GERMAN WORD FORMATION AND APHASIA*

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0. INTRODUCTION

The goal of this investigation is to show how neuropsychological dissociations in aphasic language disorders can be explained with reference to explicit linguistic theories and how aphasiological data can help to find an optimal linguistic theory – supposing, of course, that linguistic theory considers itself part of the study of cognition. Our topic is the interplay of lexical and nonlexical knowledge/processes and the internal structure of the lexicon in grammar and in its aphasic disruption. Our interest in aphasia and in this particular topic suggests the selection of generative grammar as an appropriate frame of reference. To our knowledge, no other linguistic theory that is worked out in sufficient detail makes explicit assumptions about grammar as an object of psychology, e.g. with respect to learnability and modularity.

Concerning the place of morphology, it has been rather uncontroversial since Chomsky (1970) that derivational morphology should not interfere with syntactic operations (see however Fabb 1984); on the other hand, it remains an issue of controversy whether inflection should be considered part of a lexical word-formation component or part of syntax proper. We will present two German-speaking aphasic patients with a rather rare and remarkable dissociation between a preserved morphophonological lexicon and a disrupted syntax with an almost total loss of semantics. Data from these patients, among other considerations, will be used to support theories of grammar that locate inflectional morphology, together with more “classical” domains of word formation, in the lexicon.

The article is organized as follows. In section 1 some remarks are made concerning the relationship between linguistic theory, linguistic processing,

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and brain organization. Section 2 gives a survey of some theories of morphology that focus particularly on the lexicon/syntax interface. In section 3 the neuropsychological syndrome of transcortical aphasia is introduced and some important case reports from the literature are discussed briefly. In section 4 we present clinical data from two German aphasic patients with an isolated morphophonological lexicon (mixed transcortical aphasia). We discuss in section 5 some issues in German word order and morphology as background for the neurolinguistic testing of our patients. The results of our neurolinguistic investigations are presented in section 6. Section 7 gives a general discussion of the findings with special reference to linguistic theories of morphology.

1. SOME METHODOLOGICAL REMARKS

Let us first point out what we do not intend to do in this study.¹ We do not intend to correlate functional linguistic architecture with neuroanatomical architecture. The conceptual and practical problems in such an undertaking are enormous, and to our knowledge nobody has given evidence of a successful localization of linguistic function in the left hemisphere that goes beyond the most primitive distinctions. What seems to be true for the vast majority of right-handers is that their linguistic processing can be disrupted by a lesion in the territory of the middle cerebral artery (perisylvian area) of the left hemisphere. More specific claims, such as the claim that the syntactic parser is in the third convolution of the frontal lobe (F3 or Broca's area), can be found frequently in the literature. However, the actual evidence for such claims is far from convincing (see Poeck, de Bleser and Graf von Keyserlingk 1984, and de Bleser 1986). The reason we are not terribly disturbed by this fact is that we consider questions of functional (or psycholinguistic) organization to be quite independent of matters of hardware. In this respect we follow Pick (1913).

A more important relationship is the one between linguistic theory and the language processor. This relationship poses a problem for all psycholinguistic research as long as there is no strong equivalence between grammars and parsers. Let us assume there is only a weakly transparent relation between grammars and parsers, i.e. one step in a grammatical *derivation* of a sentence/word does not necessarily correspond to one step or an equally complex step in *processing* this sentence/word. Under this assumption, an aphasic disturbance could have at least two possible sources: a disorder of the competence system, or a computational disorder. It is unclear to us how one could address this question of source in an enlightening way in the absence of an elaborate computational theory that goes beyond the level of word recognition. The need for computational models in aphasiology is

obvious in cases where performance differs drastically among tasks or modalities; for example, reading versus auditory comprehension, the on-line versus off-line nature of a task, or reading words in isolation versus reading them in context. However, if a patient shows similar functional losses across tasks and modalities in a particular component of language, it is possible – in the absence of a coherent processing theory – to draw the required distinction. As will be shown in section 4, the patients studied did not exhibit their deficit in a modality-specific way, but rather globally.

Above, we stated that we assume weak transparency between the grammar and the parser. If the objects to be parsed are grammatical representations, however, we can assume that the most crucial and uncontroversial components of linguistic theory will have a fairly direct reflection in the processor. As we indicated above, our main concern is the relationship between lexical and syntax-relevant morphology, i.e. between lexicon and syntax, and its disruption. Assuming there is a mental lexicon, and a word processor that can be distinguished from a phrase/sentence processor, we believe it is possible to relate (neuro)psychological data about linguistic performance to issues in grammatical theory. (See also Kean 1981 on these issues.)

This view of the matter has a second implication, namely, that performance data can shed light on linguistic theories and help to decide between otherwise equally plausible alternatives. Data from language breakdown would thus favor grammars that allow a straightforward way to reflect this breakdown. Grodzinsky (1985a, 1985b) speaks of the “breakdown compatibility” of grammars. We will show below that the linguistic performance of our patients favors models of inflectional morphology that do not presuppose a preserved syntactic level of representation.

2. THE PLACE OF MORPHOLOGY IN GENERATIVE GRAMMAR

In the early days of generative grammar, morphology was not a big topic, a fact that may not be completely independent of the structure of the English language. Since syntax was taken to be *the* place for predictable and productive operations, it was only natural to delegate productive morphological processes to this component of grammar. The lexicon was taken to be the place of unanalyzed material, frozen forms, and other idiosyncrasies. Regular affixes were often taken to arise in their phonological representation simply as an output of spelling rules that take certain abstract features of surface structure as their input (see Lapointe 1983:17). Most of the time, such rules remained in a somewhat sketchy stage. They served more as illustrations of a global picture than as in-depth analyses. Detailed analyses like the one in Chomsky and Halle (1968) presupposed a unitary

“late” phonological component, saying little about the place of morphology. Later on, a general point of agreement was that a distinction should be drawn between inflectional morphology on the one hand and derivation and compounding on the other, the former being in the domain of syntax, the latter in the domain of the lexicon. In the last ten years or so, increasing attention has been paid to morphology and its relation to more established components of grammar, one result of this trend being a re-thinking of the role of the lexicon and its internal structure. A recent development is the claim that all word formation is a lexical process and that syntax cannot make reference to any aspect of word-internal structure (see Lapointe 1979, 1981; Lieber 1980). Since the more traditional view of a syntax-oriented morphology persists, however, it is necessary to briefly contrast the two theoretical accounts.

Anderson (1982) proposes in his “extended word-and-paradigm model” that inflectional morphology be defined on the basis of its relevance to syntax, e.g. agreement or Case, and therefore that it be generated in the syntax. Examples are given from a variety of languages, such as Georgian, Breton, and German, which are intended to argue in favor of inflectional affixation being triggered by syntactic configurations. How the delimitation of lexical versus syntactic morphology is drawn, of course, depends on the syntactic analysis. (See the discussion of Breton and Georgian agreement in Jensen and Stong-Jensen 1984). Anderson arrives at an organization of grammar according to which morphology is not an autonomous component, but rather seems to be scattered across several components of grammar. Some morphemes attach in the lexicon, others arise as a result of certain syntactic environments and have to be spelled out in phonology/phonetics. What is crucial is that syntactic operations must be sensitive to word-internal structure. This leads Anderson to a rejection of Lapointe’s so-called Generalized Lexical Hypothesis, which says that no syntactic rule can refer to elements of morphological structure. An important fact captured by Anderson’s approach is that in inflecting languages, derivational affixes almost always appear closer to the stem than inflectional affixes. As we will see, however, this effect can also be achieved without reference to syntax proper.

A major contribution to exclusively lexicon-based morphology is Lieber (1980). According to Lieber’s view, all word formation (including inflection) is finished at the point of lexical insertion into phrase-level syntax. Lieber decidedly avoids the effects of having derivation/compounding precede inflection. Since inflection apparently has to precede derivation and compounding in certain languages, it seems to be just one of several morphological processes involved in word formation. Other such processes must be allowed to freely interact with inflection. One argument Lieber gives in support of her theory is that in German, inflection interacts with derivation and compounding. She illustrates this with the following examples:

- (1) a. mann – lich → männlich (*derivation*)
       man   ly   manly
       b. mann – er → männer (*inflection*)
               [pl]   men
       c. männer – bekleidung (*inflection + compounding*)
           men   clothes

In (1c) a process like inflection precedes another process which is taken to be purely lexical in most modern work, namely, compounding. Other examples that seem to support Lieber's point are numerous, e.g.

- (2) a. [Gäst – e] haus
       guest [pl] house
       b. [Hose – n] fabrik
           pant [pl] factory
       c. [Rind – er] stall
           cattle [pl] stable

Unfortunately, it escaped Lieber that these are only apparent plural forms, which in these cases happen to coincide with a plural meaning. However, there are many examples which either show that a plural form does not have a plural meaning or that a singular form appears where a plural meaning is required, or even that an entirely different form appears, namely, a stem with a linking morpheme. Examples (3)-(5) illustrate these cases, respectively:

- (3) a. [Rind – er] haut   ‘skin of one animal’
       cattle   skin
       b. [Scheibe – n] wischer   ‘wiper for the windscreen on a car’
           screen   wiper
       c. [Familie – n] name   ‘name of one family’ (‘surname’)
           family   name
- (4) a. [Buch] handlung   ‘a shop which sells (many) books’
       book shop
       b. [Gast] haus   ‘an inn which serves people/guests’
           guest house
       c. [Schiff] bau   ‘construction of ships in a dock’
           ship   construction
- (5) a. [Weihnachts – s] zeit
       Christmas   time
       b. [Rettung – s] ring   ‘life belt’
           saving   ring

- c. [Mannschaft – s] wagen   ‘car of or for a crew’
crew   car

Notice that linking *-s* in (5) does not correspond to any inflected form of *Weihnacht*, *Rettung*, *Mannschaft* in their respective case/number paradigms. As (3)-(5) show, it is possible that even Lieber’s examples and those in (2) do not exhibit real plural forms, but rather linking morphemes that accidentally coincide with genuine plural forms. We will return to this issue later.

A clearer example of plural inflection preceding a lexical process is the following. As Kloeke (1982) points out, the diminutive suffix *-chen* in *Kind-er-chen* ‘little children’ follows a true plural *-er*, since *Kinderchen* can never have a singular meaning. The singular form is *Kind-chen*. Notice also that in ‘compounding, the singular/plural distinction may occasionally distinguish two meanings. A crucial pair is the following:

- (6) a. [Haus] front
house front
‘front of a house’
b. [Häus – er] front
house [pl] front
‘front of a row of houses’

It is not central to our argumentation whether the forms appearing inside compounds are true plurals or just homophonous linked elements. What is central, though, is that certain morphological interactions are systematically excluded. Notice that simply putting all inflection in the lexicon, as Lieber does, may lead to undesirable overgenerations. Coming back to our example of derivation given above, if the NP *Kinderchen* is inserted in an environment in which it is c-commanded by a Dative-assigner, it will by coincidence remain unchanged, because nouns ending in *-n* do not get a distinct form in the Dative. If inflection and other word-formation operations can freely interact, there is no principled way of blocking illegitimate forms like (7):

(7)

It is unclear to us how Anderson would handle this example. If the plural morpheme is “relevant to the syntax”, it would have to be infixated in *Kindchen*. Any “late-inflection” approach would, however, correctly predict that Case-marking (and Case-affixation) has to follow derivation. But notice that once infixation is adopted as a possible rule, an ad-hoc mechanism has to be invoked which prevents infixation of the Case morpheme.

An elegant solution for this and other ordering problems can be achieved in layered models of the lexicon.² The idea with respect to morphological issues is that different layers of word formation can be postulated in the lexicon which stand in a unidirectional feeding relation, such that level- n items serve as an input to level $n + 1$, but never to level $n - 1$. Kiparsky (1982) proposes a three-level system for English. Following a list of underived lexical items in the lexicon, irregular forms and certain derivations are in level 1, regular derivation (without stress shift) and compounding are in level 2, and regular inflection is in level 3, which is the last layer before lexical insertion into syntactic configurations takes place. Since the layers are conceptualized as strict input/output systems, regularly inflected words (level 3) cannot undergo derivation or compounding (level 2). Irregular forms (level 1), however, can do so, as illustrated in the following examples (Kiparsky 1982:137):

- (8)   a. *claw – s – marks   (*regular plural*)
           b. *rat – s – infested

- (9)   a. teeth – marks   (*irregular plural*)
           b. lice – infested

Figure 1 gives an outline of lexical morphology/phonology for English. What this model would predict for the German data on compounding and derivation given above will be discussed later in this article.

Let us finally turn to a recent revival of syntax-governed morphology, namely Fabb (1984).³ Fabb claims that certain morphological affixations have to take place in the syntax for reasons that follow from an adoption of Government and Binding Theory. In his theory, Case is not only assigned to NPs, but also to verbs, PPs, APs, and, as it turns out later, even to N^0 . There is a “visibility condition” which largely coincides with government by a Case-assigner. This condition has consequences for the syntax of verbs. Verbs can assign Case and theta-roles only if they have Case themselves. Verbs can be governed by another verb or by INFL or by an affix. Thus, an affix like the 3rd person singular -s may function as a licensing element for Case and theta-role assignment. Fabb assumes that all affixations that have a definable syntactic function (and even certain forms of compounding, like “synthetic compounds”) arise in the syntax and are spelled out by “late”

Figure 1. Layered model of unified morphology (after Kiparsky 1982)

phonology. Consider the following German examples (from Fabb 1984: 131ff):

- (10) a. ein jedes Opfers fähig – er Freund
       a of every sacrifice capable friend
       b. *ein jedes Opfers fähig Freund
       c. ein Freund, jedes Opfers fähig

The visibility condition predicts that –*er* in (10a) is required, because *fähig* needs Case in order to then assign Case and a theta-role to its complement-NP *jedes Opfers*. If the affix is missing, the prenominal modifier is impossible, as in (10b). (10c) is an example in which the AP appears as the predicate of a postnominal clause.

- (10) c'. [_Npein Freund [_{INFL}" PRO [_{INFL}' INFL [_{AP}jedes Opfers fähig]]]]

In that case, there is an INFL which can license the Case-assignment property of the adjective *fähig*. We think that there is a big conceptual problem with this proposal. First of all, the affix or the appearance of INFL has no intrinsic connection whatsoever with the fact that it is always the Genitive which is the Case governed by the adjective *fähig*. Second, if the task of the affix is Case-assignment and licensing of its c-commanded domain, the following examples would be expected to be grammatical:

- (11) a. * [_Npein [_{INFL}" PRO [_{INFL}' INFL [_{AP}jedes Opfer fähig]]] Freund]
 b. * [_Npein Freund [_{AP}[[_{NP}jedes Opfer] fähig] – er]]

Unfortunately, they are not.⁴

Fabb goes on to argue in favor of compounding as a phrase-level syntactic operation. Synthetic compounds (see Roeper and Siegel 1978), i.e. compounds that show the same semantic transparency as comparable syntactic phrases, are derived in the syntax. In English, these are especially –*er* and –*ing* affixations, as in *dog killer*, *meat eating*. Notice that structural analyses like

- (12) a. [_Ndog] [_N[_vkill] – er]
 b. [_Nmeat] [_N[_veat] – ing]

are not consistent with the visibility requirement in that the underived N fails to receive Case and a theta-role. To circumvent this, an analysis is proposed according to which the recategorization by affixation takes place in the syntax:

- (13) a. [_N[_v[_Ndog] [_vkill]] – er]
 b. [_N[_v[_Nmeat] [_veat]] – ing]

There are various problems with this proposal that come to mind immediately, some of which are addressed by Fabb himself. First, it comes as a surprise that full NPs are excluded, if the input to affixation is something like a VP. That is, one would expect cases like:

- (14) a. *the a-dog-killer
 b. *John's this-meat-eating

Second, English verbs govern to the right. Therefore it is entirely unexpected that they should govern to the left in synthetic compounds. Third,

as Fabb himself states, syntactic phrases tend to be semantically transparent. In the case of synthetic compounding, this observation would predict that, similarly to Case, number distinctions should be preserved. It makes a difference whether we have *smoke a cigar* or *smoke cigars*, *play a record* or *play records*. Notice now that this kind of transparency is completely absent in

- (15) a. cigar – smok –er / –ing
 b. record – play –er / –ing
 c. song – writ –er / –ing
 d. window – clean –er / –ing
 e. crime – report –er / –ing

One must smoke many cigars in order to be called a *cigar-smoker*, but this is not encoded in the compound. Obviously, the number of the object has to be detected by other mechanisms – maybe by knowledge of the world. It should be stressed that this may follow without problems in Lexical Morphology. Fourth, since German has overt Case-marking, Case-affixes should show up in corresponding compounds. This is, however, not the case:

- (16) a. Kind –er –helferin
           child [pl] helper [fem]
 b. *Kind –er –n –helferin
           child [dative]

Since *helfen* governs Dative Case (in German, even in the appropriate left direction), Fabb's theory predicts (16b). Lexical Morphology, on the other hand, would correctly predict that (16b) is ungrammatical. Similar examples can be found in compounds with an adjectival head that assigns Case. Take *ähnlich* 'similar', which also assigns Dative:

- (17) a. [_{AP}[_{NP}Männ –er –n] ähnliche] Felsen
                   man [pl] [dative] similar rocks
 b. [_Amänn –er –ähnliche] Felsen
 c. *[_Amänn –er –n –ähnliche] Felsen

(17b, c) are examples of compounding with the adjective *ähnlich*. Clearly, Case appears only at the phrasal level and not at all at the level of word formation.

To sum up, there is massive counterevidence to Fabb's theory of syntactic affixation. Furthermore, we fail to see why Government and Binding theory should necessitate Case and theta-assignment via a licensing affix, let alone

affixation and compounding in the syntax or in a “late” phonology. We feel that the observation of regularities in word structure does not oblige one to ascribe morphological operations to the same mechanisms and principles as phrase-level operations.⁵

We have pointed out some difficulties in connection with other proposals, too. It seems, however, that both Anderson’s model of inflection in the syntax and the models of layered lexical morphology can account almost equally well for a large amount of data. As we said above, we believe that in instances where internal linguistic evidence fails to decide between competing theories, external evidence may become decisive. We will show below that neurolinguistic investigation of selective disturbances may be a good source of such evidence.

3. transcortical aphasia

The notion “transcortical” derives from 19th-century German aphasiology. The mind/brain model underlying this stage of aphasia research was strongly guided by psycho-physical identification. According to this conception, language was confined to sensory (acoustic, auditory) and motor (articulatory) memory images of words which were linked to a language-external center of concepts. The sensory and motor system were localized in the sensory (superior temporal) and motor (inferior frontal) cortex, respectively. Pathways connected the various psycho-physical centers. These were called “transcortical” pathways. In the so-called Wernicke-Lichtheim model, three types of transcortical aphasias could be predicted, which we will not all consider here. What is important is that sensory and motor centers including their connecting pathways may be cut off from the center of concepts. This would give us what is called “mixed transcortical aphasia”. (For an appreciation of this historical contribution to cognitive science, see Arbib and Caplan (1978) and de Bleser (forthcoming). The neoclassical view of various neuropsychological dissociations including transcortical aphasia is best represented in the “disconnection syndromes” theory of Geschwind (1965). The specific syndrome we will focus on in this study was seen by Geschwind as a functional as well as an anatomical isolation of the speech area (see Geschwind, Quadfasel and Segarra 1968). The clinical functional picture on which all researchers agree who have dealt with this type of aphasia is the following. Spontaneous speech is sparse and consists almost exclusively of highly automatized phrases, short repetitive utterances without meaning, and echolalic repetitions of the interlocuter’s question. Comprehension is almost nonexistent. Naming of objects is hardly possible. While there is no coherent propositional language or comprehension in these patients, their repetition of spoken words, phrases, and

sentences is close to normal. The same holds, as far as we know, for reading, although reports on reading abilities in the published case studies are scanty. The striking feature is that repetition as well as reading aloud proceeds without access to semantics.

We will now turn briefly to the few in-depth studies of such patients.

3.1. *The Sasanuma and Monoi case (M.U.)*

Sasanuma and Monoi (1975) report the case of M.U., a Japanese patient who suffered a severe head injury, followed by a left-hemispheric hemorrhage in the infra-sylvian region. Linguistic testing was performed three-and-a-half months post onset. The patient had a severe disturbance of language comprehension, both for written and for spoken language, and both for sentences and isolated words. Naming of pictures was almost impossible in both modalities. At the same time there was a remarkable preservation of phonological processing. This showed up in the patient's excellent ability to repeat words and sentences (in the absence of comprehension). Furthermore, a dissociation was shown in reading and writing with respect to the two writing systems of Japanese: while the patient could still read and write (in response to dictation) the phonology-based, syllabic *kana* characters, he had a marked deficiency in reading and writing the ideographic, morpheme-based *kanji* characters.⁶ This is to be expected in the absence of semantic processing, because decoding and encoding of *kana* can depend on grapheme-to-syllable conversion, while this is impossible in *kanji*. In the latter, sound can only be recovered by the mediation of a semantic store.

3.2. *The H. Whitaker case (H.C.E.M.)*

Whitaker (1976) reports the case of H.C.E.M., a 59-year-old speaker of English with pre-senile dementia. This woman had a general lack of cognitive and intellectual capacities as well as of semantics-based language processing. She never initiated spontaneous speech, but obviously had an operative input/output system for the phonological side of English. This was demonstrated by her excellent ability to repeat.⁷ Repetition was flawless for normal English sentences and phrases up to about seven words. Sentences with incorrect agreement (number and tense), missing auxiliaries, wrong pronouns and reflexives (e.g. Case and binding violations), etc. were spontaneously corrected over 50% of the time, when repeated. The rest of these ill-formed constructions were simply echoed. On the other hand, semantically anomalous sentences, such as *I had a building for breakfast*, were never corrected. In a sentence completion task, the patient always came out with a syntactically possible completion, which was, however,

occasionally semantically odd, e.g. *Can you tell me some . . .* (completion) *nails*. On the word level, she could always correct wrong stress patterns, e.g. **The President lives in the white HOUSE* to . . . *WHITE House*. Her corrections of wrong phoneme substitution were less clearcut.

What is remarkable in the case of H.C.E.M. is that in the absence of semantic processing, shallow syntactic abilities and intuitions about word structure could be demonstrated.

3.3. *The Davis et al. case (L.G.)*

Davis, Foldi, Gardner and Zurif (1978) report, among other cases of transcortical aphasia, the case of L.G., a case of mixed transcortical aphasia. L.G., a 52-year-old man, suffered a left internal carotid occlusion and an ulcer in the right carotid. He showed very little and non-fluent spontaneous speech, was poor in confrontation naming, and showed very little comprehension. His repetition, however, was fine. Below, we list the repetition task L.G. had to perform, with the percentage of echoing and corrective responses in brackets:

- (a) factually correct and grammatically well-formed sentences, e.g. *Russia is a big country* (60%/0%)
- (b) factually incorrect but grammatically well-formed sentences, e.g. *Russia is a small country* (60%/5%)
- (c) semantically anomalous sentences, e.g. *The milk drank the cat* (60%/6.7%)
- (d) sentences with minor syntactic deviations either in number agreement, e.g. *The cats drinks milk*, or in pronominal Case, e.g. **The boy gave she a present* (13.3%/80%)

Here also, we find a drastic dissociation between morphosyntactic and semantic abilities.

There are other cases reported in the neuropsychological literature, mostly dealing with progressive dementia, e.g. Schwartz, Marin and Saffran (1979), Irigaray (1973). Contrary to the two cases we will report below, the patients in these studies have comparatively rich spontaneous speech and well-preserved abilities in metalinguistic syntax tasks. Since we feel that these cases are only marginally relevant to our goal, we shall leave them aside.

We want to draw attention to the fact that although the few cases of mixed transcortical aphasia reported in the literature still seem rather heterogeneous, their stable common core is the clinical picture of good repetition and mostly good reading aloud, in the face of a total breakdown in creative propositional language, naming, and comprehension. In com-

parison to the cases reported above, our own patients, who will be discussed in section 4, are particularly revealing, because in contrast to, say, demented patients, their aphasic disturbance is not accompanied by other severe cognitive disorders. Moreover, they both show not only a semantic breakdown, but also the absence of syntactic processing. This enables us to examine their morphophonological lexicon practically in isolation.

4. CLINICAL DESCRIPTION OF THE PATIENTS

The two patients reported on below had to be tested intensively during a certain period of their illness, because transcortical aphasia is a transient phenomenon that usually either improves to a milder aphasia, or, depending on the etiology, leads to a total loss of language. We were fortunate to see over the years two functionally comparable transcortical patients. This enabled us to continue neurolinguistic testing on the second patient after the typical symptoms of the first patient had diminished.

4.1. H.B.

H.B. was a 54-year-old, right-handed German businessman. He had also spoken English very fluently, having lived in an entirely English-speaking environment for three-and-a-half years.

After the patient had suffered an ischemic stroke, his aphasia was assessed for both languages. Table 1 shows the results on the German version of the Aachen Aphasia Test (AAT) (Huber, Poeck and Willmes 1984) at 6 and 11 weeks post onset, and on the preliminary version of the English AAT at 6 weeks post onset.

The first test showed the pattern of mixed transcortical aphasia in both languages. Reading and repetition were only moderately disturbed, whereas the patient had zero scores in all other parts of the test. Spontaneous speech as assessed in a semi-standardized interview was sparse, mildly echolalic, and contained only highly overlearned German and English phrases, which were produced non-fluently, with mild dysarthria, severe language effort, and some phonemic paraphasias. Verbal communication was hardly possible, and the examiner had to guess, by asking and interpreting, what the patient intended to convey. Furthermore, the patient showed the completion phenomenon: When given the first part of compound nouns and idioms, he could complete them automatically, i.e. without grasping the meaning.

Retesting with the German AAT at 11 weeks post onset still yielded a clinical picture of mixed transcortical aphasia, although the patient had reacquired some semantic ability, as shown in his non-zero score in the naming and language comprehension parts of the test.

Table 1. AAT results for H.B.
(G = German; E = English)

Subtest with item groups	PRS ^b	6 weeks ^a (G)		6 weeks (E)		11 weeks (G)	
		RS ^c	PR ^d	RS	PR	RS	PR
Token Test	50	48	7	48	7	48	7
Repetition	150	120	60	115	55	143	89
1. Sounds	30	22	32	22	32	29	73
2. Monosyllabics	30	25	45	25	45	28	65
3. Loan words	30	25	52	25	52	30	93
4. Polysyllabics	30	27	84	22	61	29	94
5. Sentences	30	21	68	21	68	27	86
Written language	90	20	30	20	30	46	49
1. Reading aloud	30	20	48	20	48	25	68
2. Letter/word anagram	30	0	10	0	10	14	44
3. Dictation	30	0	14	0	14	7	40
Naming	120	0	6	0	6	45	34
1. Single nouns	30	0	7	0	7	17	37
2. Colors	30	0	7	0	7	15	31
3. Compound nouns	30	0	9	0	9	8	36
4. Sentences	30	0	9	0	9	5	29
Comprehension	120	0	2	0	2	57	25
1. Auditory words	30	0	2	0	2	14	14
2. Auditory sentences	30	0	2	0	2	15	28
3. Reading words	30	0	3	0	3	12	34
4. Reading sentences	30	0	5	0	5	15	40

^atime post onset of AAT testing

^bPRS = possible raw score

^cRS = raw score. For the Token Test, error scores are given (the two positive points are due to age correction).

^dPR = percentile rank, based on the German AAT results of the normative sample (314 aphasic patients, 90 global aphasics, 74 Wernicke's aphasics, 79 Broca's aphasics, 71 amnesic aphasics). Since no normative data are as yet available for the English AAT, the German percentile ranks are tentatively used as a guideline.

4.2. T.P.

The aphasia was assessed with the AAT twelve days after surgery. At that time, T.P. showed a clinical picture of mixed transcortical aphasia, very similar to H.B., although her spontaneous speech contained more echolalias, and she could name some colors, and write in response to dictation as long as she received feedback by constantly repeating the stimulus to herself. Table 2 shows these test results as well as those obtained two months after surgery, a stage at which she had almost fully recovered from her aphasia.

5. SOME ASPECTS OF GERMAN MORPHOLOGY AND SYNTAX

5.1. German word order

(18) [_Sdass [_Sder Hund hinter dem Haus den Knochen verschlingt]]
 NOM
 that the dog behind the house the bone devours

Table 2. AAT results for T.P.^a

subtest with item groups	PRS	3 weeks		8 weeks	
		RS	PR	RS	PR
Token test	50	47	10	0	99
Repetition	150	137	83	149	99
1. Sounds	30	27	58	30	89
2. Monosyllabics	30	29	75	30	90
3. Loan words	30	29	82	30	93
4. Polysyllabics	30	26	79	29	98
5. Sentences	30	26	82	30	98
Written language	90	53	54	90	100
1. Reading aloud	30	27	78	30	98
2. Letter/word anagrams	30	6	31	30	98
3. Dictation	30	20	70	30	99
Naming	120	29	24	111	96
1. Single nouns	30	6	22	30	96
2. Colors	30	19	41	30	95
3. Compound nouns	30	3	25	27	84
4. Sentences	30	1	19	24	90
Comprehension	120	0	2	105	92
1. Auditory words	30	0	2	27	89
2. Auditory sentences	30	0	2	27	92
3. Reading words	30	0	3	27	87
4. Reading sentences	30	0	5	24	78

^aFor abbreviations, see Table 1

In cases without complementizer, the finite verb (V/INFL) moves into the COMP-position.

(19) [_S'verschlingt_i [_Sder Hund hinter dem Haus den Knochen e_i]]

This gives the form of a yes/no question. For the derivation of declarative root sentences, any X-phrase can move to a second COMP-position that c-commands [_S' ...], e.g.

- (20) a. [_S''der Hund_j [_S'verschlingt_i [_S e_j hinter dem Haus den Knochen e_i]]]
b. [_S''den Knochen_j [_S'verschlingt_i [_Sder Hund hinter dem Haus e_j e_i]]]
c. [_S''hinter dem Haus_j [_S'verschlingt_i [_Sder Hund e_j den Knochen e_i]]]

The theta-roles associated with the arguments are easily recovered even in cases like (20b), because of overt Case-marking. Notice, however, that the unmarked word order of root sentences with non-ergative transitive verbs is either NP_{+nom} V ... NP_{-nom} or XP V NP_{+nom} ... NP_{-nom}, i.e. even in the presence of distinct morphological Case-affixes (*de-r*, *de-n*) there seems to be a canonical [NP,S]-position for the subject.⁸

5.2. Case

German is a Case-inflecting language, although the paradigm is only partially distinct. The most diversified inflectional paradigm is shown in the so-called “pronominal” (or “strong”) inflection, which occurs in determiners and in adjectives not preceded by a determiner.⁹ Bierwisch (1967:245) gives the paradigm depicted in Table 3 for the definite article, in which eight fields of syncretism are boxed.

Table 3. Case syncretism in German (after Bierwisch 1967)

Gender	Singular			Plural
	masculine	neuter	feminine	masc/neut/fem
Case				
Nominative	der	das	die	die
Accusative	den	das	die	die
Dative	dem	dem	der	den
Genitive	des	des	der	der

It is useful to distinguish two mechanisms of Case-assignment: (a) structural Case, and (b) lexical Case. There are lexical Case-assigners like V, A, P assigning Case to an NP which they govern. Notice that the lexical entry must indicate which Case is associated with the word, e.g. the adjective *treu* ‘faithful, loyal’ governs a Dative, *fähig* ‘capable’ governs a Genitive. Verbs which differ only minimally in their semantics often govern different Cases, e.g. *lauschen* ‘listen to’, ‘spy’ governs a Dative; while *belauschen* ‘spy on’ – like all *be*-verbs – governs an Accusative; and *gedenken* ‘be mindful of’ governs a Genitive. These are examples of lexical Case. Structural Case, on the other hand, is intimately connected with a specific syntactic configuration. Thus, the external argument of a non-ergative V-projection will be Nominative, if the head of this V-projection is a [+tense] V/INFL. Another

example of structural Case is the configuration

$$[{}_{NP_i} NP_i [{}_{NP_j} \text{---}]] \quad \text{or} \quad [{}_{N_i'} N_i' [{}_{NP_j} \text{---}]]$$

where NP_j will always be Genitive. It could be argued that V-governed Accusative is also structural and that the lexicon only specifies Case if V is subcategorized for a non-Accusative. Accusative would then be a kind of objective Case by default.¹⁰

Referring back to a model of inflectional morphology like that of Anderson (1982), it could be argued that at least affixation in a structural Case environment takes place in the syntax. The prediction for patients with an isolated morphophonological lexicon would be that they can still deal with lexical but not with structural Case. Lexical Phonology, on the other hand, predicts that they could well have all the Case forms but probably not be able to exploit the function of structural Case.

5.3. Gender and gender determination

German has three genders: masculine, feminine, and neuter. Gender in German is grammatically determined. Only a few exceptions show gender determination by semantic features, for example, names of trees are feminine. In general, the gender of a non-compound noun is opaque: there are mostly no formal cues in the noun itself by which its gender could be determined. This contrasts with Italian, for example, where nouns ending with *-o* are generally masculine, requiring the (definite) article *il* or *lo*, while nouns ending with *-a* are usually feminine and co-occur with the article *la*. In both cases, there are a number of well delineated exceptions, for example, elements of the *-a* class might be masculine if they are derived from Greek (*-matos*).¹¹

In composed words, the right-hand head of the word determines the gender. One could argue with Höhle (1985) that derivation and compounding are basically the same and that derivational suffixes carry a syntactic category which triggers (in the nominal case) gender assignment. Take, for instance, [_N *-er*] which is masculine and [_N *-ung*] which is feminine. Then [_N[_v*bohr*] [_N *-er*]] 'drill' will be masculine, whereas [_N[_v*bohr*] [_N *-ung*]] 'borehole' will be feminine. Notice that when compounding two simplex nouns of conflicting gender, the right-hand head will determine the gender of the compound, e.g. [_N*hemd*] (neuter), [_N*knopf*] (masculine) will become [_N[_N*hemd*] [_N*knopf*]] and be assigned masculine gender.

One could argue that highly frequent compounds and, naturally, derived forms like *Umgebung* 'surrounding' and *Frechheit* 'cheekiness' are stored in the lexicon as atomic expressions. Therefore, a crucial test to investigate word-level syntactic abilities seems to be the assignment of gender (e.g. by supplying the definite article *der*, *die*, *das*) to pseudo-compounds and non-

word derivations. Examples are creations like *Sternigans* 'star goose', *Hautglas* 'skin glass', or *Stippung* and *Mielheit*, where neither *stipp-* nor *miel-* are existing stems in the German lexicon. Supposing that such a test were performed by patients like H.B. and T.P., who are hypothesized to lack phrase-level syntactic abilities, the following paradox might arise. In order to fulfill the task, the phrase level of a simple NP is required. Gender is encoded in the simplex noun or in its head, and it percolates from there onto the NP and the non-head elements that agree with the head. If a patient is able to provide the correct definite article to a given noun, one might either conclude that he/she has at least minimal phrasal syntax or that the task is so simple that it can be mastered even without having access to phrasal X-projections. NPs beyond a certain complexity threshold, however, certainly presuppose a recursive N-category; in such cases the article may be in a position very distant from the head, e.g.

- (21) [a_{an}der] des Lebens überdrüssig gewordene alte und kranke [N_{Mann}]

Selection of the appropriate article in such cases, of course, requires syntax.

5.4. Number

In English, plural inflection of nouns is quite regularly in *-s*, and the three allomorphs /s/, /əz/, and /z/ are in complementary distribution. In contrast, German has nine distinct plural forms.¹²

(22)	Plural forms	Singular	Plural
	– Ø	Esel	Esel
	– Ø	Vogel	Vögel
	– ə	Bein	Beine
	– ə	Zug	Züge
	– əɪ	Kind	Kinder
	– əɪ	Blatt	Blätter
	– n	Flasche	Flaschen
	– ən	Frau	Frauen
	– s	Auto	Autos

It is a matter of controversy how many morphemes correspond to these forms. Suggestions in the literature range from four to nine. Kloeke (1982) adopts four morphemes, whereby he derives the Ø-form via *e*-affixation and subsequent deletion. Obviously, all the umlaut-forms are assumed to be predictable by rule. However, umlaut occurs regularly only in the *–əɪ* class. In this class, umlauting applies whenever a vowel capable of umlaut

occurs (a, o, u, au, i.e. [+ back]). This is not so in the $\emptyset$ and in the $-\text{ə}$ class, e.g. *Koffer:Koffer- $\emptyset$* 'suitcase/s', *Kuchen:Kuchen- $\emptyset$* 'cake/s', *Schuh:Schuh-e* 'shoe/s', *Tag:Tag-e* 'day/s', but: *Wagen:Wägen- $\emptyset$* 'car/s', *Vogel:Vögel- $\emptyset$* 'bird/s', *Mann:Männ-er* 'man/men', *Blatt:Blätt-er* 'leaf/leaves'.

We do not want to decide here on the issue of how many plural morphemes should be adopted for German. We do want to stress, however, that it is far from plausible to have all nine forms listed in (22) derived by active processes of word formation. We have presented to five native German speakers non-words that were phonotactically matched with the examples given in (22). The task was to pluralize these forms. It turned out that in about half of the items a pure $-\text{ə}$ plural was formed; if the noun ended in a schwa, the preferred plural was $-n$. Non-words with a non-native appearance, e.g. *Sello*, are very stable in attracting a plural $-s$. Productive umlauting in pluralization was shown to be very rare. These results shed some light on the retrieval of German plural forms from the mental lexicon.¹³ While one may argue that plural is syntactically relevant and should thus arise in syntax, it is far from clear how this would work. Since for virtually each German count noun there exists a rather idiosyncratic plural form, syntax-oriented rules of pluralization seem to be out of place. This applies, of course, to lexical rules as well, such that it seems impossible to locate the German plural uniquely in level 3 of Kiparsky's Lexical Phonology.

For patients with an isolated morphophonological lexicon, this would predict that plural formation is retained. If plural presupposes developed syntactic structures, however, then plural formation should be erased together with the syntax.

This outline of German syntax and morphology should suffice as an introduction to the linguistic structure of the material used for testing H.B. and T.P.

6. EVIDENCE FOR AN ISOLATED MORPHOLOGICAL LEXICON

As already indicated in section 4, not all test materials were used for both patients. This has to do with the fact that (a) H.B.'s aphasia changed after a period of testing, and (b) not all the materials were available at the time of H.B.'s aphasia assessment. T.P., who was tested four years later, showed symptoms very similar to H.B.'s. She could thus be used for comparative, and also more extensive, neurolinguistic testing.

6.1. Neurolinguistic testing of H.B.

In testing H.B., we focused on the following questions:

- (a) Is his lexical reading and repetition without semantics, i.e. is the phonological information in his lexicon spared while the semantic side is largely inoperative?¹⁴
- (b) Does the organization of his lexicon include inflection? I.e. does it provide evidence for the lexicalist or for the non-lexicalist morphological theory?

A dissociation between phonology and semantics could be shown by comparing reading and repetition with semantic production and comprehension. Patient H.B. was tested with a set of 50 concrete and 30 abstract nouns for German and English. The 50 concrete nouns were selected on the basis of high familiarity, easy depictability, and lack of visual and phonemic similarity between German and English (e.g. English *dog*; German *Hund*). The 30 abstract German nouns and their English equivalents had likewise no visual or phonemic similarity (e.g. *misery* : *Elend*).

6.1.1. Reading aloud

H.B.'s reading aloud was fluent for the 50 concrete German nouns; there were only two uncertainties, one phoneme deletion, one substitution, and one addition. His performance in reading the 50 corresponding English concrete nouns was comparable. The patient read once with uncertainty, made one phoneme addition, and three phoneme substitutions.

(23) Reading errors for concrete nouns

	<i>Reaction</i>	<i>Target</i>	<i>Error type</i>
German	Sjunge, Junge	Junge	uncertainty
	Bick, Briefmarke	Briefmarke	uncertainty
	Gsicht	Gesicht	deletion ¹⁵
	Stievel	Stiefel	substitution
	Sdach	Dach	addition
English	Televi, Television	Television	uncertainty
	Shirt	Bird	substitution
	Liver	River	substitution
	Truck	Duck	substitution
	Bank	Bag	Addition with devoicing

H.B. seemed to adhere to a general word-final devoicing rule in his English, even though nouns were presented one language at a time to avoid the phonological interference inherent in a mixed bilingual setting. However, devoicing consonants is quite widespread among German speakers of English, even at an advanced level.

The patient's reading of the 30 German abstract nouns was flawless. He read 5 of 30 English abstract nouns incorrectly, making two phoneme substitutions and three incorrect grapheme-phoneme correspondences (GPC). Again, though words of one language only were given in a single session, a devoicing rule for voiced consonants at the end of English words was generally applied.

(24) *Reading errors for abstract nouns: English*

<i>Reaction</i>	<i>Target</i>	<i>Error types</i>
[saʊl]	[soʊl] : soul	Substitution
[la:st]	[pa:st] : past	Substitution
[goal]	[goʊl] : goal	GPC
[dept]	[det] : debt	GPC
['foval]	['paʊə] : power	GPC with feature shifts

6.1.2. Repetition

Repetition performance was perfect for all stimuli in both languages, with the exception of final devoicing in English.

6.1.3. Semantic tasks

In all of the following semantic tasks, the patient shook his head in resignation rather than producing incorrect reactions. They were discontinued after five trials on each task, and five more trials were repeated on each of the next three days.

Naming of photographs depicting objects that corresponded to the 50 concrete nouns, as well as naming in response to descriptions of their use, was impossible in either language. When the patient was asked to complete gapped sentences with a choice from three cards on which concrete nouns were printed, he did not show any reaction. In a test for auditory and reading comprehension of the same 50 nouns, the patient was unable to match either the spoken or the written word form to one of three pictures. Distractor items were selected from the set of 50 photographs on the basis of their visual and semantic unrelatedness to the target.

Since the 30 abstract nouns could not be depicted, the patient's semantics for them was tested by having him compose a sentence with a given abstract noun, completing a sentence with one of three noun cards, and matching one of three abstract noun cards to a given definition. Distractor items were

The absence of semantic comprehension was also noted in the examination of ideational apraxia. There, action sequences have to be performed with real objects, e.g. first taking paper and scissors, cutting something out, then using glue to stick the cut-out figure onto another piece of paper. The patient had no problems when the action required a fixed logical sequence, thus showing the absence of ideational apraxia, but he did not follow the sequence of the verbal command when actions could meaningfully be performed using different sequences.

In the face of such a severe semantic deficit, evidence about syntactic processing is difficult to obtain. Hardly any spontaneous speech is produced by such patients, except for some automatized utterances.

The patient was given 15 sentences, each consisting of four constituent cards. The syntactic form of the target sentence throughout was NP + V + P + NP, e.g.

- Conversion of NP₁ and NP₂ leads to severe ungrammaticality, since the finite verb *kam* requires a nominative subject-NP and the preposition *vor* assigns Dative Case to its complement-NP. Out of 15 reactions, 10 showed case violations of the sort described. In addition, in six cases the preposition was placed after the NP, i.e. it was treated like a postposition, e.g.

- Under this interpretation of the data and in other unreported tasks, a stable pattern of placing the verb in second constituent position was observed. Since all letters were in upper case, lower case for verbs as opposed to nouns could not have been a clue. Obviously, the verb-final position which occurs in German subordinate clauses introduced by a complementizer did not play a role for the patient. We interpret his reactions with respect to verb placement as following the most frequent sentence type. The severe violation that arose in the placement of the Case-marked NPs confirms the impression that the patient lacks syntactic sensitivity.

To summarize the results with respect to question (a) above, it has been shown that H.B. has an almost complete semantic deficit and a considerable syntactic deficit as well. In spite of this, he is able to read and repeat. We turn now to question (b), which is concerned with inflection as a lexical process.

6.1.5. *Inflection for gender and number*

In order to investigate more closely the internal structure of the functioning lexicon, tasks were assigned in which the patient had to manipulate the materials given.

First, 47 count nouns from the list of 50 concrete nouns used before were presented for the production of plural forms. All required native plural forms; that is, the three words taking the non-native *-s* plural were not included. H.B.'s reactions were elicited by giving him contexts that forced him to use plurals, e.g.

- (27) Das ist ein Zug. Das sind zwei ...
This is one train. Those are two ...

H.B. failed to respond nine times, and he gave incorrect forms in five instances. Thus, he produced the correct plural form in 33 out of 47 cases. (28) lists H.B.'s incorrect reactions:

(28) *Errors in plural formation (German)*

<i>singular</i>	<i>plural</i>	<i>type</i>	<i>reaction</i>
Käse	Käse	—∅	Käser
Gemälde	Gemälde	—∅	Gemälder
Zug	Züge	—ə	Zuge
Rock	Röcke	—ə	Rocke
Tisch	Tische	—ə	Tisch

In addition, H.B. was tested for regular plurals of English. Recall that the three allomorphs *-s*, *-z*, *-əz* are predictable from the morphophonological environment, in contrast to German pluralization. Conditioned by his German phonotactics, H.B. showed only two allomorphs, namely *-s* and *-əs*. The test procedure was the same as for the task on German plurals. Out of 38 stimuli, he had 34 correct reactions. (29) lists H.B.'s incorrect reactions:

(29) *Errors in plural formation (English)*

<i>singular</i>	<i>plural</i>	<i>type</i>	<i>reaction</i>
boot	boots	-s	bootes
roof	roofs	-s	roofes
glass	glasses	-əz	glass
airplane	airplanes	-z	airplane

This indicates that H.B. has some command over productive regular morphology. Furthermore, it shows that at least some syntactically relevant productive inflection may be preserved in the absence of phrase-level syntax. These results provide evidence for a relatively unimpaired access to both regularly and irregularly derived forms of number inflection.

The following two tasks were designed to tap the patient's representation of gender in German. The 50 concrete nouns previously used were pronounced by the examiner one by one. The patient was to repeat the word, adding in each case one of the definite articles *der*, *die*, *das*. In this task, only one error and three self-corrections occurred. When the nouns were written on individual cards and H.B. had to point to one of three article cards, he made the correct choice in all cases. The same two tasks were performed with the 30 abstract nouns mentioned previously. Again, not a single error in the article selection was committed here.

The following task for adjectival inflection was performed only in the auditory modality. The 47 count nouns were pronounced by the examiner, and the patient was to add the indefinite article followed by the adjective *verdammt* 'damned' (the choice of this particular adjective was his own). He produced the correct gender form of the adjective in 41 cases. H.B.'s incorrect responses are listed in (30):

(30) *Errors in indefinite Art + Adj + N agreement*

<i>target</i>	<i>reaction</i>	<i>error type</i>
ein verdammter Stiefel	eine, ein verdammter Stiefel	self-correction
ein verdammtes Pferd	das verdammte Pferd	definite article
ein verdammtes Fenster	die verdammte Fenster	definite article (and gender or number error)
eine verdammte Puppe	ein Mal die Puppe 'one time the doll'	(substitution)
ein verdammter Esel	Ø	no reaction
ein verdammtes Dach	Ø	no reaction

The form *das verdammte Pferd* was not counted as correct because the task

was to use the indefinite article and the strongly inflected adjective, although the form in itself is correct. This test shows that H.B. has good command over grammatical gender, and that he can percolate the gender/number feature adequately in NPs of the type [NP_{Art}[N ...]] and [NP_{Art}[N' Adj[N ...]]]

In order to generalize these findings and to extend the empirical basis for our claims, T.P. was examined. The next section reports the neurolinguistic testing of T.P.

6.2. Neurolinguistic testing of T.P.

As the clinical results given in Table 2 show, there was a remarkable dissociation between preserved reading and repetition on the one hand and severely disturbed lexical semantics on the other.¹⁶

The first question that was asked with respect to H.B.'s aphasia was whether there was a morphophonological lexicon that operated independently of semantic information. As was the case for H.B., this question could be answered affirmatively for T.P. The other question concerned the morphological richness of this isolated lexicon. In testing T.P., the empirical basis was broadened by including compounding and derivational morphology and its effect on assignment to a gender class. Furthermore, agreement within NPs was tested in Case-assignment environments. This enabled us to examine to what extent T.P. could project lexical information onto phrase structure.

6.2.1. Inflection for number

To investigate T.P.'s abilities in pluralization, an extended list of stimuli was used. Each of the nine plural classes was represented by ten items. Furthermore, the task was reversed, i.e. the patient had to select a singular corresponding to a given plural form. Half of the latter items were umlaut forms that had to be converted to a non-umlaut singular. Out of 90 pluralizations, T.P. made the following three mistakes:

(31) Errors in plural formation

<i>singular</i>	<i>plural</i>	<i>type</i>	<i>reaction</i>
Dorn	Dornen	– ən	Dorne
Acker	Äcker	– ∅	Acker
Bahn	Bahnen	– ən	Bahne

Out of 20 singularizations, T.P. did not commit any errors.

6.2.2. Selection of gender in complex words

T.P. was given 30 nominal compounds of the form [N ... [N ...]] which

she had to repeat while adding one of the definite articles *der*, *die*, *das*. The three genders were equally distributed in the right-hand head of the items. Ten items were clearly non-lexicalized items, such as *Rad-hund* 'wheel + dog', *Haut-glas* 'skin + glass'; the others were conventional. In both cases, the right-hand and left-hand noun had different gender. Thus, in order to provide the appropriate article, it is necessary to apply the right-hand head rule (Williams 1981). While one may argue that lexicalized compounds are stored holistically, i.e. no morphological rule has to be applied to determine their gender, this is certainly not true for pseudo-compounds. T.P., however, had no problems in providing the correct article in all 30 cases.

T.P. was also tested for her abilities to provide an article to derived nouns, half of which had neologistic stems to which existing affixes were attached. An equal number of native and non-native words were used. Most non-native forms have endings which do not attach to an independent stem, e.g. *Etage* 'floor', *Podium* 'stage'. Nevertheless, the affix unambiguously triggers assignment to one particular gender class. For instance, all words ending in *-age* must be feminine; all words ending in *-ium* must be neutral. The affixes were selected such that they triggered an equal number of each gender. The results clearly show that T.P. has almost perfect command over the simple word-level syntax to be applied here. She made only two mistakes with existing words and one with neologisms. Her errors are given in (32):

(32) *Errors in gender assignment to derived forms*

<i>target</i>	<i>reaction</i>	<i>word</i>	<i>native</i>
das Ge-renn-e	die Gerenne	+	+
das Ge-stoss-e	die Gestosse	+	+
das Draus-tum	der Draustum	-	+

6.2.3. *Case inflection*

T.P. was given 47 simple sentences with transitive verbs, all of which had an uninflected NP of the form indefinite Art + Adj + N both preverbally and postverbally. The task was to read these sentences while providing the appropriate Case endings. 25 sentences required Nominative and Accusative, 22 required Nominative and Dative. All sentences were constructed in such a way that either NP could be the subject, i.e. sentences were semantically reversible. (33) gives examples for both Accusative and Dative subcategorization as presented to T.P.:

- (33) a. Ein ... stur ... Esel tritt ein ... schwarz ... Hengst
           a   stubborn donkey kicks a   black   stallion

- b. Ein ... klug ... Minister hilft ein ... weis ... König
     a   clever   minister helps a   wise   king

Acceptable solutions would be

- (34a) i. Ein sturer Esel tritt einen schwarzen Hengst
           NOMINATIVE   ACCUSATIVE
       ii. Einen sturen Esel tritt ein schwarzer Hengst
           ACCUSATIVE   NOMINATIVE
 (34b) i. Ein kluger Minister hilft einem weisen König
           NOMINATIVE   DATIVE
       ii. Einem klugen Minister hilft ein weiser König
           DATIVE   NOMINATIVE

T.P. produced 94 Case-inflected NPs, out of which 87 were well formed with respect to NP-internal agreement. Four reactions could not be evaluated, because the patient performed lexical substitutions, e.g. instead of *einen lieben Hund* 'a dear dog' she read *ein Lieblinghund* 'a darling-dog'. Three reactions showed NP-internal agreement violations: **einem faulem Schüler*, **ein armes Zirkus*, **ein freundlichen Chef*. The picture changes drastically when the functional role of Case is evaluated. Given that three distinct Cases are available, ignoring the Genitive, which is marginal and was in fact never required in this task, there are $3^2 = 9$ possibilities for each sentence. Only two possibilities are consistent with the (expected) canonical SVO-forms, however. T.P.'s reactions showed not even a tendency towards such a choice. As a matter of fact, 43% were structurally impossible, either because the same Case occurred twice or because both Accusative and Dative occurred in one sentence, i.e. the Nominative was missing. In addition, in 40% of the sentences involving an Accusative verb, Dative Case appeared; and in 27% of the sentences involving a Dative verb, Accusative Case appeared.

In order to investigate T.P.'s abilities to assign Case in strictly local environments, the processing load was reduced as much as possible in a further task. The patient was given 30 sentences in which only a postverbal definite NP of the form Art + N had to be completed. Again, half of the verbs involved required Accusative and the other half Dative Case. T.P.'s performance was much better here: Only 20% of the Accusatives were substituted by Datives, and 13% of the Datives were substituted by Accusatives.

A similar paradigm was used to see whether Case can be realized if the NP is governed by a preposition.¹⁷ We selected items with prepositions that uniquely assign either Accusative or Dative Case. T.P. had no problems in providing the appropriate Case form in all of the items.

Remember that all of this was carried out by the patient without having

6.2.4. *Corrective changes in repetition and grammaticality judgments*

As the results reported in section 6.2.3 indicate, T.P. seems to have syntactic problems in the face of relatively well-preserved morphological abilities. We mentioned already in our discussion of transcortical aphasia in section 3 that there is evidence from some published cases that patients with mixed transcortical aphasia have residual syntactic competence. This showed up in their repetition of sentences with agreement violations which they often “corrected” spontaneously while repeating. We will present evidence below, however, that T.P. is rather insensitive to violations of phrase-level syntax. We take this as an indication that inflectional morphology may be autonomously represented, i.e. that it does not presuppose an operative syntax module.

The materials were structured as follows. Six classes of well-formed/ill-formed constructions were used. The following examples give a representative pair for each class:

(38) *Agreement*

- a. Die Männer haben Zucker gekauft
the men have sugar bought
- b. *Die Männer hat Zucker gekauft
has

(39) *Verb-second (no complementizer)*

- a. Wir glauben, die Erde ist rund
we believe the earth is round
- b. *Wir glauben, die Erde rund ist

(40) *Verb-end (with complementizer)*

- a. Sie fragt, ob die Vase auf dem Tisch steht
she asks whether the vase on the table stands
- b. *Sie fragt, ob die Vase steht auf dem Tisch

(41) *WH-questions (resumptive pronouns ungrammatical)*

- a. Wen habt ihr gesehen?
who have you seen
- b. *Wen habt ihr ihn gesehen?
him

(42) *Subjecthood (pro-drop ungrammatical)*

- a. Wir fragten, wann es etwas zu Essen gibt
we asked when it something to eat is
‘We asked when there will be something to eat’

- b. *Wir fragten, wann etwas zu Essen gibt

(43) *Reflexive verbs (agreement with subject obligatory)*

- a. Du freust dich über das Lied
     you enjoy yourself over the song
     ‘You are enjoying the song’
 b. *Du freust ihn über das Lied
     him

60 grammatical and 60 ungrammatical sentences of this kind were randomly read to the patient and she had to repeat them. Responses were scored for literal repetitions and spontaneous changes in the materials. The same materials were presented on another occasion for judgment of grammaticality. Since the patient had no difficulties in reading aloud, the sentences were presented to her in written form. Her task was to sort them into the two categories GOOD and BAD. Examples were given first to make the task clear. T.P.’s results are shown in Table 4.

There is hardly any indication that the patient spontaneously corrects or even changes ungrammatical input. In the judgment results it is evident that T.P. has a tendency to accept anything. She might, however, be sensitive to some of the ill-formed constructions. One caveat is necessary here: when asked how the rejected sentence should be, she usually made a completely irrelevant change. For example, the sentence **Er sagt, Fritz in die Schule geht* ‘he says Fritz goes to school’ was changed into **Er sagte der Fritz in die Schule geht*, i.e. an article was added to the name. **Wer ist er gekommen?* ‘Who has he come?’ was changed into **Was ist er gekommen?* ‘What has he come?’, etc.

This shows again that even if some syntactic intuition is present, it must be extremely shallow and cannot be exploited for communicative or meta-linguistic purposes.

6.2.5. *Constituent ordering*

When T.P. was given three cards with one V-constituent and two NP-constituents, she consistently put the verb in mid-position; otherwise the order of constituents was random, despite unambiguous morphological marking of subject and object.¹⁹ In sentence arrangement tasks of higher complexity (all constituents given on individual cards) even the verb-second effect disappeared and the constructs turned out to be word salad, e.g.

- (44) a. die nette kommt damit dicke dame
     the nice comes such-that fat lady
     (possible goal: “damit die nette dicke Dame kommt”)

Table 4. Syntax testing of T.P.

	Agreement		Verb-second		Verb-final		WH-question		Subjecthood		Reflexive verbs	
	good ^a k = 10	bad ^b k = 10	good k = 10	bad k = 10	good k = 10	bad k = 10	good k = 10	bad k = 10	good k = 10	bad k = 10	good k = 10	bad k = 10
Repetition:												
(a) literal	10	8	10	9	10	10	10	10	10	10	10	10
(b) corrective	–	2	–	1	–	–	–	–	–	–	–	–
Judgments:												
(a) accepted	10	5	10	6	9	9	9	5	10	9	10	10
(b) rejected	–	5	–	4	1	1	1	5	–	1	–	–

^agrammatical test sentences

^bungrammatical test sentences

- b. kleine der hat gestern   junge süße   gewartet
 small the has yesterday boy   sweet waited
 (possible goal: "gestern hat der kleine süße junge gewartet")

6.3. *Summary*

Neurolinguistic testing of H.B. and T.P. yielded important information about the organization of morphology and lexical organization. It showed that in the complete absence of access to meaning and in the near absence of phrase-level syntactic processing, the formal structure of the mental lexicon can remain relatively intact. Both patients had good intuitions about lexical features that have crucial effects in German inflection. Not only could they determine the gender of arbitrary nouns by providing the gender-dependent definite article, but they could also inflect prenominal adjectives for gender. T.P. was shown to correctly determine the gender of nominal compounds, even if they were non-lexicalized ad hoc formations. The same was true for derivational morphology. Both patients could convert singulars into the corresponding plurals. H.B. could do that also for English. In the case of T.P. it was shown that also the conversion from plural to singular is possible. We gave some arguments in section 5.4 for German plurals to be listed, instead of being derived by rule. Still, H.B.'s command of English plurals indicated that more than simple retrieval from a list is possible in these patients. With respect to Case morphology, it was demonstrated that with the exception of Genitive, all forms were easily produced by T.P.; their use, however, was functionally appropriate only in the context of a lexical assigner like V and P.

7. IMPLICATIONS FOR THE ROLE OF MORPHOLOGY IN A MODULAR GRAMMAR

We started this study of German word formation and aphasia with a brief discussion of linguistic theories that do not draw a distinction between phrase structure and (predictable) word structure. According to these theories, if syntactic configurations are a precondition for at least inflectional morphology, a disruption of syntax proper should automatically affect the syntax-relevant morphology. Language-internal evidence from German exists, however, which precludes this gross identification. The language-external aphasiological evidence we have provided shows that this identification is also untenable from a psycholinguistic point of view. Our investigation of two severely disturbed patients with mixed transcortical aphasia has made it clear that in the near absence of phrase-level syntax (and the total loss of semantics) a considerable amount of word formation (including inflection) can be selectively preserved. In this case, the question

arises where the morphology of these patients comes from. Anderson's theory of split morphology, according to which inflectional morphology is organized in the syntax, would make the prediction that derivation (and compounding) should be preserved in our patients, while they should have problems with inflection. The first prediction is fulfilled, but the second is contradicted by the surprisingly good performance of these patients with gender, number, and Case inflection. While this part of morphology clearly interacts with and is required for phrase-level syntax, it seems to be independently available. Theories of morphology/phonology that arrange the attachment of different classes of morphemes at different strata in an autonomous lexical component can capture the neuropsychological dissociation we have observed. At the same time, they are capable of accounting for the observed interaction of inflectional and derivational morphology.

Notice that there is a controversy in the literature as to whether inflection always follows derivation and/or compounding. Interestingly enough, similar data from Yiddish were taken as evidence for both lexical morphology and split morphology. In Yiddish, plural forms can be affixed with diminutive morphemes, as shown in (45):²⁰

(45)	<i>singular</i>	<i>plural</i>	<i>dim.sg.</i>	<i>dim.pl.</i>	
a.	hant	hent	hent	hentlex	'hand'
b.	bux	bixer	bix	bixlex	'book'
c.	xosn	xasanim	xosn	xasanimlex	'bridegroom'
d.	seyfer	sforim	seyfer	sforimlex	'(religious) book'

Perlmutter (1986) argues that it would be premature to conclude that real plurals are subject to derivational affixation. He gives examples which illustrate that the plural forms must be available for processes which do not require plurals, e.g.

(46)	<i>singular</i>	<i>plural</i>	<i>derived adjective</i>
	balebos	balebatim	balebatis
	'man of status'		'respectable'

His conclusion from this and a number of other arguments is that also in the diminutive plurals of (45) it is not the plural but rather an independently listed, secondary stem which is involved in forming diminutives.²¹ In contrast to Perlmutter, Bochner (1984) interprets the diminutive plural forms of (45) as involving real plurals. His explanation of this phenomenon is that plurals in Yiddish, as in German, are unpredictable and therefore have to be learned as individual items.

According to our view, the question is irrelevant as soon as it is acknowledged that at the level of word structure, singular/plural meaning is far from parallel to singular/plural form. At least in German compounding, it seems to be obvious that plural forms can enter compounding where the plural meaning would be absurd. The same holds for singular forms that sometimes must be linked to a plural meaning. (See section 2 of this article for relevant examples.) Notice that the form/meaning parallelism is much stricter on the level of phrase structure. For example, the NP *men* could never refer to the concept "man". The interpretive mechanisms that are required for determining the meaning of nominal compounds seem to be driven to a large extent by our knowledge of the world. What is crucial for the interaction of inflectional and other word-building processes is the extent to which inflection is productively formed by rule. We observed in section 2 that the most productive plural morpheme of present-day German is *-s*. Yet in the case of compounds, even semantically motivated compounds like *Autoshändler instead of *Autohändler* 'car dealer' never occur. The conclusion to be drawn from this is that regular inflection, as opposed to compounding, must be a "late" operation. The question is just how "late" it is ordered. The answer that is given by the two aphasic subjects presented here is: "Late in the lexicon!" We leave it for further research to provide more evidence for or against this approach. As things now stand, both language-internal facts and language-external evidence are covered well by purely lexical approaches to morphology.

NOTES

1. One TLR reviewer seems to have reservations about neurolinguistic research in general, if grammatical theory enters this research. (S)he thinks that it is extremely crude to associate "modules" in the linguistic sense with "modules" in the brain. On the other hand, (s)he seems to welcome neurological research, if there are neurological correlates to the linguistic notions used. We will make clear in the text why we are not concerned at all with hardware disorders. The association of grammar modules or components with functional units in a neuro-psychological sense is another matter. This reviewer doubts, however, that a hardware disorder, e.g. a stroke, could have "tidy" effects on higher-order modules that would correspond to something like a linguistic lexicon or syntax. Our answer to this is that it is an empirical question what a hardware disorder might or might not cause. What seems to be required in order to address neurolinguistic questions that relate in a non-trivial way to linguistic theory is that there be a rule-governed dissociation of psychological functions. We freely admit that many hardware disorders which lead to aphasia do not result in dissociations that relate naturally to linguistic theory. It goes without saying that we would not consider "across-the-board" disorders to be candidates for investigations like the present one. As we will show in this paper, however, the patients reported here do show dissociations that might be revealing in a linguistic sense.
2. See Mohanan (1982), Halle and Mohanan (1985), Kiparsky (1982, 1983). Important forerunners of these were Siegel (1974) and Allen (1978).
3. Our attention was drawn to this by an anonymous TLR reviewer.

4. The role of prenominal agreement seems to be devastatingly ignored here. Examples like

- (i) Dieser Mann ist fähig zu einem Mord
this man is capable of a murder
- (ii) *Ein [fähiger zu einem Mord] Mann

shows that –*er* is an agreement marker that must be adjacent to N.

5. Arguments in favor of compounding as a module independent of syntax can be found in Fanselow (1985).

6. For a broad discussion of the fascinating neurolinguistic effects of the Japanese dual writing system, the interested reader is referred to Paradis, Hagiwara and Hildebrandt (1985).

7. H.C.E.M. also had some ability to read, but it was not comparable to her good repetition.

8. For more details on word order and markedness in German see Lenerz (1977).

9. In fact, the matter is somewhat more complicated: whereas one class is strongly inflected throughout, there is a class which is mixed in that it does not follow the strong paradigm in the Nominative, e.g. the indefinite article *ein* 'a/an'. The distribution of Case morphology in NPs is governed by *Kasusausgleich*. *Kasusausgleich* means that only one prenominal form can bind the (strong) Case morphemes. For example,

- (i) ein alte-r Mann
an old man
- (ii) de-r alte Mann
the old man

but not:

- (iii) *de-r alte-r Mann

10. More details on the distinction of lexical and structural Case can be found in Haider (1985).

11. This was pointed out to us by Claudio Luzzatti.

12. We have found that even the list in (22) is not exhaustive. The masculine noun *Bau* 'building' adopts an – *ən* – plural, but obligatorily inserts a *t*, i.e. the plural form is *Bauten*. At the same time, the plural of the masculine native noun *Stau* 'traffic jam' is not *Stauen or *Stauten, but strangely adopts the – *s* plural of non-native words. It seems that *Stau* is treated like a non-native word. A reason for that might be that traffic jams are something very recent. We leave this as a pure speculation.

13. This contrasts nicely with the results on the pluralization of non-words by English-speaking children in Berko (1958). Berko gives evidence that even pre-school children can form an – *s* (or – *z*) plural on non-words.

14. For readers familiar with psychological models of reading such as Morton (1979) or other dual or triple route reading models, it may be worth pointing out that H.B. did not simply read non-lexically by a grapheme-to-phoneme conversion route (GPC). This was demonstrated by the absence of a difference in his reading of regular and irregular English words. Since German orthography is too regular to tap such differences, our bilingual patient was tested with Baron's list given in Coltheart et al. (1980:267). There were 9 errors for regular and 11 errors for irregular words out of a possible 39 for each type.

15. Note that the form *G'sicht* 'face' is an accepted colloquial form in southern Germany. H.B., however, lived in northern Germany and was born there as well.

16. In an independent investigation (in progress) it was shown that T.P.'s reading and repetition were in a sense superior to the reading and repetition of normal controls. Due to the

absence of semantic processing, she did not "lexicalize" non-words as normal often do. T.P. read and repeated as accurately as possible any input given, irrespective of semantic content or phonological similarity to existing words of German.

17. Of course, the different tasks, i.e. assignment of Case in the context of verbs and prepositions, were randomized in order to avoid set effects in the patient's reactions.

18. The targets are:

(i) ... eines faulen Wirts ...

(ii) ... eines seltenen Vogels

19. Notice that agrammatic patients, like normal controls, show a strong tendency towards the unmarked SVO-order, at least with Accusative objects. See Dronsek, de Bleser & Bayer (in preparation).

20. The data are drawn from Bochner (1984).

21. Notice that in section 2 of this article, parallel examples from German compounding were reported, where plural/singular *forms* appear, while their respective *meanings* do not converge.

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