View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Hochschulschriftenserver - Universität Frankfurt am Main

Morphology (2008) 18:1–25
DOI 10.1007/s11525-008-9120-7

ORIGINAL PAPER

On the way from morphology to phonology: German linking elements and the role of the phonological word

Damaris Nübling · Renata Szczepaniak

Received: 7 May 2008 / Accepted: 1 September 2008 / Published online: 8 October 2008
© Springer Science+Business Media B.V. 2008

Abstract German linking elements are sometimes classified as inflectional affixes, sometimes as derivational affixes, and in any case as morphological units with at least seven realisations (e.g. *-s-, -es-, -(e)n-, -e-*). This article seeks to show that linking elements are hybrid elements situated between morphology and phonology. On the one hand, they have a clear morphological status since they occur only within compounds (and before a very small set of suffixes) and support the listener in decoding them. On the other hand, they also have to be analysed on the phonological level, as will be shown in this article. Thus, they are marginal morphological units on the pathway to phonology (including prosodics). Although some alloforms can sometimes be considered former inflectional endings and in some cases even continue to demonstrate some inflectional behaviour (such as relatedness to gender and inflection class), they are on their way to becoming markers of ill-formed phonological words. In fact, linking elements, above all the linking *-s-*, which is extremely productive, help the listener decode compounds containing a bad phonological word as their first constituent, such as *Geburt+s+tag* 'birthday' or *Religion+s+unterricht* 'religious education'. By marking the end of a first constituent that differs from an unmarked monopedal phonological word, the linking element aids the listener in correctly decoding and analysing the compound. German compounds are known for their length and complexity, both of which have increased over time—along with the occurrence of linking elements, especially *-s-*. Thus, a profound instance of language change can be

D. Nübling (✉) · R. Szczepaniak
Johannes Gutenberg-Universität Mainz, FB 05, Deutsches Institut,
Historische Sprachwissenschaft, Jakob Welder Weg 18 (Philosophicum),
55099 Mainz, Germany
e-mail: nuebling@uni-mainz.de

R. Szczepaniak
e-mail: rszczepa@uni-mainz.de

observed in contemporary German, one indicating its typological shift from syllable language to word language.

Keywords Linking elements · Compounds · Phonological word · Language change

1 Definition, inventory, and origin of German linking elements

Linking elements occur between the constituents of a compound (*Komposition +s+fuge* 'linking element').[1] However, in most German compounds there is no linking element (*Substantiv+Ø+klasse* 'declension class'). In contrast to constituents, linking elements are semantically empty. By definition, a linking element consists of phonological material that is added to the base form of a noun (nom.sg.), which is the first constituent of a compound: *Kunde* → *Kunde+n+dienst* 'customer → customer service'; *Kind* → *Kind+er+wagen 'child* → preambulator', *Kind+s+mutter* 'child's mother', *Kind+es+wohl* 'child's welfare'. The examples with *Kind* show that the same noun may have different compounding stem forms. Every compound requires a special compounding stem form, i.e. linking elements may not be interchanged: *Kind+er+wagen*, but not **Kind+s+wagen, Kind+es+wohl,* but not **Kind+er+wohl.* Linking elements belong to the first part of the compound. If two compounds are coordinated, the linking element is always attached to the first constituent: *Arbeit+s- und Erholung+s+zeiten* 'labour and relaxation times'. Here we will consider only noun–noun compounds. Adjectives, such as *ausdruck+s+stark* 'expressive', will be excluded although they can be explained in exactly the same way.

German has a rich inventory of linking elements with at least seven different 'allo'-forms. In Table 1, they are presented in order of frequency.

Most of the time, no linking element (or a zero element) occurs, i.e. this is the unmarked (default) case: *Bein* → *Bein+Ø+kleid* 'leg → trousers', *Haus* → *Haus+Ø+tür* 'house → front door'. According to Ortner et al. (1991, p. 54), 72.8% of compounds lack linking elements (base: ''Innsbrucker Korpus''); according to Baayen et al. (in press), the figure is 65% (CELEX lexical database). Kürschner (2003), whose research is based on 1,000 compounds found in German newspapers, counted only 58%. The divergent numbers are the result of using different corpora. Regardless, they exhibit the same tendency.

The most frequent linking element, *-s-*, occurs in 17% of the cases according to Baayen et al. and in 25% of them according to Kürschner

[1] Linking elements also occur before some new suffixes developed from former free lexemes, such as *-tum* and *-schaft*. The behaviour of linking elements before these suffixes is discussed in Sect. 3.3.

Table 1 Inventory of German linking elements (in order of decreasing frequency)

	+/– Productive	Linking element	Examples	Comments
1	Productive	-s-	*Abfahrt → Abfahrt+s+zeit* 'departure → departure time'	Attached to nouns of all genders
2		-(e)n-	*Blume → Blume+n+stängel* 'flower → flower stem' *Schrift → Schrift+en+verzeichnis* 'script → publication list'	Trochees: *-n-* after *schwa*, *-en-* after stressed syllable; sometimes with plural meaning, especially after weak feminines
3	Unproductive	-es-	*Kind → Kind+es+wohl* 'child → child's welfare'	Only after masculines and neuters
4		-e-	*Schwein → Schwein+e+braten* 'pork → roast pork'	Relatively rare
5		-er-	*Kind → Kind+er+wagen* 'child → preambulator'	Only after masculines and neuters
6		-ens-	*Schmerz → Schmerz+ens+geld* 'pain → compensation for pain'	Extremely rare
7		-ns-	*Name → Name+ns+schild* 'name → name tag'	

(2003).[2] The second most frequent element, *-(e)n-*, occurs in 9.7% of the cases according to Ortner et al. (1991), 15% according to Baayen et al., and 11% according to Kürschner (2003). For all others, the rate of occurrence ranges between 0.2% and 1.3% of the cases. Mention should also be made of the subtractive linking element (*Wolle → Wollkleid* 'wool → woolen dress'), which is sometimes classified as a linking element but will not be considered here.

Sometimes linking elements are determined by the gender and inflectional class of the noun to which they are attached. For example, *-(e)n-* is only attached to nouns of the weak declension class (*Blume → Blume+n+stängel* 'flower — flower stem'); *-er-* always follows stems that take a homonymous plural ending, i.e. masculines and neuters with *-er* as a plural suffix (*das Huhn—die Hühner—das Hühn+er+ei* 'the hen—the hens—the hen's egg'). It is a well-known fact that the predecessors of linking elements were inflectional affixes, i.e. case and number endings (see Sect. 2.3). *Blumen-* looks like a plural form although it does not necessarily have that function. Historically, it can be traced back to a genitive singular form (*Blume+n+stängel < der Blumen Stängel* 'the flower's stem'). In *Blume+n+strauß* 'bouquet of flowers', however, it can be analysed as a plural. Thus, a compound with *Blume+n-* as its first constituent may sometimes be analysed as a plural but not always, although it has to be understood as number-neutral. Nevertheless, speakers sometimes still associate former plural endings with plural meanings. Most compounding stem forms containing linking elements are eventually lexicalised.

[2] Ortner et al. (1991) combined *-s-* and *-es-* (= 15%), which is not useful for our purposes.

According to Aronoff and Fuhrhop (2002, pp. 461–462) and Dressler et al. (2001), only two linking elements are productive: *-s-* (after nouns of all genders), and *-(e)n-* (after weak nouns of all genders). Dressler et al. (2001) investigated the productivity of different linking elements (''interfixes'', in their words) through experimental studies in which participants had to form new compounds, each with one real word (as a left constituent) und one nonexistent word (as a right constituent). The most productive linking element is *-n-* after feminine and masculine nouns ending in a schwa (*Suppe+n+topf* 'stock pot', *Sklave+n+markt* 'slave market'), followed by *-en-* after feminine nouns (*Frau+en+haus* 'women's asylum') and (paradigmatic as well as non-paradigmatic) *-s-* (*König+s+hof* 'royal court', *Zukunft+s+angst* 'fear of the future'). One of Dressler et al.'s (2001) conclusions is that most German linking elements are rule-based.[3] Another, based on decomposition tests, is that linking elements are autonomous units that are no longer inflectional endings in cases in which the left part is homophonous with an inflected form (plural or genitive singular). The recognition rate of the first constituent does not depend on its inflectional behaviour. Thus, the following three hypotheses could not be supported by the data: (a) The inflectional status of interfixed constituents makes a difference; (b) Storage of homophonous inflectional forms makes a difference; (c) The plausibility of a plural interpretation of *-(e)n-* interfixation makes a difference.

Another important distinction concerning the diachronic distance between former grammatical endings and contemporary linking elements is that between paradigmatic and non-paradigmatic elements: In the first case, the linking element is (synchronically) homophonous with a grammatical ending of the same noun, e.g. *Blume+n+strauß—die Blumen* (pl.) 'bouquet of flowers—flowers'. In the second case, the noun is followed by another unit which may be justified historically but is synchronically absent from the inflectional paradigm: *Hahn+en+kamm* 'cock's crown', *Storch+en+schnabel* 'stork's beak', *Abfahrt+s+zeit* 'departure time', *Hochzeit+s+fest* 'wedding', *Liebe+s+brief* 'love letter' (Ortner et al. 1991). As already mentioned, *-s-* is a very productive linking element and the most frequently occurring one. Because it is attached to many feminine nouns, it contradicts the declension paradigms for feminine nouns, because feminines have never taken *-s* in the genitive singular (or plural): *die Abfahrt* (nom.sg.)—*der Abfahrt* (gen.sg.) 'the departure—of the departure'. The *s*-element is regularly attached to word formation suffixes such as *-ung, -heit/-(ig)keit, -sal, -schaft, -ität*, *-ion*, and *-ling*, i.e. what Aronoff and Fuhrhop describe as closing suffixes (2002) (see 2.6). Interestingly, *-s-* is involved in the majority of doubtful cases (see Table 8 in Sect. 3.3): In German, there are about 50 well-known doubtful cases, in almost all of which the linking element is either zero or (more frequently)

[3] Baayen et al. (in press), however, found evidence for analogical effects, especially in the case of *-s-*.

-s-: Subjekt(s)pronomen 'subject pronoun', *Seminar(s)arbeit* 'term paper', *Abitur(s)feier* 'graduation ceremony', etc. As can be seen, we need to differentiate between the different allo-forms, especially between the most frequent ones, *-s-* and *-(e)n-*.

For a correct understanding of the diachronic development and status of the various elements, an important historical distinction needs to be made concerning non-paradigmatic linking elements (see Fig. 1):

(a) The first group consists of historical residues with old inflectional endings that are not used anymore. While the nouns changed their declension class, they still retain old inflectional material in compounds: *Hahn* 'cock' originally belonged to the weak masculines, taking the nasal ending *-n-* in every case except the nominative singular (MHG *der hane* 'nom.sg.', *des hanen* 'gen.sg.', *die hanen* 'pl.'). In Early New High German (ENHG), *Hahn* moved to the strong *i*-class, taking *-s* in the gen.sg. (*des Hahn-s*) and *-e + umlaut* in the pl. (*die Hähn-e).* In compounds, however, the old nasal endings are preserved as (non-paradigmatic) linking elements: *Hahn+en +kamm* 'cockscomb'. Thus, these elements are true relics.

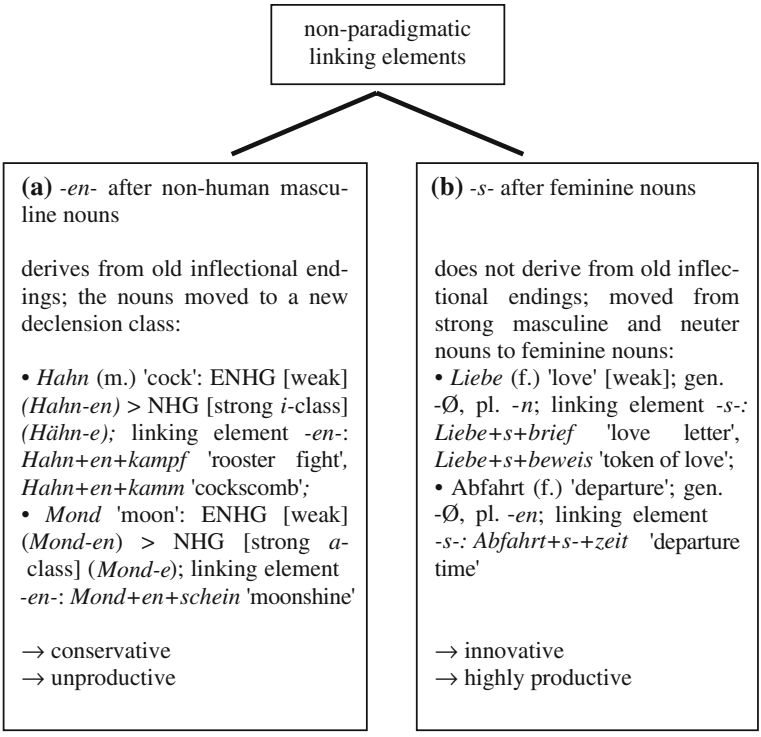

Fig. 1 Non-paradigmatic linking elements and their different origins

(b) The other group of non-paradigmatic linking elements left their original declension class and moved to another, becoming highly productive. This is always the case with *-s-* after feminines: *die Abfahrt* 'departure', *(der) Abfahrt* 'gen.sg.', *Abfahrten* 'pl.', but *Abfahrt+s+zeit* 'departure time'.

Because most research on linking elements is synchronically oriented, this important differentiation has been neglected. The behaviour of the first group is conservative, that of the second progressive. Therefore, these two types occupy completely different positions diachronically. In this article, we will focus particularly on *-s-*, since it seems to be the most developed linking element.

2 Linking elements: without a meaning, but with a function?

Many attempts have been made to assign a specific function to linking elements. The history, distribution and function of linking elements was described primarily by Grimm (1877); Wilmanns (1899); Paul (1920); Morciniec (1964); Henzen (1965); Žepić (1970); Wellmann et al. (1974); Augst (1975); Plank (1981); Ramers (1997); Ortner et al. (1991); Darski (1996); Fleischer and Barz (1992); Gallmann (1999); Fuhrhop (1996, 1998); Demske (2001); Pavlov (1972, 1983); Aronoff and Fuhrhop (2002); Wegener (2003, 2006); Kürschner (2003); Eisenberg (2006). Fuhrhop calls them ''borderline cases of morphological units'' (*Grenzfälle morphologischer Einheiten*). This description best captures the morphologically marginal status of linking elements.

The following attempted explanations of the occurrence of linking elements hold either for special allomorphs or for special compounds but there is no overall explanation. In Sect. 3, we will focus on the most progressive, mostly non-paradigmatic and therefore the most developed linking element *-s-* and argue for a new, general function, a phonological one.

2.1 Simplification of articulation and rhythmic optimisation

Some linguists have assumed that linking elements serve to facilitate articulation. This is an impression that cannot be confirmed linguistically; on the contrary, as we will show in Sect. 3.3, the very productive element *-s-* makes pronunciation more difficult, sometimes even leading to extrasyllabic units.

Nevertheless, some linking elements could have been motivated by rhythmic factors (Fuhrhop 1996; Wegener 2003; Kürschner 2003). There are some pairs of non-syllabic and syllabic units, such as *-n-* and *-en-* or *-s-* and *-es-*, which sometimes eliminate accent clashes and produce or maintain trochees. Therefore, syllabic forms tend to be attached to monosyllabic first parts, and non-syllabic forms to polysyllabic first parts:

(1)	*Frau+en+schuh*	vs.	*Blume+n+topf*
	'lady's slipper'		'flower pot'
	Bär+en+hunger	vs.	*Affe+n+theater*
	'ravenous appetite'		'charade'

(2) *Land+es+sprache* vs. *Ausland+s+jahr*
'official language' 'year abroad'

For *-(e)n-*, this can be considered a rule, but for *-(e)s-*, it is only a tendency: There are only about 30 nouns that take the (unproductive) *es*-element, whereas the *s*-element attaches even to monosyllabic first parts, e.g. *Land+s+leute* 'fellow countrymen', *Amt+s+gericht* 'local court'.

2.2 Prevention of resyllabification and fusion of constituents

Only in the case of the linking *-s-*, especially after monosyllabic first parts, does Wegener (2003, 2006) suggest a phonological motivation: The occurrence of *-s-* depends on the sonority of the coda of the first part: the higher the sonority, the lower the probability of a linking *-s-*, and vice versa. After sonorants ([m, n, l]), *-s-* occurs in 1.8–4.7% of the cases (e.g. *Heil+s+lehre* 'doctrine of salvation' whereas after [p, t, k], the percentage varies between 15% and 20% (*Ort+s+tarif* 'local rates'). Wegener's (2006) hypotheses are the following: (a) *-s-* prevents resyllabification of the two constituents when the coda and the onset differ strongly in sonority (e.g. *Ort+s+angabe* 'location' instead of **Or.tan.ga.be*); (b) *-s-* prevents the fusion of two identical (or similar) sounds (*Ort+s+tarif* 'local rate' instead of **Orttarif*). Thus, in both cases, the linking *-s-* protects the compound against opacification (loss of transparency).

There are three main problems with this explanation: First, German compounds consist of at least two separate phonogical words and therefore never undergo resyllabification, c.f. *Steinobst* $[[\text{ʃtaɪ̯n}]_F]_\omega[[\text{ʔo:pst}]_F]_\omega$ 'stone fruit' (and not $*[\text{ʃtaɪ̯.no:pst}]_\omega$). The rare apparent counterexamples such as MHG *junc-herr* 'young man' > NHG *Jun.ker* 'nobleman' are cases of lexicalisation of a former compound; for more details see Sect. 3. Second, Wegener completely ignores the glottal stop [ʔ], a highly consonantal sound that, in native words, occurs before phonological words beginning with a vowel. Hence, it always prevents resyllabification: *Ort* [ʔɔp̚t] – *Geburtsort* [gəˈbu:p̚tsˈʔɔp̚t] 'place of birth' (see also Alber 2001). Finally, there are far more cases in which the linking *-s-* does not occur than ones in which it does, c.f. *Stand[ʔ]ort, Wort[ʔ]art – Lobpreis, Bilddokument, Geldtasche*, *Weggefährte* etc. The fact that *-s-* occurs more frequently after strong than weak consonants will be explained in Sect. 3.

2.3 Linking elements as inflectional morphemes

Other linguists (e.g. Wiese 1996; Donalies 2003) consider linking elements to be closely related to inflectional morphemes since they can sometimes be paraphrased using genitives or plurals, e.g. *Ei+er+likör* 'egg nog', *Völk+er+kunde* 'ethnology', *Kind+er+arzt* 'pediatrician', *Länd+er+spiel* 'international match', whose first parts may be understood as plurals. This is often (but not always) the case with *-er-*. After weak monosyllabic feminines, *-en-* often conveys the same

information: *Schrift+en+verzeichnis* 'publication list', *Geburt+en+regelung* 'birth control'.[4] Yet there are many counterexamples that show that this is not a reliable rule: *Hühn+er+ei* 'hen's egg', *Kind+er+wagen* 'buggy', *Frau+en+hand* 'woman's hand' etc. cannot be interpreted as containing underlying plurals but must be understood as singulars. On the other hand, the first parts of *Bischof+ s+ konferenz* 'congregation of the bishops' and *Anwalt+s+kammer* 'Chamber of Lawyers' each correspond to a genitive singular but must be paraphrased as plurals. Even though many linking elements resemble case and/or number markers, they need not convey this information. Because they have lost this function and acquired a new status, they should be considered to have been completely dissociated from grammatical markers. In ENHG, the following reanalysis took place, as can be seen by the change of the definite article $des_{[gen.]}$ (*Teufels Sohn*) > $der_{[nom.]}$ (*Teufelssohn*) (Demske 2001):

(2) $[[\underline{des}_{Det}\ Teufels_N]_{NP}\ Sohn]_{NP} > [des_{Det}\ [Teufel\text{-}s\ Sohn]_N]_{NP}$
$> [\underline{der}_{Det}\ [Teufelssohn]_N]_{NP}$
$[[the\ devils_N]_{NP}\ son]_{NP} > [the_{Det}\ [devil\text{-}s\ son]_N]_{NP}$
$> [the_{Det}\ [devilsson]_N]_{NP}$

Thus, the *-s-* in *der Teufelssohn*, literally translated as ''devilsson'', can be traced back to a former genitive. There are, however, many cases of secondary *-s-* insertions,[5] especially, as already mentioned, after feminine nouns due to the fact that feminine nouns have never taken *-s* in the genitive (except proper names which are not considered here).

2.4 Structuring complex compounds

The most convincing explanation is that linking elements structure compounds and thus help the listener in decoding word formation (see, for example, Augst 1975; Henzen 1965; Ortner et al. 1991; Fuhrhop 1996, 1998). Sometimes, linking elements even help the listener correctly analyse words hierarchically by marking the border between head and non-head. The *-s-* in *Handwerk+s+zeug* 'tool of the trade', for example, does not support the division *Hand* + *Werkzeug* 'hand + tool' but *Handwerk* + *Zeug* 'handcraft + stuff' (*-zeug* is the head of the formation), i.e. $[_w[YZ]X]$, and not $*[_w[Y]ZX]$ (see nr. 1–4 in Table 2).

In addition to bipartite formations, there are many that are tripartite or even more complex, so linking elements have an important function. The

[4] This corresponds to what Gallmann (1998) says: First parts (''non-nuclei'') of compounds cannot contain any externally licenced morphosyntactic information, i.e. case, whereas number may be internally licenced. Therefore, compounds like *Staat+en+bund* 'confederation' or *Länd+er+spiel* 'international match' may be interpreted as containing plurals. However, these first parts are often underspecified with regard to number, as can be demonstrated by *Staat+s+vertrag* 'treaty' which always includes at least two states. Therefore, linking elements may sometimes be understood as number suffixes but never as case suffixes (Fuhrhop 1996, p. 212). Possible genitive interpretations (as in *Amt+s+diener* 'usher') are coincidental and not expressed by the linking *-s-*.

[5] Henzen (1965, p. 58) calls them ''inorganic *s*-elements''.

Table 2 Monomorphemic and polymorphemic first parts of compounds and the probability of linking elements

	monomorphemic	**polymorphemic**	translation
1	*Werkzeug*	*Handwerk+s+zeug*	tool – tools of the trade
2	*Hofmauer*	*Friedhof+s+mauer*	courtyard wall – graveyard wall
3	*Marktbude*	*Jahrmarkt+s+bude*	booth – fairground booth
4	*Hofbeamter*	*Bahnhof+s+beamter*	court servant – railway station officer
5	*Fahrtzeit*	*Abfahrt+s+zeit*	journey time – departure time
6	*Schlagkraft*	*Vorschlag+s+recht*	momentum – right of proposal
7	*Fangarm*	*Anfang+s+gehalt*	tentacle – starting salary
8	*Wurfgeschoss*	*Vorwurf+s+haltung*	projectile – attitude of reproach
9	*Fallbesprechung*	*Verfall+s+datum*	case discussion – expiration date
10	*Kaufpreis*	*Verkauf+s+preis*	purchase price – market price
11	*Rufname*	*Beruf+s+name*	first name – profession name
12	*Triebfeder*	*Betrieb+s+feier*	mainspring - company party

Table 3 Correlation between occurrence of the linking elements zero and *-s-* and the complexity of the first part (according to Kürschner 2003)

Linking element	All compounds (%)	Compounds with polymorphemic first constituents	
		First part is a compound (%)	First part is derivationally complex (%)
zero Ø	58	66	29
-s-	25	27	67.5

more complex the first part of a compound, the more probable the occurrence of a linking element (see Table 2).

Obviously, there is a strong tendency for a linking element to support the structure and hierarchy of a word's formation. A typical doubtful case is the bipartite compound *Seminar(s)arbeit* 'term paper', in which the linking *-s-* occurs relatively infrequently (in about 1/3 of the cases in an informal oral interview of students at the University of Mainz), as opposed to the more complex formation *Hauptseminar(s)arbeit* 'term paper in an advanced seminar', which more frequently takes *-s-* than not (*-s-* occurs in about 2/3).

Kürschner (2003, 2005), who conducted a corpus-based investigation, found that morphological complexity does not always increase the probability of a linking *-s-* (the occurrence of the other linking elements never depends on the complexity of the first part), see Table 3.

The presence or absence of *-s-* is highly dependent on the polymorphemic first constituent: After derivationally complex first parts (i.e. those containing a prefix as in examples 5–12 in Table 2), the *s*-element occurs in 67.5% of the cases, compared to only 25% in all compounds. However, after first

constituents that themselves consist of a compound (see examples 1–4 in Table 2), *-s-* occurs in only 27% of the cases, and zero in 66%. Consider the following examples (taken from Kürschner 2003) with compounds as first constituents, but without a linking-*s*: *Bilderbuch+Ø+wetter* 'picture book weather', *Rückruf+Ø+aktion* 'product recall', *Selbstmord+Ø+anschläge* 'suicide assaults', *Waldbrand+Ø+gefahr* 'risk of forest fire'.

Unfortunately, Kürschner (2003) does not differentiate between stressed and unstressed prefixes within derivationally complex first parts. A more appropriate explanation based on the phonological word will be provided in Sect. 3. It will be shown that the occurrence of the linking *-s-* correlates with the (bad) phonological quality of the first constituent. The two most important causes of bad phonological words are derivationally complex first parts with unstressed prefixes (such as *Berúf+s+name* 'profession name', cf. no. 9–12 in Table 2) and foreign words with non-native structures and accent positions (such as *Religión+s+unterricht* 'religious education'). Since compounds often form good phonological words, they need not to be linked by *-s-* when used as first parts (*Rückruf+Ø+aktion* 'product recall'). The same holds for derivatives with stressed prefixes, as will be shown in Sect. 3 (*Ánruf+Ø+beantworter* cf. no. 5–8 in Table 2). Thus, the border between no. 8 and 9 in Table 2 is most relevant. We will generally argue against morphological complexity as the main factor and for phonological complexity, which is often (but not always) the result of a morphologically and especially derivationally complex first part.

2.5 Indicators of morphologised compounds

Another function of linking elements is to indicate the (degree of) morphologisation of compounds. This function mainly concerns compounds that have adjectival second constituents and have arisen from syntactic units: *richtung(s)weisend* < *Richtung weisend* 'giving direction', *zukunft(s)weisend* 'trend-setting', *achtung(s)gebietend* < *Achtung gebietend* 'commanding respect' (Fuhrhop 2000). Whenever a linking *-s-* occurs in one of these syntactic units, it has to be classified as a compound and written as one word. However, there are not many examples of this sort.

2.6 Linking elements as re-openers of stems with closing suffixes

Linking elements, especially non-paradigmatic ones such as *-s-* after feminine stems, tend to re-open word formations ending with morphologically closing suffixes such as *-ung, -heit/-(ig)keit, -sal, -schaft, -ling, -ität*, and *-ion*. Usually, words ending with such suffixes do not allow further derivation: *Liebling* 'darling', but not **lieblinglich, *lieblinghaft*. It is, however, precisely these suffixes that take linking elements that allow further composition: *Liebling+s+essen* 'favourite dish', *Erstling+s+werk* 'debut', *Entschuldigung+s+schreiben* 'letter of apology', *Schicksal+s+schlag* 'stroke of fate'. This important function was discovered by Aronoff and Fuhrhop (2002), but it does not explain all occurrences of *-s-*. Even these cases can be explained phonologically, as will be shown later (Sect. 3.3).

2.7 Further functions

Some linking elements seem to be semantically conditioned, but this conditioning is not very pronounced. For example, there is an observable tendency to insert *-e-* after stems designating animals (*Pferd+e+stall* 'horse stable'*, Hund +e+leine* 'dog leash'*, Schwein+e+braten* 'roast pork', *Maus+e+falle* 'mousetrap' with many counterexamples such as *Rind+er+braten* 'roast beef') and to insert *-s-* before a stem designating a person (*Bauer+s+frau* 'countrywoman'*, Lehrer+s+gattin* 'spouse of a teacher'). Furthermore, linking elements sometimes help clarify semantic differences between homophones, but this only occurs in very few cases such as *Land+Ø+mann* 'farmer' vs. *Land+s+mann* 'compatriot'. Sometimes, linking elements indicate lexicalised compounds, e.g. *Haar+es+breite* 'hairbreadth' vs. *Haar+Ø+breite* 'breadth of a hair', *Name+ns +tag* 'name day' vs. *Name+n+forschung* 'onomastics', where the meaning of the former formation in each pair may not be derived from the sum of its parts. Generally speaking, semantic factors may be neglected. The same holds for the differentiation of homonyms: There are only few examples such as *Volk+s +kunde* vs. *Völk+er+kunde* 'folklore' vs 'ethnology' and *Mensch+en+kind* vs. *Mensch+ ens+kind* 'human being' vs. 'golly! ' (exclamation).

Finally, we would like to mention an extraordinary fact. In technical terminology (economics, law, etc.), a linking element is often missing even in cases where it would be obligatory in comparable instances: *Erbschaft+ Ø+steuer* 'inheritance tax', *Schaden+Ø+ersatz* 'compensation for loss', *Mehrwert+Ø+steuer* 'value added tax (VAT)'. All first constituents ending in *-schaft* take the linking *-s-* except in terms of this type.

3 Linking elements as a prosodic means of phonological word optimisation

We will now present a new view concerning the function of the German linking elements. As a result of reanalysis in the process of univerbalisation (see example in Sect. 2.3, *Teufel+s+sohn* 'devil's son'), former inflectional endings became phonological material. We argue that, besides the morphological function, a new function of linking elements emerges which is phonological: This phonological material strengthens the right edge of the phonological word (pword), e.g. $[Teufel\underline{s}]_{\omega}[sohn]_{\omega}$. This new phonological function applies exclusively to the linking *-s-* and is sensitive to the quality of the pword, as will be shown below. Other linking elements preserve their role as means to achieve or maintain trochaic structures. We will begin by explaining the notion of the pword in German.

3.1 The notion of the phonological word (pword)

In prosodic phonology, as developed by Nespor and Vogel (1986), the pword is one of the hierarchically arranged phonological constituents. In spite of

differences related to details of prosodic structure, it can be stated that the pword dominates the phonological foot, which in turn dominates the phonological syllable. It is widely assumed that the constituent directly above the pword in the hierarchy is the phonological phrase (cf., though, Nespor 1999 und Nespor and Vogel 1986).[6] The intonational phrase and the phonological utterance are commonly considered to be the outermost layers in the prosodic hierarchy.

The prosodic hierarchy is governed by a series of principles leading to a tree-shaped structure (for these principles, see Selkirk 1984; Nespor and Vogel 1986; Hall 1999 among others). Hall (1999, p. 11) mentions the following constraints related to the principle, which is called the Strict Layer Hypothesis: LAYEREDNESS, HEADEDNESS, NONRECURSITIVY, and EXHAUSTIVITY. The first two constraints require a strict and unchangeable order of the individual layers. Hence, any pword comprises one or more phonological feet and any foot contains one or more syllables. The second, third, and fourth constraints (HEADEDNESS, NONRECURSIVITY and EXHAUSTIVITY) are violable. We will refer to this later in the article.

Unlike the lower-level phonological/prosodic constituents, the phonological syllable and the phonological foot, the pword is constructed based on morphological information (Nespor and Vogel 1986, p. 109). This means that there is an interaction between the phonological and the morphological components of grammar, leading to a direct connection between morphological boundaries and the edges of a pword. Thus, a pword always contains at least one morpheme and a morpheme is always dominated by one pword. With few exceptions, it is not possible for one morpheme to be shared by two pwords.[7]

Furthermore, Nespor and Vogel (1986, p. 109f.) point out that the reason for postulating the pword as a phonological domain (as along with the other parts of the prosodic hierarchy) is the very frequent nonisomorphism between the possible size of the pword and that of the morpho-syntactic word. This is the case with German compounds, which, as we will see, consist of at least two pwords, e.g. $[Teufels]_{\omega}[sohn]_{\omega}$. The size of a given pword may vary from language to language. A pword can be bigger than, to the same size as, or even smaller than one morpho-syntactic word (for examples, see Booij 1983; Nespor and Vogel 1996; Hall 1999 among others). In NHG, we have suprasegmental evidence for word-internal pwords, i.e. pwords smaller than grammatical (morpho-syntactic) words. Raffelsiefen (2000) points out that NHG compounds behave differently from simplexes, even though the latter are polysyllabic or polypedal pwords. Firstly, within a polysyllabic and poly-

[6] According to Nespor and Vogel (1986) and Vogel (1990), the constituent directly above the pword in the hierarchy is the clitic group (CG). For a discussion, see Hall (1999).

[7] There are only a few examples that violate this constraint. NHG words like *Abenteuer* 'adventure' consist of only one lexical morpheme but behave like compounds phonologically. They have two stressed syllables; the main stress lies on the first syllable, which is the prominent one in the first monopedal pword: $[Áben]_{\omega}[tèuer]_{\omega}$. This is an example of a *pseudo-compound* (Raffelsiefen 2000, p. 45).

pedal pword there is only one tense vowel that can be long, e.g. *Schokolade* [[ʃɔkɔ]$_{Fw}$[la:də]$_{Fs}$]$_{ω}$ 'chocolate' vs. *Steinobst* [[ʃtaɪ̯n]$_{F}$]$_{ω}$[[ʔo:pst]$_{F}$]$_{ω}$ 'stone fruit'. Secondly, within a polysyllabic and polypedal pword all intervocalic consonants are syllabified in the syllable-onset position, e.g. *Zauber+er* [tsaʊ̯.bə.ʀɐ.] 'wizard'.[8] Thirdly, whereas in a polysyllabic and polypedal pword the last branching foot is the most prominent (*Schòkoláde* [[ʃɔkɔ]$_{Fw}$[la:də]$_{Fs}$]$_{ω}$ 'chocolate'), in compounds we normally have the opposite situation (*Stéinòbst* [[ʃtaɪ̯n]$_{F}$]$_{ω}$[[ʔo:pst]$_{F}$]$_{ω}$ 'stone fruit'). Irrespective of the number of syllables, the first foot dominated by a separate pword carries the main stress. These three criteria provide an understanding of the phonological structure of German words and are important for our further discussion.

3.2 The typological drift from a syllable language to a word language: The diachronic optimisation of the pword in German

In its 1500-year history, German has changed typologically from a syllable language (OHG) to a word language (MHG>ENHG>NHG).[9] This is explicitly shown in Szczepaniak (2007). In ENHG, when linking elements arose, a series of phonological processes optimising the pword can be observed. Most of the pword optimisations are at the expense of the syllable's quality. They relate, first, to the size of the pword and, second, to its form. Both types of this phenomenon will be considered now (3.2.1 and 3.2.2). In Sect. 3.3, it will be further shown that they are supported by linking elements. Thus, the diachronic development of linking elements perfectly fits into the drift of German to a word language.

3.2.1 The regulation of the size of the German pword

Since MHG, processes regulating the size of the pword occur. Whereas the OHG pword is not so strictly regulated with regard to its size—there are pwords comprising up to three feet—from the MHG period on, there is a very strong tendency to regulate the size of a pword through reduction to one foot. Figure 2 contains an example of this reduction. The OHG form *ahtōtin* 'to ponder, 3.pl.pret.conj.'represents a tripedal pword,[10] which is minimised to a monopedal trochaic pword in MHG. Thus, the trochee is the prototypical pword in NHG (see Eisenberg 1991).

The processes of regulation and minimisation of the pword in MHG were also decisive with regard to its shape. This is because in MHG vowel reduction in the non-prominent part of the foot assumed the additional function of

[8] According to Nespor and Vogel (1986, p. 72), the pword is the universal domain for syllabification. In NHG, however, there is a small group of unstressed prefixes each of which constitutes neither a foot nor a pword but does constitute its own syllabification domain. Thus, these prefixes are unparsed syllables that block syllabification, e.g. *er.ahnen*, *ver. üben* (see Sect. 3.3).

[9] For more on the phonological typology of word and syllable languages, see Auer (2001).

[10] OHG is a quantity-sensitive language. A foot must be bimoraic (for more details, see Szczepaniak 2007).

Fig. 2 The change of pword structure from OHG to MHG

marking the pword. Since MHG, the non-prominent part of the foot has also been the non-prominent part of the monopedal pword.

3.2.2 The form of the German pword

In addition to vowel quality, consonantal strength is an important factor in the optimisation of the form of a pword. In the history of German, the pword has been marked through processes involving consonantal change in a certain word position (word-initial, word-medial, or word-final). In the following we list some of these processes.

3.2.2.1 Word-medial consonantal weakening

In the MHG period, there were many processes of lenition in the word-medial position, sometimes also in the word-final position. Due to limited space, we will focus on the development of the OHG *t* (from the Germanic đ). Whereas it has remained *t* in the word-initial and the word-final positions, cf. NHG *Traube* 'grape', in the word-medial position it has been weakened to a *d*, cf. NHG *blindes* 'blind, neutr.sg.'

3.2.2.2 Contraction

In MHG, the weakening of word-medial consonants led to a series of contractions. In these cases, word-medial *b, d, g* and *h* were weakened until they disappeared, e.g. MHG *getregede* > *getreide* 'grain' or MHG *sëhen* > *sên*, NHG <*sehen*> [ze:.ən] 'to see'.

3.2.2.3 Development of sibilants

The MHG sibilants, predorsal /s/, /ss/ and apical /ʒ/ /ʒʒ/, began to merge in the 13th century. The articulatory difference inherited from OHG was replaced by a new distribution of sibilants licenced by word position. Therefore, the three sibilants [ʃ] (product of palatalisation), [z] and [s] mark the form of a pword. The word-initial position was limited to [z] (before a vowel) and [ʃ] (before a consonant) (cf. NHG *Sonne* [zɔnə] 'sun', *Straße* [ʃtʀa:sə] 'street'), whereas in word-final position [s] and [ʃ] was allowed, e.g. *Fuch*[s] 'fox', *Dur*[s]*t* 'thirst', *Hir*[ʃ]'hart'.

3.2.2.4 Word-final consonantal neutralisation (auslautverhärtung)

Although the details of the history of word-final consonantal neutralisation are very complicated, we can point to an observable development from no neutralisation in the OHG period to *auslautverhärtung* in NHG times (for details see Vaught 1977; Szczepaniak 2007). According to Auer (1994), NHG *auslautverhärtung* is not a uniform process but varies from region to region. Regarding the simple pword, we can very easily assign a prosodic function of pword-edge optimisation to *auslautverhärtung*. Hence, we pronounce a fortis [t] at the end of a pword, e.g. *Kind* [kɪnt], but a lenis [d] in the word-medial position, e.g. *Kinder* [kɪndɐ]. In morphologically complex words, we can observe a dependency of the consonantal quality on the direct environment, due to the lack of a pause between two pwords within a compound like Bil[d˥b]and 'picture book' (no release) or a derivative like re[d͜l]ich 'fair' (no *auslautverhärtung* at all; for details see Auer 1994, p. 75).

3.2.2.5 Word-final epenthetic consonants

A series of processes optimising the right edge of the pword can be observed in ENHG. The most important of them is the *t*-epenthesis. A historically unjustifiable dental occurs very frequently in ENHG at the right egde of a pword, whether within or at the end of a morpho-syntactic word:

(3) At the very end of a morpho-syntactic word

(a)	MHG *mâne*	>	ENHG *man<u>d</u>/mon<u>d</u>*	'moon'
(b)	MHG *nieman*	>	ENHG *niemand<u>d</u>*	'nobody' (lit. "no man")
(c)	MHG *ackes*	>	ENHG *ax<u>t</u>*	'axe'
(d)	MHG *selbes*	>	ENHG *selbs<u>t</u>*	'self'

(4) Within a morpho-syntactic word (before the suffix *-lich*)

(a)	MHG *ordenlîch*	>	ENHG *orden<u>t</u>lich*	'orderly'
(b)	MHG *eigenlîch*	>	ENHG *eigen<u>t</u>lich*	'actually'

3.2.2.6 Foot-initial consonantal aspiration

NHG consonantal aspiration is a process strengthening the left edge of monopedal pwords, e.g. *Panne* [[pʰaṇə]$_F$]$_\omega$ 'malfunction, breakdown', *Tanz* [[tʰan͜ts]$_F$]$_\omega$ 'dance', *kommen* [[kʰɔṃən]$_F$]$_\omega$ 'to come'. As aspiration is limited to the strong foot in a polypedal pword, it can be considered a phonetic marker of the whole word, indicating its most prominent part, [apʰʀiːl]$_\omega$ 'April', [aṭʰʀapə]$_\omega$ 'dummy', [aḳʰɔɐ̯t]$_\omega$ 'accord' (examples from Hall 1992, p. 54).

3.2.2.7 Word-final extrasyllabic consonants

Extrasyllabic consonants are those syllable-final consonants whose consonantal strength is lower (i.e. the sonority is higher) than that of the adjacent consonant to the left. In the history of German, there has been a considerable increase of such consonants, mostly as a result of vowel reduction. The one that occurs most frequently in this extrasyllabic position is [s], in the genitive singular

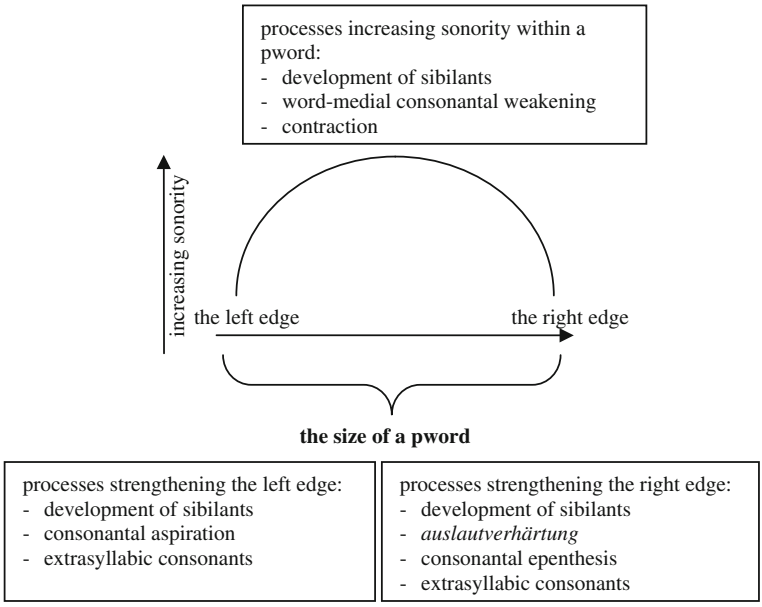

Fig. 3 Pword optimisation in the history of German

among other forms, and [t], in verbal forms of the 3.sg., e.g. *Flugs* 'flight, gen. sg.', *gibt* 'to give, 3.sg.pres.' (for details see Vennemann 1982, p. 297f.).

These processes have noticeably improved the form of the pword. The tendency has been to strengthen the edges of the pword by increasing consonantal strength and also by constructing very complicated word-final syllable codas, and to make the interior of the pword more sonorant by decreasing consonantal strength in the word-medial position; see Fig. 3 (for more details on the strategy of marking the pword, see Szczepaniak 2007).

Table 4 recapitulates what we have said about the optimisation of the pword in the history of German, as related to its typological shift from syllable language (OHG) to word language (MHG>ENHG>NHG):

Table 4 Pword optimisation in MHG and ENHG

Middle High German	Early New High German
• reduction of unstressed vowels • subsequent deletion of reduced vowels	• word-medial consonantal weakening • contractions • development of MHG sibilants • *auslautverhärtung* • consonantal epenthesis • extrasyllabic consonants
↑	↑
primarily processes regulating the size of a pword	primarily processes improving the form of a pword

3.3 Linking elements to improve the pword

In contemporary German, a pword usually starts with the stressed syllable followed by one reduced syllable. This monopedal structure is characteristic of almost all nominal simplexes. The quality of the pword worsens when the number of feet increases (e.g. through the addition of a derivational syllable bearing secondary stess) or when the pword does not start with the stressed syllable. The distribution and productivity of the linking elements are sensitive to the form of the pword.

The distribution of the no longer productive linking elements *-es-*, *-e-*, *-er-*, and *-(e)ns-* depends on the phonological size of the first constituent. They occur only after monosyllabic stems and thus produce trochees. Two productive linking elements—syllabic *-en-* and non-syllabic *-n-*—show a dependency on trochaic structure; see Sect. 2.1. Because processes optimising the size of the pword have been very strong since MHG, it is no surprise that former inflectional endings contained in compounds remained there as phonetic material to ensure that the form of the first component is trochaic, i.e. to optimise the size of the pword.

The non-syllabic *-s-* is the only element that has broken through trochaic constraints and evolved into a means of improving the form (the right edge) of the pword. It is the only linking element that makes a word-final syllable coda more complex. The highest degree of effectivity is achieved after plosives, where this linking element has the status of an extrasyllabic element. When it follows a liquid or nasal, however, it only affects the complexity of the coda. This also explains why a linking *-s-* never occurs after vowels, e.g. **Auto+s+bahn* (see Sect. 2.2). Hence, the linking *-s-* fulfills the same function as epenthetic consonants in ENHG: it strengthens the right edge of a pword as in *Betriebs-* 'company, occupational' (see Fig. 4). We therefore consider it a closing element, as it seals a pword completely.

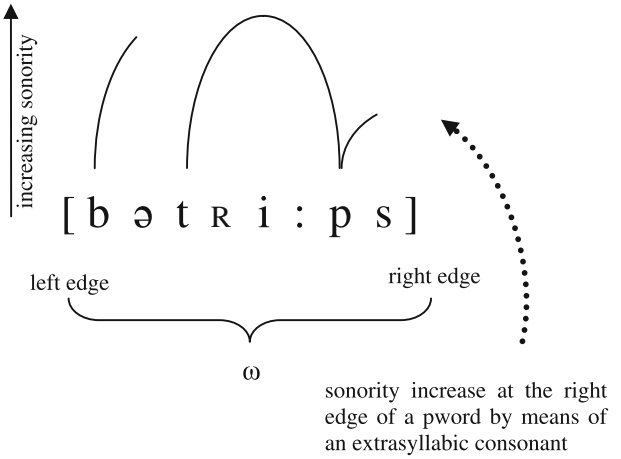

Fig. 4 The linking element's phonological function of marking the right edge of a pword

Thus, the occurrence and the increasing productivity of the linking *-s-* are conditioned by the degree to which a pword deviates from a monopedal, (mostly) trochaic form. This is indicated by our corpus-based analysis, which we will present below.[11]

3.3.1 Prefixed first constituents

Whereas the size of German simplexes—particularly nouns—does not exceed that of disyllabic, monopedal (i.e. trochaic) pwords (Eisenberg 1991), most morphologically complex words exhibit more complex phonological structures. As shown in Raffelsiefen (2000), German prefixes have different phonological structures. A monosyllabic prefix can constitute a phonological foot at best. It depends on the degree of vowel reduction: Only the prefix *ent-* does not undergo vowel reduction and always constitutes a phonological foot. The prefixes *ver-*, *er-*, and *zer-* can have the structure of a phonological foot or that of a phonological syllable depending on vowel quality. If one of these prefixes contains a full vowel, it constitutes a phonological foot, e.g. [fɛɐ̯]$_F$; if it contains a *schwa* it only constitutes an unparsed syllable <fɐ>, which is dominated by the pword including the lexical base that follows, e.g. *Vertrieb* 'marketing' [<*Ver*>[*trieb*]$_F$]$_\omega$.[12] The prefixes *be-* and *ge-* always contain a *schwa*. Thus, they each constitute an unparsed syllable <bə> and <gə>, e.g. *Beruf* 'profession' [<*Be*>[*ruf*]$_F$]$_\omega$ (for details see Raffelsiefen 2000, p. 47). The phonological structure of derivatives with a prefix of this kind differs very strongly from the trochaic ideal. They exhibit an ill-formed phonological structure, because the pword does not start with the strong foot, but with an unstressed syllable.

All other German prefixes such as *an-*, *auf-*, *aus-*, *bei-* *mit-*, *um-*, and *wider-* constitute separate pwords, e.g. *Anruf* 'telephone call' [*An*]$_\omega$[*ruf*]$_\omega$. Hence, we call them the pword-forming prefixes. The evidence for this is the vowel quality (tenseness), syllable structure, and stress pattern (see the discussion in Sect. 3.1 above). Consequently, the first constituent of a compound that contains a derivative with a prefix constitutes a pword of minor quality: [<bə>[RU:f]$_F$]$_\omega$ *Beruf* in *Beruf+s+name* 'profession—profession name'; it can also constitute two pwords as in [a:n]$_\omega$[RU:f]$_\omega$ *Anruf* in *Anruf+beantworter* 'telephone call—answering machine'. In contemporary German, we can observe a very strong tendency to add a linking element after those first constituents of a compound that contain a derivative with an unstressed prefix, like *Beruf* 'profession', whereas derivatives with stressed prefixes are predominantly unlinked (*Anruf*). We conducted a corpus-based investigation, in which we

[11] We used the largest corpus of written German (archive of written language, "W") in Cosmas II of the *Institut für Deutsche Sprache* in Mannheim (www.ids-mannheim.de), containing 1.105.545.477 words (mostly newspapers) at the time of research (March 2008).

[12] Here, the constraints of HEADEDNESS and EXHAUSTIVITY are violated (Hall 1999).

Table 5 List of first parts with unstressed and stressed prefixes considered in our corpus-based investigation

Unstressed prefixes		Stressed prefixes	
1. Bedarf	11. Geburt	1. Anfahrt	10. Überfall
2. Bedenken	12. Geduld	2. Anfang	11. Übergang
3. Befehl	13. Geflügel	3. Anrecht	12. Überleben
4. Bestand	14. Gelenk	4. Ansicht	13. Übermaß
5. Bezirk	15. Gesang	5. Aufsehen	14. Überschrift
6. Entgelt	16. Verbrechen	6. Aufsicht	15. Übersicht
7. Entscheid	17. Verbund	7. Aufstand	16. Umland
8. Entsetzen	18. Verdeck	8. Auftritt	17. Umtausch
9. Entwurf	19. Verfall	9. Aufzucht	18. Umwelt
10. Entzug	20. Verkauf		19. Umzug
	21. Zerfall		

Table 6 Occurrence of the linking *-s-* in prefixed first parts

	First parts with:	
	Unstressed prefix	Stressed prefix
Tokens	85% (of 495,887 compounds)	36% (of 324,503 compounds)
Types	82% (of 17,999 compounds)	37% (of 11,325 compounds)

considered all compounds with randomly chosen first parts, 21 of them with unstressed prefixes and 19 with stressed prefixes. They are listed in Table 5.

The first parts with unstressed prefixes, whose phonological structure strongly differs from that of a trochaic pword, are linked in 85% of the cases, whereas those with stressed prefixes occur only in 36% of the cases with a linking *-s-*. In sharp contrast, the majority of first parts with stressed prefixes are unlinked (64% of all instances). This relation applies to tokens as well as to types.

Thus, the occurrence of the linking *-s-* depends on phonological structure: Less well-formed pwords with unstressed prefixes almost regularly attract the linking *-s-*. The right egde of the pword is strengthened. This leads to an optimisation of the whole word, which deviates dramatically from the trochaic ideal. Derivatives with a stressed prefix, however, contain two phonological words, each of which is well-formed. Therefore, the frequency of the linking *-s-* after such derivatives is much lower. Hence, it is not morphological complexity that is crucial for the appearance of the linking *-s-* (see above in Sect. 2.4), but rather phonological complexity. Only this parameter explains the fact that the *s*-element occurs after derivatives with unstressed prefixes (*Beruf+s+*) more than twice as often as after those with stressed prefixes (*Anruf+*), as shown in Table 6. We will now look at how this also applies to derivatives with a suffix and compounds that occur as first parts.

3.3.2 Suffixed first constituents

The phonological structure of derivatives differs depending on the form of the suffix. On the one hand, German has vowel-initial suffixes that do not form a separate pword. Most of them are integrated into the pword of the lexical morpheme, e.g. *Les+er* 'reader' [[leː.zɐ]$_{F}$]$_{ω}$ (evidence: resyllabification and vowel reduction). Two native vowel-initial suffixes, *-ung* and *-in,* form a weak phonological foot each, as they each contain a full vowel, [ʊ] and [ɪ], respectively, e.g. *Staffelung* [[ʃtafl̩ə]$_{Fs}$[lʊŋ]$_{Fw}$]$_{ω}$. The main stress remains on the base. The suffix bearing a secondary stress makes the pword more complex. Its polypedal structure differs considerably from the trochaic ideal. In contrast, the Latinate suffixes *-ität* and *-ion*, which bear the main stress, each constitute a strong phonological foot. The complexity of the phonological structure in Latinate-suffixed derivatives is a result of the fact that the suffix forms the strong foot, while the lexical morpheme each constitute only one or more weak feet: [[*Natio*]$_{Fw}$[*nali*]$_{Fw}$[*tät*]$_{Fs}$]$_{ω}$, [[*Na*]$_{Fw}$[*tion*]$_{Fs}$]$_{ω}$. All of these suffixes (except for *-in*) require the linking *-s-*.[13] The strong deviation from the trochaic-pword ideal explains why the linking *-s-* occurs regularly after derivatives with suffixes that each constitutes a phonological foot.

German also has native suffixes that each constitute a separate pword: *-tum*, *-schaft*, *-sal*, *-heit*/*-*(*ig*)*keit*, *-ling*. Some of them are closing suffixes, i.e. suffixes that prevent further suffixation (see Sect. 2.6). In order to allow compounding, these suffixes need the linking *-s-*, e.g. *Frühling+s+gefühle* 'spring fever'. The suffix *-schaft*, although not a closing suffix, takes the linking *-s-*, e.g. *Wissenschaft+s+markt* 'science fair' (Aronoff and Fuhrhop 2002). The suffix *-tum* and the rare suffix *-sal* also require the linking *-s-* for compounding, e.g. *Eigentum+s+wohnung* 'freehold flat', *Schicksal+s+schlag* 'blow of fate'. All of these suffixes have pword status. Thus, unlike Aronoff and Fuhrhop (2002, p. 466), we believe that there is a strong connection between linking elements and prosodic wordhood. From our point of view, a linking element improves the form (as well as the size) of a pword by making or keeping it disyllabic (*Blume+n+stängel* [**bluːmən**]$_{ω}$[ʃtɛŋəl]$_{ω}$ 'flower stem') or by sharpening its right edge (*Eigentum+s+wohnung* [a͡ɪ̯gən]$_{ω}$[**tuːms**]$_{ω}$[voːnʊŋ]$_{ω}$ 'freehold flat'). The linking *-s-* in particular is an ideal phonological means to close the last pword of the first part entirely, thus allowing further composition.

We believe that the reasons for the different degrees to which affixes with pword status attract the linking *-s-* are the decreasing relative prominence structure of the whole (recursive) pword and the position of the affix. The second (less prominent) pword in a derivative, such as *-ruf* in *Anruf*, can also appear in a prominent position as the first part of a compound (*Rufmord* 'calumny') or as a simplex (*Ruf* 'telephone call'). In constrast, suffixes like *-schaft* are always less prominent pwords. Interestingly, exactly these pwords

[13] The suffix *-in* takes *-en*, e.g. *Freundinn+en+treff* 'girls' get-together', *Präsidentinn+en+rede* '(female) president's address'.

Table 7 List of compositionally complex first parts considered in our corpus-investigation

-bund	Völkerbund		Gastland		Mittelstand
	Geheimbund		Hochland		Wohlstand
	Sportbund	-leben	Menschenleben		Stillstand
-fahrt	Raumfahrt		Stilleben	-tritt	Fußtritt
	Kreuzfahrt	-maß	Längenmaß		Hahnentritt
-fall	Notfall		Mindestmaß	-welt	Halbwelt
	Wasserfall		Versmaß		Finanzwelt
-fang	Walfang	-recht	Asylrecht		Zauberwelt
	Fischfang		Baurecht		Traumwelt
-gang	Bildungsgang		Bürgerrecht	-wurf	Speerwurf
	Gehörgang	-schrift	Blindenschrift		Maulwurf
	Lehrgang		Lastschrift	-zucht	Notzucht
	Spaziergang		Maschinenschrift		Tierzucht
-kauf	Aktienkauf	-sicht	Klarsicht		Viehzucht
	Autokauf		Fernsicht	-zug	Nachtzug
-land	Bergland		Weitsicht		Reisezug
	Flachland	-stand	Messestand		Kreuzzug

exhibit a strong tendency to strengthen their right edges. They are, in fact, not ill-formed, but limited to a weak position (i.e. bearing the secondary stress).

3.3.3 Compounds as first constituents

Finally, our corpus-based analysis indicates that the probability of a linking *-s-* after a compositionally complex first constituent is comparable to that after derivatives with stressed prefixes (cf. Table 6). In both cases, the last constituent is a freely occurring morpheme (and a pword). Of the 2,934 compounds that we considered, the linking *-s-* occurs in 36% of the types and only in 21% of the tokens (27,552 instances). Again, it cannot be simply morphological complexity that governs the insertion of the linking *-s-* (see Sect. 2.4). If it were, a clear difference in the frequency of the *s*-element based on morphological complexity (derivatives vs. compounds) would be expected. Table 7 provides the list of all compositionally complex first parts considered in our corpus-based inverstigation.

3.3.4 Relation between the phonological structure of the first constituent and the linking -s-

The results clearly show that the productivity of the linking *-s-* is phonologically conditioned. It depends on the quality of the preceding pword. Both the form and the relative prominence of the last pword of the first part are crucial for the occurrence of the linking *-s-*. It optimises pwords with low quality (see Fig. 5). Thus, it attaches in a very regular manner to polypedal pwords (derivatives with *-ung*) and pwords occurring exclusively in less prominent positions (derivatives with *-tum*, *-schaft,* and so on). Furthermore, there is a strong tendency for the linking *-s-* to attach to pwords starting with unstressed

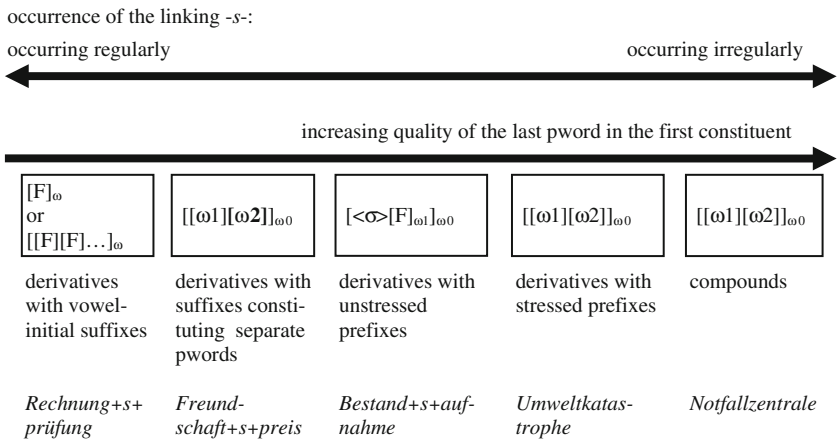

Fig. 5 The spread of the linking *-s-* as a pword marker

Table 8 Doubtful cases: morphological complexity of the first constituent[a]

Simplexes (foreign words)	Derivatives with stressed prefixes	Compounds
Praktikum(s)platz/ -stelle/ -bericht	*Ablaut(s)reihe*	*Denkmal(s)pflege*
Präteritum(s)-schwund	*Antrag(s)formular*	*Dreieck(s)tuch*
Seminar(s)arbeit	*Anwalt(s)beruf*	*Handwerk(s)gipfel*
Subjekt(s)pronomen	*Aufzug(s)vorrichtung*	*Sachstand(s)anfrage*
	Auslaut(s)verhärtung	*Schiffahrt(s)unfall*
	Ausschlag(s)richtung	*Seehund(s)jagd*
	Aufwand(s)entwicklung	*Sorgerecht(s)prozess*
	Einkauf(s)führer	*Festland(s)dialekte*
	Umbruch(s)geschichte	*Merkmal(s)analyse*
	Umlaut(s)bezeichnung	*Sprachwandel(s)phänomen*
		Widerrufrecht(s)belehrung

[a] Cases with the sequences of s+s (e.g. *Advent(s)singen*) or s+[ʃ] (e.g. *Einkommen(s)steuer* are excluded as in spoken German the linking s is supposed to be totally assimilated to the following sound.

syllables (derivatives with *ent-*, *ge-* and so on). Derivatives with stressed prefixes and compounds whose last pwords are not restricted to the less prominent position do not attract the linking *-s-* as strongly.

Therefore, it is no coincidence that the linking *-s-* is involved in many doubtful cases. In most of the examples provided by the *Duden-Sprachberatungsstelle* (Duden language advisory) in Mannheim,[14] the first part is a derivative with a stressed prefix or a compound (see Table 8). Here, the linking *-s-* is still not well established and therefore causes doubtful cases.

[14] We would like to express our gratitutde to Yvonne Goldammer, Franziska Münzberg, and Melanie Kunkel for providing us with many examples.

The productivity of the linking *-s-* as a marker of the right edge of a pword also applies to non-native words (cf. Nübling and Szczepaniak in press). In fact, derivatives ending in *-ität* or *-ion* always take the linking *-s-*. Among the doubtful cases, there are derivations with the foreign suffix *-um* that also tend to take the linking *-s-* due to their phonological complexity, e.g. [[pʀak.ti]$_{Fs}$[kum]$_{Fw}$]$_{ω}$. There are even instances of simplexes such as *Seminar*(*s*)- 'seminar' and pseudo-derivatives such as *Subjekt*(*s*)- 'subject' (see Sect. 2.4). All of these words are phonologically more complex than the prototypical (monopedal) German pword, e.g. *Blume* 'flower' [[blu:mə]$_{F}$]$_{ω}$ because they constitute polypedal pwords: [[zɛmi]$_{Fw}$[na:e̯]$_{Fs}$]$_{ω}$.[15] Thus, the benefit of the linking *-s-* for the deviant pwords is to strengthen their right edges. The hearer gets more support in correctly decoding the compound.

4 Conclusion

Linking elements are on their way from morphological units to phonological ones. Thus, there has been a diachronic downgrading from a higher, i.e. semantic-morphological, to a lower, i.e. phonological-prosodic, level in the sense of a form-orientated reorganisation of the distribution and function of these elements. Originally inflectional endings, linking elements have developed to something that lies between morphology and phonology. Their hybrid status can best be demonstrated by the fact that their occurrence is strictly dependent on the existence of compounds, i.e. their domain is, on the one hand, morphology—albeit no longer inflection but word formation. Their morphological function consists in the demarcation of the lexical units. The distribution of some linking elements, mainly *-en-, -er-,* and *-es-*, still depends on morphological characteristics such as gender and inflectional class. These elements are less dissociated from their ancestral forms than the most developed and most frequently occurring linking element *-s-*: It has broken free from its original (inflectional) restrictions by spreading to other noun classes without an inflectional *-s-,* particularly feminines. On the other hand, linking elements show prosodic and phonological properties: in many cases, they produce or preserve trochaic structures (c.f. *Bär+en+fell* vs. *Affe+n+fell* 'bear-skin' vs. 'ape-skin'). More importantly, the occurrence of linking elements, above all *-s-*, strongly depends on the quality of the preceding pword: The more distant it is from the ideal pword (i.a. a trochee, the second syllable containing [ə] or [ɐ]), the more probable a linking *-s-* becomes. The most deviant and therefore most complex pwords take *-s-* obligatorily, for example words with *-ung, -schaft, -heit, -ität*, many foreign words, and derivatives with unstressed prefixes, such as *Gesícht+s+punkt* 'viewpoint'. Our analysis of doubtful cases has shown that at present derivatives with stressed prefixes (*Umlaut*(*+s+*)*bezeichnung* 'umlaut labeling') increasingly tend to take *-s-*, as do compounds (*Dreieck*(*+s+*)*tuch* 'triangular bandage') and ill-formed foreign

[15] For more details see Nübling and Szczepaniak (in press).

words (*Subjekt*(+*s*+)*pronomen* 'subject pronoun'). Here, the linking *-s-* indicates an ill-formed phonological word and strengthens its right edge. In both cases, evidence for the morphological structure and for the borderline within the complex compound is available for the hearer. Thus, the behaviour of linking elements depends on morphological complexity only insofar as it leads to phonological complexity. From a typological perspective, the behaviour and development of linking elements strongly confirms (and supports) the typological change of German from a syllable language (OHG) to a word language (NHG).

Acknowledgements We would like to thank the reviewers for useful comments on an earlier version of this paper.

References

Alber, B. (2001). Regional variation and edges: Glottal stop epenthesis and dissimilation in standard and southern varieties of German. *Zeitschrift für Sprachwissenschaft, 20*(1), 3–41.

Aronoff, M., & Fuhrhop, N. (2002). Restricting suffix combinations in German and English: Closing suffixes and the monosuffix constraint. *Natural Language & Linguistic Theory, 20,* 451–490. doi:10.1023/A:1015858920912

Auer, P. (1994). Einige Argumente gegen die Silbe als universale prosodische Hauptkategorie. In K.-H. Ramers, H. Vater, & H. Wode (Eds.), *Universale phonologische Strukturen und Prozesse* (pp. 55–78). Tübingen: Niemeyer.

Auer, P. (2001). Silben- und akzentzählende Sprachen. In M. Haspelmath, et al. (Eds.), *Language typology and language universals. An international handbook* (Vol. 2, pp. 1391–1399). Berlin: de Gruyter.

Augst, G. (1975). Über das Fugenmorphem bei Zusammensetzungen. In G. Augst (Ed.), *Untersuchungen zum Morpheminventar der deutschen Gegenwartssprache* (pp. 71–155). Tübingen: Narr.

Baayen, H. R., Dressler, W. U., Krott, A., & Schreuder, R. Analogical effects on linking elements in German compounds. (Internet Homepage Baayen), (in press)

Booij, G. E. (1983). Principles and parameters in prosodic phonology. *Linguistics, 21,* 249–280.

Darski, J. (1996). Die Fugenelemente im Deutschen. In Sroka, K. (Ed.), Kognitive Aspekte der Sprache (pp. 49–55). Tübingen: Niemeyer.

Demske, U. (2001). *Merkmale und Relationen. Diachrone Studie zur Nominalphrase im Deutschen*. Berlin: de Gruyter.

Donalies, E. (2003). *Hochzeitstorte, laskaparasol, elmas küpe, cow's milk, casa de campo, cigarettefiltre, ricasdueñas*…. Was ist eigentlich ein Kompositum? In *Deutsche Sprache, 31*, 76–93.

Dressler, W. U., et al. (2001). The processing of interfixed German compounds. In G. Booij & J. Van Marle (Eds.), Yearbook of morphology 1999 (pp. 185–220), Dordrecht.

Duden Das große Wörterbuch der deutschen Sprache (Vol. 1–6). (1978). Mannheim: Dudenverlag.

Duden Das große Wörterbuch der deutschen Sprache (Vol. 1–10). (1999). Mannheim: Dudenverlag.

Duden Deutsches Universalwörterbuch (^{4}2001). Mannheim: Dudenverlag.

Duden Richtiges und gutes Deutsch. Wörterbuch der sprachlichen Zweifelsfälle (2001). Mannheim: Dudenverlag.

Eisenberg, P. (1991). Syllabische Struktur und Wortakzent. Prinzipien der Prosodik deutscher Wörter. *Zeitschrift für Sprachwissenschaft, 10,* 37–64.

Eisenberg, P. (2006). *Grundriß der deutschen Grammatik* (Vol. 1), Das Wort. Stuttgart: Metzler.

Fleischer, W., Barz, I. (1992). Wortbildung der deutschen Gegenwartssprache. Tübingen: Niemeyer.

Fuhrhop, N. (1996). Fugenelemente. In E. Lang & G. Zifonun (Eds.), *Deutsch—typologisch* (pp. 525–550). Berlin: de Gruyter.

Fuhrhop, N. (1998). *Grenzfälle morphologischer Einheiten*. Tübingen: Stauffenburg-Verlag.

Fuhrhop, N. (2000). Zeigen Fugenelemente die Morphologisierung von Komposita an? In R. Thieroff, et al. (Eds.), *Deutsche Grammatik in Theorie und Praxis* (pp. 201–213). Tübingen: Niemeyer.
Gallmann, P. (1998). Fugenmorpheme als Nicht-Kasus-Morpheme. In M. Butt, & N. Fuhrhop (Eds.), *Variation und Stabilität in der Wortstruktur* (pp. 177–190). Hildesheim: Olms.
Grimm, J. (1877). Deutsche Grammatik, 2. Teil. Gütersloh.
Hall, T. A. (1999). The phonological word: A review. In T. A. Hall & U. Kleinhenz (Eds.), *Studies on the phonological word* (pp. 1–22). Amsterdam: Benjamins.
Henzen, W. (1965). *Deutsche Wortbildung*. Tübingen: Niemeyer.
Kürschner, S. (2003). *Fugenelemente im Deutschen und Dänischen—eine kontrastive Studie zu einem Grenzfall der Morphologie*. Freiburg (Internet: www.freidok.uni-freiburg.de/volltexte/1256/)
Kürschner, S. (2005). Verfugung-s-nutzung kontrastiv: Zur Funktion der Fugenelemente im Deutschen und Dänischen. *TijdSchrift voor Skandinavistiek, 26*(2), 101–125.
Lindner, T. (1988). Zu Geschichte und Funktion von Fugenelementen in Nominalkomposita am Beispiel des Deutschen. In: *Moderne Sprachen* (Vol. 42, pp. 1–11).
Morciniec, N. (1964). *Die nominalen Wortzusammensetzungen in den westgermanischen Sprachen.* Wroclaw: Ossolineum.
Nespor, M., & Vogel, I. (1986). *Prosodic phonology*. Dordrecht: Foris.
Nübling, D., & Szczepaniak, R. (in press). *Religion+s+freiheit, Stabilität+s+pakt* und *Subjekt(+s+) pronomen*:Fugenelemente als Marker phonologischer Wortgrenzen. In P. O. Müller (Ed.), *Studien zur Fremdwortbildung.* Hildesheim: Olms.
Ortner, L., et al. (1991). *Deutsche Wortbildung. Typen und Tendenzen in der Gegenwartssprache* (Vol. 4). Substantivkomposita. Berlin: de Gruyter.
Paul, H. (1920). Deutsche Grammatik. Tübingen: Niemeyer.
Pavlov, V. (1972). *Die substantivische Zusammensetzung im Deutschen als syntaktisches Problem.* München: Max Hueber Verlag.
Pavlov, V. (1983). *Zur Ausbildung der Norm der deutschen Literatursprache im Bereich der Wortbildung* (pp. 1470–1730), Vol. 6: *Von der Wortgruppe zur substantivischen Zusammensetzung*. Berlin: Akademie-Verlag.
Plank, F. (1981). *Morphologische (Ir-) Regularitä*ten. Tübingen: Narr.
Ramers, K.-H. (1997). Die Kunst der Fuge: Zum morphologischen Status von Verbindungselementen in Nominalkomposita. In C. Dürscheid, et al. (Eds.), *Sprache im Fokus* (pp. 33–45). Tübingen: Niemeyer.
Raffelsiefen, R. (2000). Evidence for word-internal phonological words in German. In R. Thieroff, et al. (Eds.), *Deutsche Grammatik in Theorie und Praxis* (pp. 43–66). Tübingen: Niemeyer.
Szczepaniak, R. (2007). *Der phonologisch-typologische Wandel des Deutschen von einer Silben- zu einer Wortsprache*. Berlin: de Gruyter.
Vaught, G. M. (1977). *A study of Auslautverhärtung in Old High German*. Amherst, Mass.: University of Massachusetts.
Vennemann, T. (1982). Zur Silbenstruktur der deutschen Standardsprache. In T. Vennemann (Ed.), *Silben, Segmente, Akzent. Referate zur Wort-, Satz- und Versphonologie anlässlich der 4. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Köln* 2.-4. *März 1982* (pp. 261–305). Tübingen: Niemeyer.
Vogel, I. (1990). The clitic group in prosodic phonology. In J. Mascaró & M. Nespor (Eds.), *Grammar in progress. glow essays for Henk van Riemsdijk* (pp. 447–454). Dordrecht et al.: Foris.
Wegener, H. (2003). Entstehung und Funktion der Fugenelemente im Deutschen, oder: warum wir keine **Autosbahn* haben. In *Linguistische Berichte, 196,* 425–458.
Wegener, H. (2006). Statistical evidence for the role of phonology in the distribution and motivation of the linking element *-s-* in German. In *Pre-Proceedings of the International Conference on Linguistic Evidence, Empirical, Theoretical and Computational Perspectives, Tübingen, 2–4 February 2006* (pp. 201–203). Tübingen: SFB 441.
Wellmann, H., et al. (1974). Zur morphologischen Regelung der Substantivkomposition im heutigen Deutsch. *Zeitschrift für deutsche Philologie, 93*, 358–378.
Wiese, R. (1996). *The phonology of German*. Oxford: Clarendon Press.
Wilmanns, W. (1899). *Deutsche Grammatik, Bd. 2: Wortbildung*. Strassburg: Trübner.
Žepić, S. (1970). *Morphologie und Semantik der deutschen Nominalkomposita*. Zagreb: University of Zagreb.