

Any reflection on the computation–storage trade-off discussed above in the representation and processing of multimorphemic words would lead to the conclusion that semantic transparency is an extremely important factor. If all multimorphemic forms were semantically transparent, that is, if the meaning of the multimorphemic form were predictable from the meaning of the constituents, all words could easily be represented in a decomposed form. The problem is, however, that although newly coined multimorphemic forms are always transparent, it is common for the meanings of such forms to drift away over time from the meanings of their constituents (Aronoff, 1976). This tendency creates words such as DEPARTMENT and CASUALTY whose meanings cannot be described as a composite of DEPART + MENT or CASUAL + TY and would therefore provide a stumbling block to any procedure that routinely parsed these forms into their roots and affixes during word recognition.

This prediction has received experimental support in studies reported in Marslen-Wilson et al. (1994). Using a cross-modal priming paradigm with lexical decision as the dependent variable, they found significant facilitation effects in cases where a semantically transparent prime (e.g., INSINCERE) was followed by its target root (e.g., SINCERE). This priming result did not obtain, however, for semantically opaque primes (e.g., RESTRAIN) and their roots (e.g., STRAIN). The priming of a derived form on its stem was also found for derivational suffixation (e.g., PUNISHMENT–PUNISH) but not for semantically opaque forms (e.g., CASUALTY–CASUAL).

An interesting component of the Marslen-Wilson et al. (1994) study was the discovery that, for specific morphological forms, semantic relatedness may result in inhibition across words rather than facilitation. They found, for example, that although derived suffixed words show stem-word priming and word-stem priming in cases of semantic transparency, semantically related derived forms (e.g., GOVERNMENT and GOVERNOR) do not prime each other. This result could only be explained by postulating inhibitory connections between the suffixed forms. A possible generalization of this finding is that related affixed forms inhibit each other. It turned out, however, that this was not the case. They found that semantically related prefixed forms (e.g., UNFASTEN–REFASTEN) showed a very strong priming effect. This forced the conclusion that the effect of semantic transparency must be understood as modulated by the specific morphological type involved because the pattern for suffixed forms was opposite to that of prefixed forms.

Although the concept of semantic transparency plays a central role in the Marslen-Wilson et al. (1994) account of morphological processing, they do not provide an explicit definition of it. Rather, they operationalize semantic transparency in terms of the results of a semantic-relatedness questionnaire distributed to subjects. Another recent paper on morphological processing, however, does provide an explicit definition. In their 1995 paper Schreuder and Baayen present a metamodel of morphological processing in which semantic transparency plays a decisive role in whether a multimorphemic form is represented as a whole or in terms of its constituents. Their model employs three levels of lexical representation: access representations, concept nodes, and semantic and syntactic nodes. The relationship between a word and its meaning is described as a mapping of associations between nodes at these levels.

In their proposal, Schreuder and Baayen (1995) define a semantically transparent relation between a complex word and its constituents as a substantial overlap between the set of semantic representations of the complex word and the sets of representations of its constituents. Schreuder and Baayen's (1995) approach to modeling semantic transparency has the advantage of explicitly linking transparency to the whole word-constituent overlap at the semantic level. However, their model does not easily handle asymmetries in this overlap that, as we shall see below, are very relevant to the representation and processing of compounds.

COMPOUNDS AND SEMANTIC TRANSPARENCY

Compound words present a paradox for models of morphological representation and processing. On the one hand compounding is a very productive morphological process, so that in a language such as English, the probability of encountering a novel compound form (e.g., SLUSHFOAM) is very high. Because such forms are easily comprehended and because this comprehension can only be achieved through the meanings of the compound's constituents, these forms seem to be ideal candidates for routinized morphological decomposition. On the other hand, however, compounds are perhaps the multimorphemic forms that are most sensitive to semantic drift and thus frequently show high degrees of semantic opacity. It is this opacity that would thwart a routinized morphological decomposition procedure.

This paradox was investigated experimentally with Dutch compounds by Sandra (1990) in an immediate semantic priming paradigm with lexical decision as the dependent variable. In his experiments Sandra used the semantic associates of compounds' constituents as primes and the compounds as targets in the comparison of priming effects for transparent compounds (e.g., BIRTHDAY primed by DEATH), opaque compounds (e.g., SUNDAY primed by MOON) and pseudocompounds (e.g., BOYCOTT primed by GIRL). Of these three, only the semantically transparent compounds exhibited faciliatory priming effects. Sandra concluded, therefore, that only transparent compounds undergo morphological decomposition.

The Sandra (1990) study raises two concerns. First, it is not clear that his opaque compounds were completely opaque. Stimuli such as SUNDAY and BUTTERFLY have their opacity localized in one constituent only. Because Sandra only tested priming effects on the opaque constituent it remains unknown whether priming effects would have obtained for the other constituent of the compound. Second, the valuable conclusion that only transparent compounds undergo automatic morphological decomposition raises a perplexing question: how could an automatic morphological decomposition procedure distinguish between opaque and transparent compounds, and if it could, in what sense would it still be automatic?

These questions underline the need for a model of compound processing which contains a more fine-grained representation of the locus of semantic opacity as well as a mechanism by which Sandra's (1990) results would obtain without the need for a decision-making procedure.

The first issue, the locus of semantic opacity, has been recently addressed in a study by Zwitserlood (1994), who investigated the processing of Dutch compounds using an immediate partial repetition priming paradigm in which compounds served as primes, constituents served as targets, and lexical decision was the dependent variable. This study found priming effects for both constituents of transparent compounds and opaque compounds such as those used in the Sandra study. In a subsequent experiment, Zwitserlood distinguished between fully opaque compounds (e.g., KLOKHUIS; meaning = core of an apple; literally = CLOCK + HOUSE) and partially opaque compounds (e.g., DRANKORGEL; meaning = a drunk; literally = DRINK + ORGAN) and employed a semantic priming paradigm. Here priming effects were also found for transparent and partially opaque compounds, but not for truly opaque compounds and pseudocompounds such as BOYCOTT. In these latter two cases the compound primes showed a trend toward inhibiting activation of the first constituent. Thus the Zwitserlood study offers important evidence that compounds with one opaque constituent share properties of fully transparent compounds and may be strongly distinguished from compounds in which both constituents are semantically opaque.

To summarize to this point, we have evidence that the semantic transparency of multimorphemic words is correlated with priming effects shown between constituents and whole word forms. This seems to be strongly the case for compounds and points to the view that semantic transparency should play a prominent role in any model of compound representation and processing. In the sections below I sketch an outline of such a model.

TOWARD A MODEL OF COMPOUND REPRESENTATION AND PROCESSING

I begin by assuming that the recognition and interpretation of various compound forms can be described at three levels of representation: the stimulus level, the lexical level, and the conceptual level.

The Stimulus Level

A separate stimulus level is required to account for our ability to recognize novel compound forms which, as I have claimed, occur with considerable frequency in a language such as English. A compound such as REDBERRY for example is easily comprehended. This comprehension however cannot be achieved through the lexical representation of the compound, for by definition, such a representation does not exist. Thus we cannot account for the comprehension of REDBERRY in the same way that we might be able to account for the comprehension of BLUEBERRY, even though constituent activation may occur in both cases. The identification of the constituent morphemes of REDBERRY can only occur through a process of morphological parsing. In Libben (1994) I pointed out that the morphological parsing of compounds presents difficulties that are not present in the parsing of affixed words. Because affixes comprise a closed set in a language, it is in principle possible for them to be isolated using a procedure that consults a ‘‘short list’’. Compounds are composed of multiple roots and therefore do not allow for the use of a short list matching procedure. The automatic progressive parsing and lexical excitation (APPLE) model of morphological parsing proposed in Libben (1994) isolates constituent morphemes of a compound through a left to right recursive parsing procedure. Because the parsing procedure incorporates a check for the lexical and orthographic status of both constituents of a parse, it predicts the activation of RED and BERRY for the stimulus REDBERRY but not the activation of the lexical representation of RE (because the remainder and DBERRY is illegal). Thus this portion of the model accounts for Zwitserlood’s failure to find priming effects for Dutch pairs such as KERSTFEEST–KERS, where the compound means Christmas and just happens to contain an initial substring KERS meaning cherry (leaving the illegal remainder TFEEST).

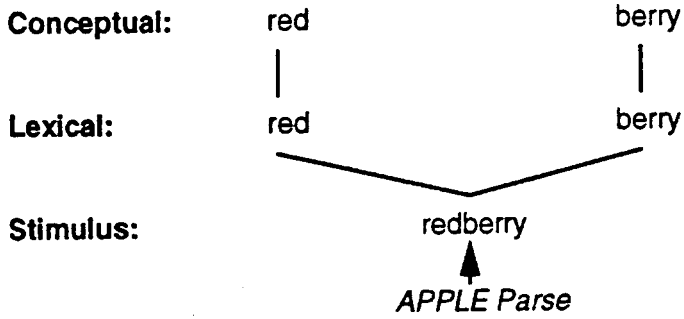

FIG. 1. The processing of novel compounds.

The role of the APPLE parser at the stimulus level provides an account of two aspects of compound recognition: How are the morphological constituents of novel compounds activated and why are not all lexical substrings of compounds activated? It also makes it possible to represent the comprehension of novel compounds in the manner shown in Fig. 1.

The Lexical Level

It is at the lexical level that word forms are represented. Thus compounds such as STRAWBERRY and BLUEBERRY would have representations at this level, but REDBERRY would not. The surname ‘‘Thornberry’’ might also be represented at this level in the minds of native speakers of English but, as I argue, this representation would not show constituent structure. It seems necessary to postulate a purely morphological and not semantic level of constituent structure to account for the observations that native speakers seem to know that a compound such as STRAWBERRY contains the lexical unit STRAW but not the meaning STRAW. This observation has received experimental support in studies such as Sandra (1990) and Zwitserlood (1994) that show a dissociation between repetition priming effects and semantic priming effects for opaque compound constituents. The additional distinction in the model between units with constituent structures and units without morphological structure allows us to represent the distinction between true compounds and units which may have a bimorphemic compound structure for linguistic and etymological reasons but are essentially monomorphemic in the minds of native speakers.

Thus at the lexical level the strings BLUEBERRY, STRAWBERRY, and THORNBERRY would be represented in the manner shown in Fig. 2. The distinction between the structures for BLUEBERRY and STRAWBERRY and the structure for THORNBERRY is represented in the absence of connections at the lexical level for the latter stimulus type. Note, however, that the APPLE parse of the stimulus string does uncover THORN and BERRY.

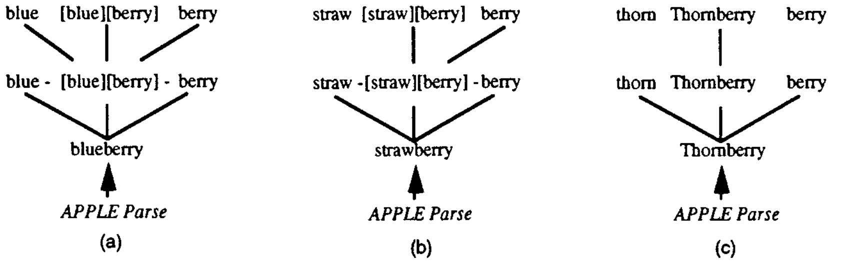

FIG. 2. Transparent (compounds (a), partially opaque compounds (b), and pseudocompounds (c).

The fact that the parse does not result in lexical access is accounted for by assuming that the absence of faciliatory links at the lexical level creates the type of competition described in Marslen-Wilson's (1987) cohort model. The effect of this competition reduces the activation of the pseudoconstituents after the full string has been recognized, resulting in the type of negative semantic priming effect that Schwitserlood found between pseudocompounds and their constituents. It is important to note that although there is a substantial difference in semantic transparency between BLUEBERRY and STRAWBERRY, they show identical representations at the stimulus and lexical levels in this model. To capture the distinctions related to semantic transparency among compounds, we must consider their representations and links at the conceptual level.

The Conceptual Level

In the proposed model of compound representation and processing, the notion of semantic transparency is represented in two distinct ways. The first deals with the semantic relationship between the meaning of a morpheme within a compound and the independent meaning of that same morpheme. Consider, for example, the compound SHOEHORN. Its opacity derives from the fact that one of its constituents, HORN, is not transparently related to its meanings as a single independent morpheme. In that same compound however the meaning of SHOE is fully transparent. By this criterion therefore it is appropriate to classify SHOEHORN as a T–O compound (where T = transparent and O = opaque). This yields a four-way classification for compounds as is represented in Fig. 3. As can be seen in Fig. 3, the model represents the constituent semantic transparency of compounds in terms of links between a compound's constituents within the structured representation at the lexical level and the representations for these constituents at the conceptual level.

In addition to the semantic transparency associated with individual constituents, we must also, at the conceptual level, consider transparency associated

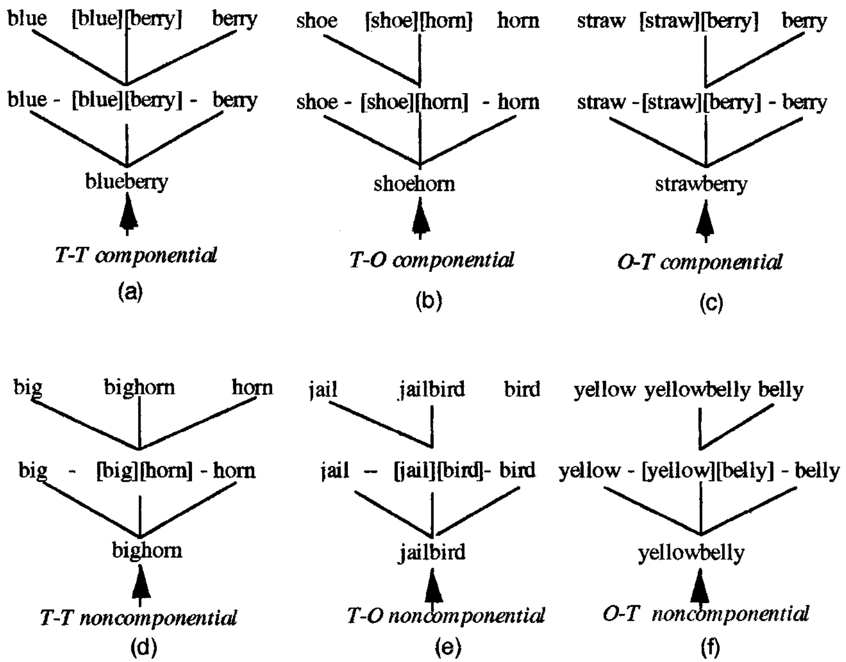

FIG. 3. Constituency and componentiality at the lexical and conceptual levels.

with the compound as a whole, which from this point onward I will call componentiality. Consider for example a compound such as BIGHORN. This compound also shows considerable semantic opacity, but unlike SHOEHORN, this opacity does not seem to be related to any particular constituent. Rather, the opacity is related to the fact that the meaning of BIGHORN is noncomponential—i.e., cannot be understood as a horn that is big.[1] Of relevance here is the fact that each constituent of BIGHORN is transparently related to its independent morpheme. Thus, BIGHORN can be described as a T–T noncomponential compound. Again, this stands in contrast to the T–O compound SHOEHORN which does have a componential meaning (i.e., a horn for a shoe).

In the model, componentiality is represented at the conceptual level in the same way that morphological constituency is represented at the lexical level—that is, through a structured representation. This arrangement is represented in examples (a) to (c) in Fig. 3. The noncomponential compounds are represented in (d) to (f).

The view expressed in this model therefore is that the semantic opacity that has been shown to play an important role in compounds is not monolithic

[1] These structures are also known as ''bahuvrihi compounds'' or ''exocentric compounds.''

but rather is composed of two broad types yielding eight possible transparency profiles (including the 0–0 compounds not shown in Fig. 3). I suggest that a closer examination of these profiles and the time-course of their relevance in word recognition would account for much of the variance in the experimental literature [compare for example Monsell (1984), Schillcock (1990), Sandra (1990), and Zwitserlood (1994)].

How Does It All Work?

I have sketched a model in which constituents of compounds can be activated on the basis of representations and processes at three distinct levels of structure. Together these levels of structure are able to support an account of how novel compounds are comprehensible, pseudocompounds are not erroneously analyzed, and partially opaque compounds are nevertheless processed as having morphological structure. The key to the organization of the model is the principle that representational links between and within levels are faciliatory, but the absence of those links creates competition among representations and ultimately inhibition of nontarget units. It is this inhibition that prevents activation of the lexical representation for BOY following the processing of the compound BOYCOTT. The inhibition at the conceptual level also prevents the meaning of STRAW from interfering with the interpretation of STRAWBERRY. This interplay between activation and inhibition is a key element in the normal interpretation of compounds and in the understanding of the results obtained from priming experiments. I now turn my attention to a case of aphasia in which an imbalance between activation and inhibition is presented.

RS: WHEN INHIBITION FAILS

In Libben (1993), I reported a case of a patient who exhibited a curious pattern of impairment in the interpretation of compounds that I think can be accounted for within the framework of the model of compound representation and processing discussed above.

Background

The patient, RS, was hospitalized following a left temporal–parietal intracerebral hemorrhage which was evacuated. Post-operatively, she was classified as a mixed aphasic and showed length and complexity effects on all verbal command processing tests. Conversational speech was decreased in fluency and was characterized by frequent word finding pauses, interjections, and paraphasic errors. Narrative speech and oral reading were also characterized by paraphasic errors and her responsive naming (i.e., ‘‘What do you do with soap?’’) was 90% with errors being accounted for by length effects. Response time was slow.

TABLE 1
RS's Lexical Decision Responses

	Yes	No	No response
Novel compounds	27	58	35
Existing compounds	82	23	15

She scored 36/60 on the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983). The mean score for adults age 20–29 on this subtest is 55.86. Writing words to dictation was poor with spelling errors and writing sentences to dictation was poor with spelling and structural errors. On selected subtests of the Ross Information Processing Assessment (Ross, 1986), she showed a percentile score of 19 for recent memory, 20 for orientation to environment, and 4 for auditory processing and retention. In reading words aloud, her performance was good with some visual, auditory, and semantic errors.

Her patterns of semantic impairment were particularly noteworthy. She was unable, for example, to supply superordinate terms such as FURNITURE to characterize the stimuli CHAIR, TABLE, and SOFA. RS also performed poorly on tasks of semantic classification. For example, when she was given the stimuli TULIP, CARNATION, ROSE, and OAK and asked to indicate which one of these does not belong, she chose CARNATION rather that the correct target OAK. When asked why she made this choice, RS responded: ''Because it comes in a can.''[2]

Performance on Compounds

The tendency that RS exhibited in her comprehension of compounds was toward the activation of constituents for all stimuli. One possible account of this tendency was to assume that RS was treating all compounds as novel forms which, as has been discussed above, are always semantically transparent. In terms of the model this would mean that RS was achieving constituent activation solely through an APPLE parse of the stimulus and that she had lost the representations for compounds at the lexical and possibly conceptual level. In other words, her processing of BLUEBERRY would be identical to the processing representation of the novel compound REDBERRY in Fig. 1. This possibility was ruled out, however, by the results of a lexical decision test in which RS was presented with 120 existing compounds and 120 novel compounds formed through the recombination of constituents from the real word set. Her responses are given in Table 1.

As can be seen in Table 1, RS's lexical decision response patterns indicate

[2] Carnation is a well-known North American brand name of evaporated milk that ''comes in a can.''

TABLE 2
Compound Paraphrases That Contain Blends of Whole-Word and Constituent Meanings

Compound	Paraphrase
1. Fairytale	Story with fairies and monsters
2. Butterfly	A pretty fly . . . it's yellow
3. Doorman	A man comes to your door in a uniform
4. Wetsuit	The suit is warm and wet
5. Bellybutton	The button in your stomach . . . for kids
6. Dumbbell	Stupid weights . . . Arnold
7. Earthquake	The earth kills people
8. Blockhead	A stupid guy with a square head
9. Flashlight	You can put it in your pocket and it flashes
10. Landlord	Like the king owns the land
11. Greenhorn	A new cow horn
12. Handlebar	A bicycle bar
13. Hotrod	A hot car
14. Lipstick	A red stick for lips
15. Pancake	A cake in a pan for breakfast
16. Yellowbelly	A yellow stomach . . . a chicken
17. Pegboard	A board on the wall for pegs

a distinction between existing and novel compounds (χ^2 50.9, $df = 2$, $p < .001$). Thus it does not seem to be the case that she was simply treating all compounds as though they were newly constructed forms, and it is this fact that makes her interpretations of the 120 existing compounds in the stimulus set all the more interesting.

These interpretations were explored through a paraphrase task in which RS was presented with compound noun stimuli on 3.5 × 5-in. index cards and was instructed to read each word silently and then to provide a paraphrase of its meaning. For 64 of the 120 compounds, she produced transparent readings (e.g., BIRDHOUSE → ''a house for a bird'', BLUEPRINT → ''a print that is blue''). This resulted in essentially correct paraphrases for the semantically transparent compounds such as BIRDHOUSE but incorrect paraphrases for partially opaque compounds such as BLUEPRINT.

The results of the lexical decision task force us to assume that RS did possess compound representations at the lexical level. However, her tendency to produce only semantically transparent interpretations or compounds would be consistent with the view that compounds lacked distinct representations at the conceptual level and could therefore be only understood in terms of their constituents.

Compelling evidence however that she did indeed possess compound representations at the conceptual level comes from a consideration of the 17 paraphrases provided in Table 2. As can be seen in Table 2 RS shows activation of both opaque and transparent constituents. However, her paraphrases

TABLE 3
Semantically Opaque Compounds for Which RS Provided Correct (Noncompositional) Responses

Dubious constituent entry	Phonological opacity	Other
Plywood	Highland	Jellybean
Beehive	Handkerchief	Placemat
Corncob	Breakfast	Shortcake
Woodchuck	Bullseye	
Bridegroom	Cardboard	
	Cupboard	
	Postman	
	Gentleman	

also reveal activation of the whole word's conceptual representation. This is evident in, for example, her paraphrase of item 16—YELLOWBELLY. RS's comprehension seems to be a novel blend of constituent meanings and the whole word representation. Perhaps the best example is her somewhat humorous response to item 6—DUMBBELL—in which her interpretation represents activation of the compound (weights), a constituent (stupid), and an associate of perhaps both (Arnold Schwartzenegger).

What then has gone wrong in RS's compound recognition? I will assume a deficit hypothesis and therefore rule out the possibility that her deficit reflects an addition of representations or processes to the model of normal compound processing sketched above. We have seen, however, that the evidence points to the view that RS's representations contain at least all the elements for opaque compounds shown in Fig. 3. I think we are forced therefore to the following conclusion: RS has lost the inhibitory processes at the conceptual level that normally result in the suppression of units following competition for activation. This accounts for her transparent readings (because constituents are more frequent than their compounds) and her constituent–compound blends. The interpretation, incidentally, is also consistent with her observed semantic deficits. Normally, activation of the word CARNATION at the lexical level would trigger the representation for its homophone (a brand name of evaporated milk). However, the presence of stimuli such as TULIP and ROSE in the stimulus set would inhibit the homophone's activation. It is exactly this inhibitory process that RS has lost and so she responds ''because it comes in a can.''

The loss of inhibitory processes represents the best overall characterization of RS's deficit. There remain however 16 opaque compounds that she did produce correctly. These are represented in Table 3. Of these, all but three paraphrases can be given an account within the model. This account is centered at the lexical level in which it is assumed that constituent links only occur in cases in which the morpheme exists as a separate entry in the mind of the native speaker. It seems likely that this is not the case for constituents in column 1 in Table 3. The result is that individual conceptual units are not activated and therefore do not interfere with the interpretation of the whole form.

I propose a similar account for the compounds in column 2 in Table 3. These are all cases in which phonological opacity may have compromised links to constituents at the lexical level or to the development of a structured morphological (i.e., bracketed) representation. Again the result is the absence of links to constituent conceptual representations and therefore the absence of the ‘‘semantic flooding effect.’’

GENERAL DISCUSSION

In this paper, I have presented a review of studies that point to the importance of semantic transparency in the study of morphology in general and in the study of compound representation and processing in particular. I have sketched a model in which the notion of compound semantic transparency is decomposed into patterns of constituent properties and whole-word properties to produce eight possible patterns of semantic relationship that I think will turn out to have significant effects on how compounds are represented in the mind. Thus, the next step in this investigation is to examine how compound stimuli, classified along these lines, behave in semantic and repetition priming experiments.

The sketch of a model of compound processing and representation presented in this paper is but a preliminary step in providing a framework for additional experimental investigations. The model claims that paradigms such as repetition priming and semantic priming tap different aspects of a compound’s representation and that the constituent activation that results in novel compound recognition is associated with the stimulus level of representation whereas for real compounds, the stronger effects come from the structured nature of morphological representations. The architecture of the model also suggests that different results would be obtained for constituent–compound priming as opposed to compound–constituent priming (with the latter expected to provide the stronger effects in general) and that a gradation in priming strength would be found to be dependent on the locus of opacity and the degree of componentiality of individual compound stimuli.

In terms of aphasic deficits in which the processing of compounds is noteworthy, the model again predicts that the subclasses of semantic transparency will play an important role. The reanalysis of RS’s compound processing offers additional support for the view that patterns of semantic transparency offer an important organizing principle to the understanding of how compounds are processed. However, because RS’s testing predates this classification, we do not have reliable information on whether, for example, her performance would be sensitive to the distinction between compositionality and transparency.

It seems important to also point out that the model I have sketched implicitly predicts dissociations of impairment associated with each level of representation. The model also predicts that for some patients compound processing should be easier than processing other multimorphemic forms and perhaps easier than processing other monomorphemic forms, because of the multiple and converging sources of activation and the built-in redundancy in the model.

This last point brings us back to the question of efficiency and the issue with which this paper began: Is it preferable for the lexical processing system to decrease processing costs or to decrease storage costs? It seems to me that the straightforward answer to this question is ‘‘Neither,’’ and the architecture of the model reflects this. There seems to be very little evidence that the lexical processing system is terribly concerned about storage or processing efficiency. Rather, as perhaps the case of RS indicates, it is often much more difficult to inhibit connections and representations than to create them.

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