Interfix knowledge is fixed: Evidence from the composition of German compounds by persons with Aphasia

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Compound words represent a rich source of evidence concerning the manner in which multimorphemic words are represented in the mind. In many languages, such as German and English, compounding is a highly productive device for the creation of new words. In order for these words to be understood on first presentation, it is critical that lexical and, ultimately, semantic access to the compound's morphological constituents be possible in on-line word comprehension. A key question in the psycholinguistic literature has been the extent to which this constituent access, often termed morphological decomposition, also plays a role in the recognition and processing of compound words that are already well entrenched in the language.

In general, there seems to be converging evidence that morphological decomposition is not simply a procedure that is invoked by the language user in order to understand new words. Rather, it seems to be an integral part of the of the human lexical processing system. This finding has opened up a number of investigative opportunities that have used the phenomenon of morphological decomposition to understand both the overall nature of the human lexical processing system and roles played by various constituent characteristics.

With respect to the overall nature of the lexical processing system, Libben (2006) has noted that although morphological decomposition appears to be ubiquitous in the processing of compounds, it often leads to less efficient, rather than more efficient processing. He suggests that this points to a view of compound word processing in which the cognitive system seeks to maximize the opportunity for both whole-word and constituent activation rather than to maximize processing speed.

With respect to the roles played by characteristics of individual constituents, a number of studies have shown subtle effects of constituent frequency, morphological family size, and morphological role. It is a well-established fact that the frequency of a word is related positively to the speed and accuracy with which it is recognized. A number of studies have used this frequency effect to probe the relative activation of individual constituent morphemes in the recognition of compounds. Taft and Forster (1976) observed that the frequency of the initial constituent of English compound words played a larger role than the frequency of the second constituent. Andrews (1986) found comparable effects of both first and second constituent frequency. In a study of Dutch compound processing using eye-tracking, Kuperman et al. (in press) were able to track both the magnitude and time course of constituent frequency effects. They found effects of both first and second constituent frequency. Crucially, however, frequency effects for the initial constituent were observable at the same time as the whole-word frequency effects, but effects of second constituent frequency were observed subsequent to whole-word frequency effects. A difference between the nature of first constituent and second constituent frequency effects in English was also found by Goral, Libben, & Baayen (submitted). However their comparison of compound processing across English and Hebrew suggested that the nature of these effects depended not on the position of the constituent within the word, but rather whether it functions as a morphological head or modifier. Such compound processing differences associated with morphological role have also been highlighted in cross-linguistic studies of Jarema, Busson, Nikolova, Tsapkini, & Libben (1999).

It appears that the role played by constituent morphemes in compound processing cannot be adequately understood by considering these constituents as autonomous morphological units. Much of the research on the role of morphological family size (defined as the number of compound and derived words that have a particular morpheme as a constituent) plays a substantial role in compound processing. This suggests that there may be a spread of activation in the mental lexicon that is driven by morphological connections among units within the mental or morphological memory traces that correspond to an individual's experience with the constituent patterning of multimorphemic words in his or her language.

As is the case in many domains of language research, the study of persons with aphasia can be very revealing. In the case of compound processing, such investigations can contribute valuable information regarding fundamental questions of the extent to which compounds are composed and decomposed during online processing, whether the syntactic properties of embedded roots and stems can affect processing, and the manner in which compounds and their elements are linked to other lexical representations.

One of the dominant themes that have emerged for the study of compound processing among aphasics is the extent to which compounds show distinctiveness as word type. For example, Delazer & Semenza (1998) have contributed evidence that compound processing dissociates from other types of morphological disorders and can be selectively impaired in aphasia. They also demonstrated that when aphasic patients produce errors, target compounds are generally substituted by other existing or neologistic. Thus, knowledge that the target word is a compound seems to be retained even when the particular target compound cannot be produced.

Evidence from aphasia also seems to support the overall view in which compounding routinely involves morphological composition and decomposition. Badecker (2001) reported that aphasic patients tend to omit one of the compound's constituents and show misorderings of compound constituents, thus demonstrating compound parsing. Buchanan et al. (2001) report similar findings among two cases of acquired dyslexia/agrammatism. Finally, the view that morphological decomposition is characteristic of compound processing in aphasia is supported by the study of Mondini, Luzzatti, Zonca, Pistarini and Semenza (2004) who demonstrated that verbs are omitted more frequently than nouns in Italian noun-verb compounds. Because aphasics show greater difficulty with verbs as compared to nouns in general, this suggests that, to some extent, the grammatical properties of compound constituents continue to play a role for aphasics, even when they are in the non-head position.

Aphasic errors and German compounds

In the section above, we have made three observations: The first is that compounding can offer a rich source of evidence concerning the overall nature of the lexical processing system. The second is that although broad tendencies (e.g., morphological decomposition) may characterize compound processing in general, a full appreciation of processing details requires a consideration of the particular ways in which compound words are formed in individual languages and a language user's experience with such forms. Finally, our third observation was that evidence from aphasia can often contribute insights that might be unavailable through the study of unimpaired lexical processing. These three observations constitute the background to the present investigation.

As described more fully in Section 3 below, German compounding is considerably more complex morphologically than compounding in other languages. The locus of this complexity is the interfixation system of the language which often requires the obligatory presence of interfixes between compound constituents. Although both the linguistic and psycholinguistic status of these interfixes have been discussed in the literature, there is little agreement on the nature of the interfixation, the extent to which morphological decomposition involves interfixes as independent constituents in online lexical comprehension, and the extent to which interfixes are distinct elements of the composition process. The goal of the present study was to shed light on these questions by observing patterns of interfix errors in a task in which aphasic participants were presented with pairs of lexical items and required to produce compound forms from those pairs. In the sections below, we review the key aspects of German compounding under investigation and the evidence currently available concerning how interfixed and non-interfixed German compounds are processed.

Compound words and compound processing in German

In English, compounding is a relatively simple morphological process that involves the concatenation of two root morphemes (e.g. *teapot*). In German and other languages (e.g., Dutch, Polish, Ancient and Modern Greek) the root morphemes of a compound can be separated by a linking element or interfix (Malkiel 1958). Thus in German, for example, the interfixed compound *Geburtsort* 'birth place', is composed of the word *Geburt* ('birth'), the interfix *-s-*, and the word *Ort* ('place'). Interfixes have also been termed linking morphemes (Kehayia, Jarema, Tsapkini, Perlak, Ralli & Kadzielawa 1999), linking phonemes/graphemes (Schreuder, Neijt, van der Weide & Baayen 1998), confixes (Mel'čuk 1982, 86) and *Fugenmorpheme* (Ortner & Müller-Bollhagen 1991, 73-111; Fleischer 1976, 121-131; Žepić 1970) in the German literature. Fuhrhop (1996, 1998, cf. Krott et al. 2007) considers interfixes to be stem-forming elements of the first noun of a binary compound.

German has two properties that distinguish its noun composition typologically from that of the other above-mentioned languages. First, German interfixed compounds co-exist with relatively frequent simple root+root compounds. Second, interfixed compounds include many different interfixes. As was elaborated by Dressler et al. (2001), among interfixed German compounds, eight groups can be categorized and comparatively investigated, plus one subtractive group and the above-mentioned interfixless group, as shown in Table 1. Dressler et al. (2001) explored the extent to which these distinctions among interfixed forms generate differential results with healthy participants in a morphological composition paradigm. In this experiment, participants were shown German compounds and were asked to name the first or second word in the compound as quickly as possible. The prediction was that constituent extraction would be more difficult when underlying words in their citation forms must be recovered (or reconstructed, i.e., in cases such as *Firmensitz* in which the initial constituent, *Firma*, is not actually present in the word). This prediction was supported by the data. Initial constituents of interfixed compounds were named faster when words did not have to be recovered (i.e. all categories but 1, 9, 10).

Moreover, both Dressler et al. (2001, cf. 2005) and Libben et al. (2003) have found in on-line and off-line composition and on-line decomposition tests effects of productivity in increasing accuracy of response and decreasing response latency.

In addition, the processing of German compounds has also been found to show effects of morphological family size (cf. Krott, Schreuder, Baayen & Dressler 2007): bigger positional family size has been shown to facilitate processing. Left position has been found to be more important than right position (Jarema et al. 2002).

Passing over to our off-line experiments with aphasics, we clearly expect them to commit more errors than healthy participants. But the aims of our study are to investigate whether the same factors play a role in the processing of aphasics as in the productions of healthy. This must be broken down into correct productions and errors (cf. Söderpalm-Talo 1980). We are also interested to see in which way the severity of impairment and differences in aphasic syndromes (e.g. Broca's aphasia) play a role in the quantity and quality of errors and of their distributions. And finally we would like to know whether new factors can be identified that may play a role in the processing of aphasics.

Linguistic and psycholinguistic approach to the present study

We start with the assumption that compounds, such as the German noun-noun compounds studied in this contribution, are or at least can be processed both as wholes and according to their parts. Here we consider only the most basic type, two-member compounds. They are concatenated with the head to the right. This concatenation can be complicated by the addition of an interfix or the subtraction of the word-final stem-forming schwa of the base or citation form of the first element, as in *Sprache* + *Labor* → *Sprach-labor* 'language lab' (category 10 below). The type *Gebirge* + *Bach* → *Gebirg-s-bach* 'mountain creek' (category 9 below) displays both subtraction and interfixation.

We assume interfixation and not Fuhrhop's stem formation (see section I), because, first, we do not consider her arguments to be decisive, second, we want to keep the generalisation of the notion interfix for both compounding and derivation (as in Romance and Slavic languages, e.g. It. *volpe* 'fox' + diminutive suffix *–ina* → interfixed *volp-ic-ina*, cf. Dressler & Merlini 1994: 529ff), third we find the diachronic development from an inflectional suffix to an interfix more straightforward than to a thematic element (e.g. in G. *König-s-hof* 'king's court', diachronically derived from a genitive singular construction *des König-s Hof*), fourth, speakers sometimes vary between interpretation of an inflectional suffix and an interfix, as in G. *Land-s-mann* 'compatriot' (i.e. 'man of the same country' indicating a genitive singular) vs. *Länder-match* 'match between two countries' (indicating a plural formation). Again this wavering is better understood, if it occurs between two affixes than between an affix and a thematic element. Of the below categories the interfixed first elements are identical with inflectional forms in categories 1-6 and 8, but not in categories 7, 9, 10. Interfixes are semantically empty linking elements which apply to the left element of a binary compound.

Furthermore we assume subtraction in *Sprach-labor* and not root-based morphology, because there is abundant evidence that lexemes are primarily stored in their citation form (e.g. *Sprache*) and not in their root form (*Sprach-*), cf. Kilani-Schoch & Dressler (2005). Also subtraction applies morphotactically to the left element of a binary compound.

The above-mentioned techniques of interfixation and subtraction allow the establishment of a first complexity scale which has two bases: first, a deductive linguistic basis in the theory of Natural Morphology (cf. Dressler et al. 1987, Kilani-Schoch & Dressler 2005, Dressler 2005), particularly in two of its universal parameters of naturalness, i.e. morphotactic transparency and iconicity. The second basis is psycholinguistic and has been supported by the previous results of processing experiments (cf. Dressler et al. 2001, Krott et al., 2007, Libben et al., 2003)

A) The least complex compounding type is pure concatenation of two nouns (i.e. without interfixation), which is iconic and most transparent morphotactically (category 8 below).
B) The type which is already more complex consists in concatenation of the two nouns plus subsequent insertion of an interfix at the end of the first element (categories 2-7 below).
C) Subtraction (as in category 10 below) is more complex than addition, because it represents an anti-iconic technique as opposed to the most iconic technique. Since more iconic techniques are predicted to have a wider distribution than anti-iconic techniques, the existence of just one type of pure subtraction in compound formation as opposed to the presence of many types of addition of interfixes (and there are many more in German than those investigated here), fits this prediction.
D) The combination of subtraction and interfixation (as in the categories 1 and 9 below) is the most complex technique of compound formation and should be most difficult for processing (cf. the results in Dressler et al. 2001).

Now the question is whether the relative ease of processing of categories 2 – 7, all belonging to type B, can be further differentiated and whether such further distinctions agree or disagree with the complexity scale above.

One candidate firmly established in the theory of Natural Morphology (cf. Kilani-Schoch & Dressler 2005, Dressler & Ladányi 2000, Dressler, 2007) and shown to be relevant in psycholingustic studies (cf. Dressler et al. 2001, 2005, Libben et al. 2003, Laaha et al. 2006) is morphological productivity, to which we have a two-level approach.

First, those compound patterns (analogously to inflectional and derivational patterns) are productive that combine recent loan-words. This holds for the following categories below, illustrated with one example each: 1: *Pizz-en-verkauf* ‘pizza sale’, 2: *Garage-n-besitzer* ‘garage owner’, 4: *Armatur-en-brett* ‘dashboard’, 5: *Koyote-n-fell* ‘coyote hide’, 6: *Distrikt-s-vorsteher* ‘district head’, 8: *Laser-drucker* ‘laser printer’.

Another important criterion for productivity is application to new abbreviations. This criterion holds only for category 8: *KFZ-Versicherung* ‘car insurance’. Both loan-words and abbreviations are at first strangers to the indigenous language system and thus represent an obstacle to the application of a morphological rule which only productive rules can overcome.

A less important criterion for productivity is application to conversions as first element. This supports productivity of category 2: *Liege-n-hersteller* ‘deck-lounge producer’ (*Liege* being converted from the verb *liegen* ‘to lie’), 8: *Stau-raum* ‘traffic congestion space’(*Stau* being converted from the verb *stauen* ‘to be digested’). Conversions enter the lexicon without a derivational suffix that may predetermine the application of further morphological rules.

Another less important criterion is recent diachronic change from one category to another, thus at least slightly productive category, as evident in the coexistence of older forms of the unproductive category 10 and more recent ones of the productive category 2: *Kirsch-baum & Kirsche-n-baum* ‘cherry tree’, *Birn-baum & Birne-n-baum* ‘pear tree’. Here we have to mention that in Austrian German many compounds which have category 8 correspondents in Northern German (within the respective subdomains) are not in this interfixless productive category 8 but in categories 2, 6 or 7, e.g. *Braunkohle-bergwerk* vs. *Braunkohle-n-bergwerk* ‘lignite mine’*, Anstalt-kleid* vs. *Anstalt-s-kleid* ‘institution dress’.

These criteria demonstrate categories 8 and 2 to be most productive, 1, 4, 5, 6 less productive and 3, 9, 10 unproductive.

The second level of our productivity approach assigns highest productivity to those productive rules which have no productive competitor within a given input domain. They are the most predictable and reliable rules. Two productive rules that compete with each other for the same input are less predictable and reliable. Among two competing rules the one is more productive which has the larger domain. Competing productive patterns are 2 and 8, where 8 has the larger domain with many subdomains which have no competitor, e.g. in *Braunkohle-(n)-bergbau* ‘lignite mine’, similarly categories 1 and 8, as in *Pizza-verkauf* = *Pizz-en-verkauf* ‘pizza sale’.

These three ways of scaling allow to propose a composite scale: 8 – 2 - 5 - 4 – 6 - 7 - 1 – 3 - 10 - 9 , but the relative weighting of the first scale of complexity and of the two scales of productivity allows some variation. This is then matter for empirical investigation. What cannot be properly included is the fact that a subpart of category 7 is productive without competitor, namely suffixations in *–ung*, as in *Rettung-s-mannschaft* ‘rescue team’.

The core compound stimuli investigated

Two lists of stimuli were developed with a total of 292 items from ten different categories.

With regard to noun compounds, the selection of interfixes depends on structural properties of the first component (note that *e* in interfixes and word-finally means schwa). The categories used in this study are:

1) Singular final *–a* is replaced by interfix *–en*, e.g. *Firma* + *Chef* → *Firm-en-chef* (E. *company boss*) (productive category, complexity degree D)
2) A feminine noun in *–e* adds *–n*, e.g. *Dame* + *Mode* → *Dame-n-mode* (E. *ladies' fashion*) (highly productive, complexity B)
3) Masculine and neuter nouns with plural in *–e* add to this an interfix *–n*, e.g. *Dokument* + *Mappe* → *Dokument-e-n-mappe* (E. *document file*) (unproductive, complexity B)
4) Interfix *–en* = plural of feminine nouns, e.g. *Frau* + *Heim* → *Frau-en-heim* (E. *women's residence)* (productive, complexity B)
5) Masculine nouns in *-e* plus interfix *–n* equals all oblique cases, e.g. *Sklave* + *Markt* → *Sklave-n-markt* (E. *slave market*) (productive, complexity B)
6) Masculine and neuter nouns plus interfix *–s* equal the genitive singular case, e.g. *Staat* + *Kirche* → *Staat-s-kirche* (E. *state church*) (productive, complexity B)

7) Interfix –s is added to feminine nouns (which have no genitive or plural –*s*), as a default after word-final consonant clusters, e.g. *Zukunft + Angst* → *Zukunft-s-angst* (E. *fear of the future*), obligatorily after the suffix *-ung*, e.g. *Wohnung + Amt* → *Wohnung-s-a*mt (Engl. *housing administration)*, (thus partially productive, complexity B)
8) No interfix, e.g. Auto + Transport → Autotransport (Engl. *car transport*) (Default and most productive pattern, complexity A)
9) Interfix –*s* replaces final -*e*, e.g. *Gebirge + Bach* → *Gebirg-s-bach* (Engl. *mountain brook*) (unproductive, complexity D)
10) Truncation of final –e of feminine, e.g. *Schule + Arbeit* → *Schul-arbeit* (Engl. *school test*) (unproductive, complexity C)

These compounds consisted both of reversible and irreversible compounds. Reversible or twin compounds (cf. Stark & Stark 1991) consist of the same two constituents but in reverse order AB and BA, irrespective of whether they include interfixes or not, e.g. *Orange-n-saft* and *Saft-orange* 'orange juice & juice orange-s'. In order to keep the number of phonemes and morphemes of the reversible compounds equal, Stark & Stark (1991) even tested the plural *Saft-orange-n* instead of the singular. Both compounds in this example are actual, existing compounds. Irreversible compounds have no existing actual twin partner, although it may be a potential compound. For example *Lärm-pegel* 'noise level' is an actual compound, whereas *Pegel-lärm* is not, although it is structurally well-formed, but pragmatically highly unlikely to be coined.

Method

Participants

Four persons with aphasia participated in the study. All were native speakers of German residing in Vienna, Austria. For each participant, aphasia diagnosis was based on results from the Aachen Aphasia Test. The key characteristics of the four aphasic participants investigated in this study are summarized in Table 1.

Table 1. Key participant characteristics.

Partici-pant	Age	Education/ Pro-fession	Aphasia Type (Time Post-onset in months.)	Neurological data
N. B.-V.	30	College graduate, risk manager	Broca's (10 months.)	CVA; large left hemisphere le-sion extending from the insula to parietal cortex.
G. R.	42	High school graduate, social worker	Anomic (24 months.)	CVA; Complete occlusion of the left internal carotid artery.
B. S.	26	College student, computer science, website designer	Anomic (44 months.)	Encephalitis; left temporo-occi-pital to upper fronto-parietal a diffuse hypodense area.
E. H.	43	Printer's trade school, manager	Anomic (30 Months.)	CVA; thrombosis of the left in-ternal carotid artery; extensive parieto-occipital lesion.

The Compound Production Task

The overall goal of the production task that we employed was to probe the manner in which compound words with and without interfixes would be formed by the aphasic participants. Because the key feature of German compounding under investigation is its relatively complex system of interfixation, we sought to maximize the opportunity for interfix selection errors. A pilot study which we had conducted with the same participants (Stark et al., 2004) had shown that the participants' ability to form correct compound forms was well intact. In this pilot experiment, the participants were provided with a simple repetition task in which they were asked to read German compound words aloud. The participants produced virtually no errors involving the interfixation form of the first constituent. This suggested that a simple repetition task was either not challenging enough to create difficulties in interfix selection or was too shallow, in the sense that it could be accomplished by simply attending to the surface form of the stimuli.

Accordingly, the compound production task that that we report here was designed to foster depth of processing. In this task, two whole words were presented to participants on a single card. The words were presented in upper case letters. By presenting the compound elements to participants in this non-canonical orthographic form we hoped to both increase depth of processing (All German nouns are capitalized and all compounds were noun-noun compounds. Thus, the alternative was to have both words beginning with an upper-case letter. It seemed possible that this might interfere with their use as compound constituents).

The participant's task was to look at each card and to form a compound word from the two words that he or she saw on the card. Words were arranged one above the other. Again, the alternative, namely presenting the two words side by side, would have induced participants to simply read them from left to right. Indeed, this is exactly the strategy that we wanted to discourage. Therefore, two additional properties of the stimulus cards were introduced.

The first property was that compound words were organized into two lists. In List 1, for example, the compound *fashion show* was presented with the stimulus FASHION above the stimulus SHOW. In List 2, the participant would see the same compound, this time with the stimulus SHOW above the stimulus FASHION. All participants saw both lists. For each participant, at least one week elapsed between the presentations of List 1 and List 2.

The second key property was the inclusion of reversible compounds in the core stimulus list. These are compounds such as *orange juice*, which, in German, form existing compounds both as ORANGE+JUICE, and as JUICE+ORANGE (a type of orange used primarily in the preparation of juice). Thus, whereas for non-reversible compounds only one of the orderings of compound constituents would be correct, for the reversible compounds, both orderings of the words presented on the cards could be considered to be correct. Again, the presentation of vertically, rather than horizontally, arranged stimuli made it more likely that reversibility of compounds would be perceived. As has been shown by Stark and Stark (1991), the use of reversible compounds in the examination of compound processing among aphasics can yield valuable data on both the morphological and semantic nature of compound representation in aphasia. Reversible compounds allow the lexical properties of constituents (e.g., their length, abstractness, whole-word frequency) to serve as their own controls. Using these compound types in a case study of a patient who showed particular difficulty in the production of compounds, Stark and Stark (1991) showed that the first compound constituent was considerably easier to produce than the second.

In our study, the use of reversible compounds allowed us to investigate whether particular interfixed forms are avoided. In the case of ORANGE+JUICE, for example, the form *Orangensaft* (orange juice) contains the interfix (-n-), but the reversal *Saftorange* (juice orange) is uninterfixed. The use of reversible compounds also increased the depth of processing required for the task because, for these stimuli, a card would contain two potentially correct responses.

Testing Procedure

Testing was conducted in two sessions. Each session corresponded to one of the two lists. Participants 1 & 2 saw List 1 before List 2; Participants 3 & 4 saw List 2 before List 1. At least one week elapsed between testing sessions. The upper-case stimuli were presented in 7.5 cm. X 13 cm. cards in 24-point font. So, for the example *Orangensaft* (orange juice) above, a participant would see card with ORANGE (in 24-point font) in the upper portion of the card and SAFT (in 24-point font) in the lower portion of the card.

Within each session, the stimuli were presented in blocks, in order to reduce participant fatigue. The size of the presentation blocks varied for each participant. In total, 413 observations were recorded for Participant 1, 333 for Participant 2, 332 for Participant 3, and 318 for Participant 4.

Participants were told that their task was to produce a compound from the two words on each card. They were also told that the ordering of words on the card was random. Responses (i.e., the compound productions) were produced by participants orally, and all test sessions were audiotaped. The participant's productions were subsequently transcribed and served as the basis for the response analysis reported below.

Results

Scoring and Categorization of Responses

Participant responses to each stimulus presentation were recorded in terms of which morphemes were used and the orderings of those morphemes. The number of response attempts for each stimulus was also recorded.

Calculation of Frequency Values

We established the token frequency of compounds by consulting the Google search engine and the Wortschatz database (Quasthoff, Richter, & Biemann 2006). As the Google search engine accesses texts in business and academic websites as well as in private websites and therefore shows more creativity on the site of the writers, the search revealed many structurally well-formed compounds (e.g., potential compounds and possible reversible compounds) whose applicability in a wider speech community were debatable. Thus, one criterion for inclusion in the reversible compound category, for example, was that these structurally well-formed compounds show more than 100 hits in the Google search engine. The other criterion was that the compound word had to be represented in the Wortschatz database. Its German language corpus encompasses 30 million words from newspaper texts.

The token frequencies of the constituent nouns were calculated from their token frequencies in their status as autonomous words in Google and the Wortschatz database. In addition, the respective family sizes of the first member of a compound was calculated as the type frequency of both constituent A in compounds AB, AC, AD, AE etc., and of constituent B in BA, BN, BO, BP, etc. using the CELEX database (Baayen, Piepenbrock, & Gulikers 1995).

The Order of Compound Production.

As has been discussed above, participants were shown compound word constituents on cards in which the compound elements were arranged vertically, with one constituent in the upper portion of the card (henceforth *Above*) and the other shown below it (henceforth, *Below*).

As is shown in Table 2, participants showed a roughly equivalent ordering of compounds. This suggested that the manner of constituent presentation, and the instructions "Combine these elements to form a compound word in any order that you think is right", did not produce a significant bias toward a simple concatenation of elements in the order provided. However, as Table 3 shows, Participant 1 was exceptional in that he showed a certain tendency to retain the presented order of constituents (i.e., the constituent presented Above, followed by the constituent presented Below).

Table 2. The order of constituents in compound productions for all compounds.

Production Order		
	Above-Below	Below-Above
Initial responses only	554	552
All responses	679	665

Table 3. The order of constituents in compound productions for all compounds divided by participant (P1-P4).

Production Order								
	Above-Below				Below-Above			
	P1	P2	P3	P4	P1	P2	P3	P4
First response only	157	142	126	129	121	141	152	138
All responses	224	164	148	143	172	167	176	150

The Analysis of Ordering Errors.

In this study, participants were free to choose how to combine two morphemes into a compound word, but were required to use all and only those morphemes in the word formation task. Relatively few errors produced by participants involved the substitution or omission of constituents. For Participants' first responses, the overall constituent error rate was 3.4% (39/1145). For all responses taken together, the constituent error rate was 3.7% (52/1396).

More common error types in the data involved the creation of a novel (i.e., unattested in the language) ordering for compound constituents. As can be seen in Tables 3 and 4, participants showed an overall error rate of 14% (23/(23+139)) when the presented order of constituents was the only order that was acceptable (in this case, constituent reversals constituted errors). In the case, however, when the correct response required that constituents be reversed we were indeed surprised to find that participants showed basically the same error rate (13%). This suggested to us that they were indeed considering all ordering possibilities.

As can be seen in Table 4, this relationship between the two error types remains the same (18% for both) when all participant productions are taken into consideration. These included a participant's initial response to the stimulus and all subsequent reformulations on the same trial. While in 79% of the cases (902/1145) the first response was the only response, some participants did, on occasion, produce up to four reformulations on a single trial (2 responses (20%), 3 & 4 responses, (less than 1% each (7/1145, 1/1145). In our analysis, we considered the first response to be the most "on-line", but considered that subsequent responses also constituted valuable data regarding participant choices.

Table 4. The order of constituents in compound productions for non-reversible compounds. In this analysis, only the participant's first response was analyzed.

Production Order		
	Above-Below	Below-Above
Stimuli for which only *Above-Below* results in a real word	139	23
Stimuli for which only *Below-Above* results in a real word	30	204

Table 5. The order of constituents in compound productions for non-reversible compounds. In this analysis, all participant responses were analyzed.

Production Order		
	Above-Below	Below-Above
Stimuli for which only *Above-Below* results in a real word	157	34
Stimuli for which only *Below-Above* results in a real word	49	225

As can be seen in Tables 4 and 5, participants showed sensitivity to the lexicality of alternative production options ($p<.001$; using linear mixed effects modelling with participants and stimuli as random factors). Moreover, as can be seen in Table 5, this sensitivity was seen across all participants. Participant 1, in contrast to the others, shows an overall tendency to retain the order of presentation.

Table 6. The order of constituents in compound productions for non-reversible compounds. In this analysis, only participants' first responses were analyzed

Production Order								
	Above-Below				Below-Above			
	P1	P2	P3	P4	P1	P2	P3	P4
Stimuli for which only *Above-Below* results in a real word	37	35	34	33	4	7	6	6
Stimuli for which only *Below-Above* results in a real word	13	7	2	8	45	53	57	49

Table 7. The order of constituents in compound productions for non-reversible compounds. In this analysis, all participant responses were analyzed.

Production Order								
	Above-Below				Below-Above			
	P1	P2	P3	P4	P1	P2	P3	P4
Stimuli for which only *Above-Below* results in a real word	42	41	37	37	6	11	8	9
Stimuli for which only *Below-Above* results in a real word	25	9	4	11	51	57	62	53

The Analysis of Reversible Compounds

The next stage in our analysis focused on the production of reversible compounds. These compounds (e.g., ORANGE + SAFT = *Orangensaft* or *Saftorange*). We classified stimuli as reversible if they met the following criteria (a) both versions had attested frequencies in the Wortschatz Uni-Leipzig database, (b) both versions had more than 100 hits in a Google search of German web pages.

Table 8. The order of constituents in compound productions for reversible compounds. In this analysis, only the participant's first response was analyzed.

Production Order		
	Above-Below	Below-Above
First response only	221	169
All responses	270	228

As was the case of the non-reversible compounds, we investigated the extent to which there were between-participant differences in the data. These are shown in Table 9.

Table 9. The order of constituents in compound productions for all compounds divided by participant

Production Order								
	Above-Below				Below-Above			
	P1	P2	P3	P4	P1	P2	P3	P4
First response only	58	60	53	50	41	37	45	46
All responses	87	67	62	54	72	50	59	47

Explanatory Variables in Participants' Choices of Compound Constituent Order.

As can be seen in Table 8, participants produced a substantial number of compounds both in the order presented and in the reversed order. As will be discussed more fully below, the fact that this was much less the case for non-reversible compounds, suggests that the participants must have been considering alternative ordering as part of their production process.

If this is indeed the case, we would expect that variables associated with both whole-word properties and constituent properties could play a role in the determination of participants' ordering choices. Table 10 below isolates the effect of three variables. The first variable, whole-word frequency bias refers to which of the alternative orderings (AB or BA) has the higher whole-word token frequency. The second variable, constituent-frequency bias, refers to which of the two constituents (A or B) has the higher token frequency. The third variable, positional family-size bias, refers to which constituent (A or B) has the greater first-position family-size in German two-member compounds. This is the number (type frequency) of two-member compounds that have a particular noun as first member in a two-member compound.

The effects of the three potential predictor variables were analysed using logistic regression in which participants and items were treated as random factors. Neither constituent frequency nor positional family size (taken as a categorical balance variable or as separate A and B values) had a significant effect upon AB choice rates. Compound frequency, however, was significant, with higher AB compound frequency raising AB choice rates ($z=3.7$, $p=0.0002$) and higher BA compound frequency lowering AB choice rates ($z=-2.97$. $p= 0.003$).

The primary importance of whole word token frequency is also evidenced in the production of irreversible compounds (those for which only one of the constituent orderings results in an attested compound in German). If only the AB order is possible, and we have the same constituent frequency bias, then only roughly 6.1% BA orderings (in this case errors) were produced. However, if the constituent frequency bias contradicts the only attested order, the percentage of erroneous responses is more than doubled (14%). We also employed logistic regression to analyse these effects. Again, only compound frequency was a significant determinant of ordering choice, with higher AB compound frequency raising AB choice rates ($z=7.6$, $p<0.0001$) and higher BA compound frequency lowering AB choice rates ($z=-2.9$, $p= 0.004$).

Table 10. The roles of whole word frequency, constituent frequency, positional family size bias in participant production patterns

Whole word frequency bias	Constituent frequency Bias	Positional family size Bias	Number of Above-Below productions	Number of Below-Above productions	% Above-Below productions
1. AB	A	A	20	17	54
2. AB	A	B	40	8	83
3. AB	B	A	30	11	73
4. AB	B	B	35	20	64
5. BA	A	A	30	25	55
6. BA	A	B	7	21	25
7. BA	B	A	15	29	34
8. BA	B	B	30	28	52

Interfix Errors

At the outset, it is important to underline the fact that the task that participants were required to perform biased results in favour of interfix omissions. The reason for this is that participants were shown the bare compound constituents. Thus, all interfixes needed to be created by the participants in their output.

Thus, it is perhaps unsurprising to see that the majority of interfix errors involved the failure to supply a required interfix. As can be seen in Figure 1, the patterns of interfixation are very similar for compounds produced in the AB order and the BA order. Most productions are correct, and very few interfix substitutions were attested. For the AB order, the 3% of interfix substitutions represented 10 errors in total. Three of these involved substituting s→ (e)n interfixation. Seven involved substituting (e)n → s interfixation. For compounds produced in the BA order, the overall number of interfix substitutions was 13 (4% of the total). Of these, 3 involved substituting s → (e)n interfixation and 7 involved substituting (e)n → s interfixation.

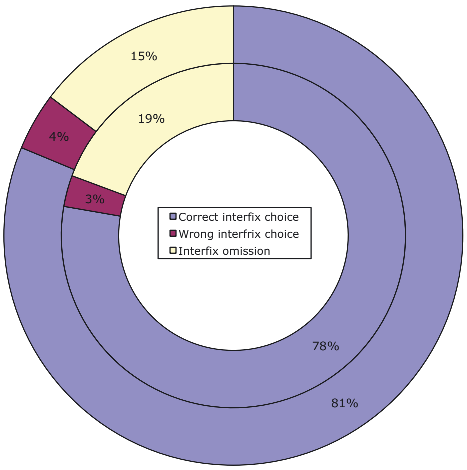

Figure 1. The percentage of correct interfix productions, wrong interfix choices, and interfix omissions in the compound production of participants. The inner ring of the chart shows the proportions for compounds produced in the order given (AB order). The outside ring shows the proportions for the compounds produced in the BA order.

The Preference for Non-interfixed Compounds.

In figure 1 above, the failure of participants to supply a required interfix in compound production is characterized as an interfix omission. It is clear that not supplying an interfix is a more common error type than supplying the wrong interfix type. In Figure 2 below, we see the preference for non-interfixed compounds displayed from a slightly different perspective. This Figure compares the number of non-interfixed compounds presented to the number produced (both in terms of first responses and in terms of total responses).

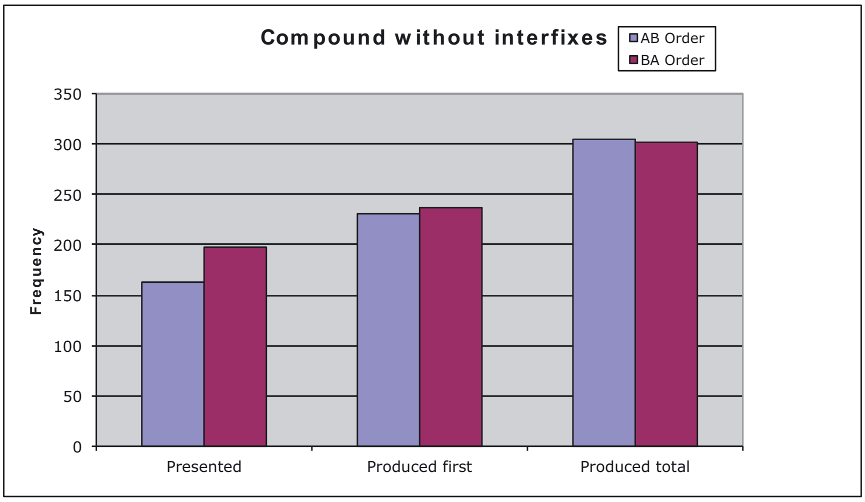

Figure 2: Production frequency vs. presentation frequency of compounds without interfixes

Preference for Particular Interfix Categories

If we consider the interfixation categories with which we began this study, there is, again, a remarkable convergence of the production preferences across categories in the AB and BA orders.

In Figures 3 and 4, the patterns of interfix production are shown (as in Figure 2 above) as relations between the number of compounds presented for which a particular category would be the most correct, and the number of cases in which that compound category was actually produced (taken both in terms of first productions and total productions).

In terms of complexity, Category 1 has been identified as representing the most complex Type D, Category 8, the least complex Type A. As can be seem in figures 3 and 4, Category 1 (Firmensitz), showed a lower number of occurrences as compared with presentations overall. As has been discussed above, this is a predicted pattern, because the less productive and much more complex Category 1 should lose items to the more productive and much less complex Category 8. Indeed, all changes of Category 1 stimuli were to the default uninterfixed category 8.

Category 2 (Suppentopf), on the other hand, showed more productions than presentations (104 presentations, 116 initial productions). Thus, it gained 12 new members in the productions of participants. As has been discussed above, this is expected because Category 2, as the productive pattern in which feminine nouns ending in Schwa would gain members from the unproductive Category 10. Moreover, Category 10 belongs to the complexity Type C, whereas Category 2 belongs to the less complex Type B. Indeed, this expected pattern is borne out in the data. All the extra first occurrences of Category 2 are compounds for which Category 10 was the initial classification.

Category 3 (Zwergenhaus) shows fewer productions than presentations by losing items to Category 8. This is predicted because Category 3 is unproductive and more complex (Type B) than the productive and least complex Category 8.

Category 6 (Königshof) is slightly productive and mildly complex (Type B). It is in competition with the more productive and less complex Category 8. As can be seen particularly in Figure 5, Category 6 appears to function as an attractive alternative production type, particularly in the later productions of a series of multiple attempts at a target. This is compatible with its relative complexity and productivity status.

Category 7 has the same overall status as Category 6, with two differences: First, the interfix is not identical with an inflectional suffix. Second, it includes the derivational suffix *–ung*, which always has an interfix -s-

Category 10 (Sprachlabor) gains some items from the equally unproductive but still more complex Category 9, e.g., *Hilfsmittel* being substituted by *Hilfmittel*. The number of observations in this category, however, is quite small.

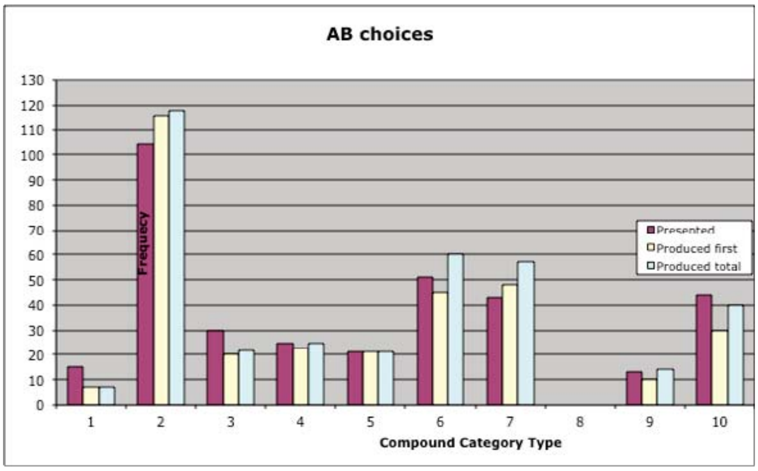

Figure 3: AB production frequency broken down by compound type

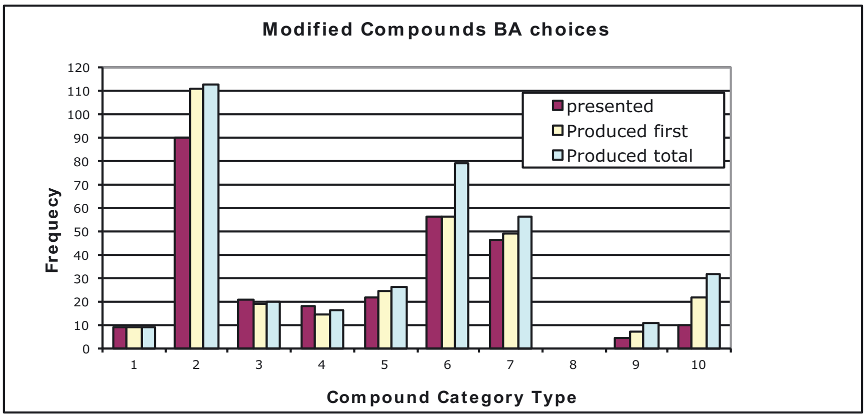

Figure 4: BA production frequency broken down by compound type

Discussion

This study has built upon previous work we have conducted in the investigation of the mental representation and processing of interfixed compounds. We have noted that, with respect to interfixation, the German system of compounding can be considered to be relatively complex. The majority of German compounds are not interfixed, and interfixation, when it does occur, takes a variety of forms. This was expected to present challenges to both impaired and unimpaired language users. Indeed, in previous studies, we found that the non-interfixed form can be considered to be the default in German based on relative type frequency, degree of productivity and lack of complexity. Dressler et al. (2001), Libben et al. (2002) and Jarema et al. (2001) have documented that non-interfixed compounds are also more easily processed than interfixed compounds.

The relative processing difficulty of interfixation in German, coupled with the general finding in the literature that compounds are obligatorily and automatically decomposed into their constituent morphemes, formed the background to the study of aphasic compound composition that we report in this paper.

Four aphasic participants were given a compound composition task in which they were presented with compound constituents arranged one above the other. They were asked to form compound words from these constituents. The general pattern of results indicates that the aphasic participants did not simply concatenate the constituents in the given order. Rather, they showed evidence of compound word creation.

The evidence for compound word creation comes from three sources: First, they produced almost as many compounds from the reversal of the presented order of constituents as they did from the order given. Second, their overall accuracy was very high, so that the vast majority of their compound creations were existing words of German. Third, in creating German compounds, they most often used the correct appropriate interfix, when one was required. This suggested that their compound creations made reference to existing patterns in the language for individual compound constituents and, most likely, to stored representations for the whole words.

We consider it very likely that stored representations were being referenced because the strongest determinant that was observed in their choice of constituent order (for compounds in which both orders resulted in a real German compound) was the relative frequency of the whole compound word. Also, we assumed that, if participants had not been referencing stored whole-word forms, their error rate would have been considerably higher than that which was, in fact, observed.

It is important to bear in mind that, although we have described this task as a compound production task, it is clearly morpheme based, and in this way, quite distinct from naturally occurring compound production. If a native speaker seeks to retrieve or create a compound form, production is typically driven by semantic and pragmatic factors. It is hard to imagine a natural communicative setting in which a speaker would first consider two lexemes and then wonder what compound(s) could be formed from them.

Yet, our results have shown that even in this relatively challenging morpheme-based compound creation task, the aphasic participants perform remarkably well and, moreover, function in a manner that suggests automatic access to the stored forms of the compounds and their constituents in the mental lexicon. Not only were aphasics better in this task than might have been expected, their response patterns show very little evidence of interfix substitution. When interfix errors were made, they almost always involved interfix omission. At first blush, this may seem to be a surprising result. If compounds are formed through morphological decomposition, and if the system of interfixation involves a relatively large number of choices, one might expect that a large number of substitution errors would occur, particularly in a morpheme-based test such as this.

At first sight one may think that our results may be seen as supporting Fuhrhop's (1996, 1998) reanalysis of interfixed first constituents as stem forms which compete with the non-interfixed stem. However, first, there exists the following linguistic counter-argument: Fuhrhop's view of coexisting (non-interfixed vs. interfixed stem-forms) does neither account for the complementary distribution of the interfixes *-(e)n-, -(e)s-* being combinable only with subtraction but not with umlaut and of the interfixes *-e-, -er-* the other way round, nor for the fact that interfixation is restricted in German to compounds and compound-like suffixoids, cf. *Beamte-n-stand* 'official class, lit. status of officials', *Beamte-n-schaft = Beamte-n-tum* 'officialdom' (or lit. 'officialship'). Evidence from our test data allows two further counter-arguments: The greatest number of the replacement of non-interfixed compounds by interfixed compounds occurred with the productive interfix *-n-* after schwa. This looks like generalization of a productive rule. Also note that in first language acquisition *–n-* after schwa is the first interfix to be acquired (cf. Dressler et al. 2009).

Second, if one lexeme has several different stem-forms (according to Fuhrhop's analysis), we would expect substitutions of interfixed first constituents by all sorts of different stem forms, as in *Land-* vs. *Land-s-* vs. *Land-es-* vs. *Länd-er-*, not just by non-interfixed first constituents. But this is not the case.

Our explanation for the observed pattern of compound elements makes reference to two factors: the nature of the task and the nature of interfixation in German. To be sure, the task biased the error patterns toward interfix omission. As has been mentioned above, the "path of least resistance" in a task such as this is to omit interfixes. However, we know from the fact that compounds were produced in both the presented and counter-presented order that appeal to simple concatenation cannot be the whole answer. Rather, it seems to us, that data from this study suggest that interfixation in German, however complex, might not be as confusing to native speakers as one might think. In fact, although there are many German compounds for which there are interfixation alternatives, almost all those alternatives involve choices between the presence of interfixation and the absence of interfixation. There are practically no compounds for which an individual compound can be interfixed by both –s- and –(e)n (e.g. *Sinn-en-lust = Sinn-es-lust*). This suggests that in the premorbid experience of aphasic native speakers of German, there may never have been confusion between these two interfixes. Once a compound constituent is used (or encountered) in a compound it is encoded as following a particular interfixation pattern. As Dressler et al. (2001) showed in a word-nonword composition task, unimpaired native speakers of German have reliably correct knowledge of which interfixes are associated with particular initial compound constituents.

To summarize, our results in this study of compound production in aphasia indicate that this aspect of lexical/morphological knowledge is surprisingly well retained subsequent to language disturbance following brain damage. We suggest that this finding offers further support for the view that interfixation is quite distinct from inflectional affixation from which it may have developed diachronically. Whereas inflection is commonly disturbed in aphasia, our results suggest that interfixation is relatively protected. In a sense this is hardly surprising. The difficulties that aphasics have with inflectional morphology may be directly related to the fact that the online selection of the correct inflectional suffix must be online, because many choices are available, given a single morphological stem. By contrast, the choice between the correct –s and -n interfixes for a particular initial compound constituent is not a choice at all, although there may be a choice between no interfix, a given interfix and subtraction.

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Non-reversible compound constituents [for which AB order is correct]

ANGRIFF_KRIEG
ARMUT_MASS
AUGE_APFEL
AUSKUNFT_BÜRO
BÖRSE_KRACH
BÜRGER_MANN
BLUT_LEERE
BOTE_FRAU
BRUNNEN_BAUER
BUCHE_FINK
DOGMA_KRIEG
DRAMA_PREIS
ERBE_GUT
ESSEN_MARKE
FABRIK_TOR
FARBE_KÜBEL
FARM_KAUF
FEUER_BRUNST
FICHTE_HARZ
FIRMA_SITZ
FLAGGE_GRUSS
FLANKE_SPIEL
FORM_SINN
FRAU_ QUOTE
GEBIRGE_BACH
GEFAHR_HERD
GEFOLGE_HERR
GESCHICHTE_HEFT
GREIS_ALTER
GRUBE_GAS
HÜLSE_FRUCHT
HANDEL_RECHT
HASE_FELL
HEIRAT_GUT
HILFE_MITTEL
HIMMEL_BRAUT
HIRSE_BREI
HOSE_BEIN
LÖWE_MUT
LAIE_BÜHNE
LEDER_STUHL
MENSCH_AFFE
PALME_WEDEL
PFLICHT_KREIS
PRISMA_GLAS
PRISMA_LICHT
PSALM_BUCH
SCHÖPS_FLEISCH
SCHLACHT_FRONT
SCHLANGE_BISS
SCHRIFT_REIHE
SCHULE_ARBEIT
SEGEL_REGATTA
SICHT_WEITE
SINN_LUST
SKALA_STRICH
SKLAVE_MARKT
SPRACHE_LABOR
SPRACHE_LEHRER
STÄRKE_MEHL
STRASSE_LÄRM
STRAHL_BÜNDEL
STRAUSS_EI
SUPPE_LÖFFEL
TAT_DRANG
VALUTA_HANDEL
VERKEHR_CHAOS
VILLA_BAU
VORFAHRT_REGEL
VORKAUF_RECHT
WASSER_RAND
WILD_GEHEGE
WINTER_SCHLAF
WIRTSCHAFT_MACHT
WOLLE_DECKE
ZELLE_GEWEBE
ZUFLUCHT_ORT
ZWERG_HAUS

Non-reversible compound constituents [for which BA order is correct]

ANGST_ZUKUNFT
ART_AFFE
BACH_GEBIRGE
BAND_GESCHICHTE
BAUM_APFEL
BILD_LANDSCHAFT
BLICK_FALKE
BOCK_SÜNDE
BRATEN_RIND
BRIEF_LIEBE
BROT_ROGGEN
BRUCH_STIMME
CHEF_FIRMA
DANK_ERNTE
DIEB_TASCHE
DRANG_ARBEIT
EILE_WIND
FADEN_GEDULD
FAHRT_HIMMEL
FALL_ZWEIFEL
FANG_KREBS
FEDER_STRAUSS
FEDER_TUSCHE
FELL_BÄR
FREUND_GESCHÄFT
FRIST_MONAT
FUTTER_KRAFT
GANG_BOTE
GASSE_SACK
GAST_SOMMER
HASE_ANGST
HEIM_FRAU
HOF_KÖNIG
HOF_PFARRE
HUND_HIRTE
HUT_FINGER
KLEID_ANSTALT
KNOPF_KRAGEN
KOPF_PFEIFE
KRAFT_ANTRIEB
KRAUT_HEIDE
KREIS_THEMA
KUCHEN_KIRSCHE
LÄRM_GETRIEBE
LACK_NAGEL
LAND_HEIDE
LAND_WEIDE
LAUF_HÜRDE
LOCH_SCHLÜSSEL
MANN_GEFOLGE
MAPPE_DOKUMENT
MARSCH_TAG
MASS_ARMUT
MEER_FLAMME
MODE_DAME
NEST_RABE
NOT_HUNGER
OEL_ERDE
OHR_ESEL
ORT_GEBURT
PEGEL_LÄRM
PFLICHT_GURT
PLAN_STUNDE
PLATZ_MENSA
RAD_RIESE
REGATTA_SEGEL
RING_JAHR
SCHACHTEL_PAPPE
SCHAU_MODE
SCHEIN_MOND
SCHIFF_SEGEL
SCHLAG_TAUBE
SCHMALZ_BUTTER
SCHRANK_WÄSCHE
SCHWARM_STAR
STEIN_ZIEGEL
STIFT_LIPPE
STREICH_SCHELM
STUFE_SCHULE
TAUSCH_SCHRIFT
TIER_BEUTEL
TOPF_SUPPE
VALUTA_HANDEL
WANDEL_DOGMA
WECHSEL_WORT
WEITE_SICHT

WIND_WIRBEL
ZAHN_WEISHEIT
ZEICHNUNG_TUSCHE
ZELLE_GEWEBE
ZELT_STERN
ZEUGNIS_ARMUT
ZUNGE_HUND
ZUSTAND_AUSNAHME

Reversible compound constituents

ADEL_BRIEF
AFFE_MAUL
ALTER_GRENZE
AMT_POST
AMT_WOHNUNG
ANGRIFF_FLÄCHE
ARBEITER_HILFE
AUSTER_ZUCHT
AUTO_DIENST
AUTO_FLUCHT
AUTO_TRANSPORT
BEGRIFF_BILDUNG
BERG_FESTUNG
BIENE_HONIG
BIER_FLASCHE
BILDUNG_BEGRIFF
BLATT_SPINAT
BLOCK_EIS
BLUME_TOPF
BLUME_WIESE
BOMBE_STIMMUNG
BOOT_RUDER
BREITE_WIRKUNG
BRIEF_ADEL
BUND_STAAT
DAME_MODE
DIENST_AUTO
DIENST_HERR
DOSE_SPRAY
DUFT_KERZE
ECKE_FENSTER
EIS_BLOCK
ENDE_LAGER
FENSTER_ECKE
FEST_MUSIK
FEST_TRACHT
FESTUNG_BERG
FLÄCHE_ANGRIFF
FLASCHE_BIER
FLASCHE_MILCH
FLUCHT_GEDANKE
FOLGE_ZEIT
FORM_SPRACHE
GEBET_STUNDE
GEBIET_SCHUTZ
GEBURT_HAUS
GEDANKE_FLUCHT
GEIGE_KONZERT
GESCHÄFT_STRASSE
GEWEBE_ZELLE
GRÖSSE_ORDNUNG
GRENZE_ALTER
HANDEL_MÜNZE
HAUS_GEBURT
HEIM_STUDENT
HEIRAT_WUNSCH
HERR_DIENST
HILFE_ARBEITER
HONIG_BIENE
KAMPF_HAHN
KERZE_DUFT
KIRCHE_STAAT
KONZERT_GEIGE
KONZERT_PLATZ
LAGER_ENDE
LEHNE_STUHL
LIFT_SESSEL
MÜNZE_HANDEL
MÜTZE_SCHIRM
MARKE_SCHUTZ
MAUL_AFFE
MILCH_FLASCHE
MUSIK_FEST
MUTTER_TIER

ORANGE_SAFT
ORDEN_SCHULE
ORDNUNG_GRÖSSE
PARTEI_STREIT
PFEIFE_TON
PLAN_WIRTSCHAFT
PLATTE_BAU
PLATZ_KONZERT
POST_AMT
QUOTE_FRAU
ROSE_ZUCHT
RUDER_BOOT
SAFT_ORANGE
SCHIRM_MÜTZE
SCHULE_ORDEN
SCHUTZ_GEBIET
SCHUTZ_MARKE
SCHWERPUNKT_THEMA
SESSEL_LIFT
SPINAT_BLATT
SPRACHE_FORM
SPRAY_DOSE
STAAT_BUND
STAAT_KIRCHE
STADT_WELT
STIMMUNG_BOMBE
STRASSE_GESCHÄFT
STREIT_PARTEI
STUDENT_HEIM
STUHL_LEHNE
STUNDE_GEBET
THEMA_SCHWERPUNKT
TIER_MUTTER
TON_PFEIFE
TOPF_BLUME
TRACHT_FEST
TRANSPORT_AUTO
UNGLÜCK_ZUG
WELT_STADT
WIESE_BLUME
WIRKUNG_BREITE
WIRTSCHAFT_PLAN
WOHNUNG_AMT
WUNSCH_HEIRAT
ZEIT_FOLGE
ZUCHT_AUSTER
ZUCHT_ROSE
ZUG_UNGLÜCK