



Universiteit  
Leiden  
The Netherlands

## **Cultural evolutionary modeling of patterns in language change : exercises in evolutionary linguistics**

Landsbergen, F.

### **Citation**

Landsbergen, F. (2009, September 8). *Cultural evolutionary modeling of patterns in language change : exercises in evolutionary linguistics*. LOT dissertation series. Retrieved from <https://hdl.handle.net/1887/13971>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/13971>

**Note:** To cite this publication please use the final published version (if applicable).

## Chapter 3

# The competitive exclusion principle in language: a case study of AN-combinations

### 3.1 Introduction<sup>1</sup>

In ecology, the notion that no two species can co-exist if they occupy the same niche is known as the *competitive exclusion principle* or *Gause's Law*. Based on laboratory experiments, Gause stated that 'as a result of competition two similar species scarcely ever occupy similar niches, but displace each other in such a manner that each takes possession of certain kinds of food and modes of life in which it has an advantage over its competitor' (Gause 1934: 19, cited in Chapman & Reiss 1999: 110). In other words, competition for the same niche either leads to extinction of one of the two species, or to some sort of differentiation so that both species come to occupy different niches.

With respect to language, a similar principle is known as the *isomorphism principle*. Like species, different forms with the same meaning (synonyms) or different meanings with the same form (homonyms) can be said to 'compete' with each other for the same resource. Hockett (1958: 399) writes: 'When two forms [...] are in competition, then the non-survival of one of them may simply be the negative aspect of the survival of the other. Of course, sometimes both survive indefinitely. When this happens, we usually find that some semantic distinction has arisen, so that, in effect, they have ceased to be in competition.'

An example is given by Keller (1994: 80-82), who discusses the German adjective *Englisch*. This word used to mean both 'angelic' and 'English', but the former use has disappeared from the language and has been replaced with *engelhaft*. In ecological terminology, two meanings, 'angelic' and 'English', were competing for the same niche, the form *Englisch*.

---

<sup>1</sup> I would like to thank Matthias Hüning and Barbara Schlücker, whom I collaborated with on this topic at the FU Berlin. I would also like to thank Michaela Poss for helping me with the German examples, and Ariane van Santen for helping me with the semantic characterization.

Another example deals with the name that had to be given to the mobile phone, which came into general use in the last decade. In Dutch, two words, *gsm* and *mobiele telefoon* (abbreviated as *mobiël(tje)*), were initially used for the object, but recently, the latter form seems to have become the general word of reference.<sup>2</sup> This means that, in the competition for the niche of the name for the object ‘mobile phone’, the form *mobiël(tje)* has survived at the cost of the form *gsm*.

Finally, Dutch had two verbs that meant ‘to throw’ at a certain point in time, *gooien* en *werpen* (Van Bree 1996: 112). However, contrary to the previous example, no extinction of one of the two forms occurred. Instead, semantic differentiation took place, and both verbs now still mean ‘to throw’, but occupy different registers: *gooien* is standard whereas *werpen* has a more formal use.

‘Competition’ of two words is the result of the behavior of individual language users, who base their choice of variants on factors such as the entrenchment of both words and the probability of successful communication. As was noted by Hockett, competition of variants arises in such a situation, because high values (e.g. of entrenchment) for the one necessarily leads to low values for the other variant.<sup>3</sup>

The principles of competitive exclusion and of one form-one meaning both imply that equilibrium states, in which two variants live in free variation in the same niche, are uncommon. If such a case occurs, it is therefore interesting to study it in more detail and to try to come up with explanations for its presence: what are conditions under which an equilibrium between two competing forms can exist over a considerable amount of time, without a change in the mechanisms that mostly lead to the extinction of one of two competing forms?

One such case in language is that of adjective-noun combinations, which appear in many of the Germanic languages. These combinations can appear as both compounds, such as English *widescreen* (single words, with stress on the adjective), and phrases, such as English *full moon* (separate words, with stress on the noun). Both forms occupy the same linguistic ‘niche’ in that they are both category names. However, they seem to be in state of equilibrium in that both forms are productive, not just in English but also in German and Dutch and other Germanic languages as well.

---

<sup>2</sup> Interestingly, the ‘surviving’ word differs across languages: *cell phone* in American English, *mobile* in British English and *Handy* in German. See also: [http://en.wikipedia.org/wiki/Mobile\\_phone\\_terms\\_across\\_the\\_world](http://en.wikipedia.org/wiki/Mobile_phone_terms_across_the_world).

<sup>3</sup> With regard to isomorphism, Croft (2003: 105-106) provides another explanation by using the interplay between the factors *economy* and *iconicity*: synonymy is not iconically motivated because it lacks a one-to-one mapping between words and meanings, nor is it economically motivated: it is superfluous for communication. For both homonymy and monosemy, one of the two factors is not motivated. Polysemy on the other hand is more likely to occur because it is both iconically and economically motivated: several meanings are shared by a single form (economy) and these meanings are related (iconicity).

These adjective-noun (AN) combinations and their equilibria in German, Dutch and English are the topic of the present chapter. I will start by discussing their presence in the three languages in more detail. This will show that within the main type of ‘AN-names’ three semantic subtypes can be distinguished, and that free variation of compounds and phrases only occurs in one the three subtypes. Based on this finding, I argue that this particular distribution can explain the equilibria in the three languages. I will present a computer model in which I simulate the case of AN-names to support this claim.

### 3.2 AN-combinations in Dutch, German and English

Compounds that consist of an adjective and a noun have a specific function, which is described by Booij (2002: 313) for Dutch as providing ‘names for a relevant class of entities’. Examples of Dutch AN-compounds are *zuurkool* ‘sauerkraut’ and *kleingeld* ‘small change’. These compounds are not descriptive: they do not refer to any *kool* ‘cabbage’ that is *zuur* ‘sauer’ or any *geld* ‘money’ that is *klein* ‘small’, but to specific categories of cabbage and money instead. Such compounds exist in German and English as well; examples are *Vollmilch* ‘whole milk’ and *grandchild*.

Whereas compounds are blocked from having a descriptive function, another type of AN-combination exists for which such a restriction does not hold. These are AN-phrases, which can appear both as descriptions and as category labels. In general, phrases are descriptive, as they are a syntactic pattern in which an adjective specifies a noun. Of this type, an almost infinite number of examples could be given: *kleine jongen* ‘little boy’, *rode muur* ‘red wall’, *zure smaak* ‘sour taste’, etc. However, there is a small subset of these phrases which serve as category labels and can be said to have name function. Dutch examples are *vrije trap* ‘free kick’, *rode kool* ‘red cabbage’ and *harde schijf* ‘hard disk’. Like compounds, their meaning is not simply compositional: a *harde schijf* does not refer to any disk that is hard, but to a particular kind of data storage in a computer. And even when both adjective and noun have literal meaning, like in *rode kool* ‘red cabbage’, the phrase as a whole does not refer to any cabbage that is red, but to a particular category: a type of cabbage with a reddish (actually a purple) color (with the Latin name *brassica oleracea* (var. *rubra*)).

This last type of phrase is generally referred to as a ‘lexicalized phrase’, because it has to be listed in the lexicon. As Booij (2002: 313) puts it: ‘They are conventional, established names for [...] entities, and [have] unpredictable meaning aspects.’ Like AN-compounds, lexicalized AN-phrases also exist in German and

English: *saure Sahne* ‘sour cream’, *kalter Krieg* ‘cold war’, *whole milk* and *free market*.

### *Characteristics of lexicalized AN-phrases*

The lexicalized status of AN-phrases can be shown in several ways. The list below is a summary of characteristics given in several different studies (Bloomfield 1933: 232, Marchand 1969, De Caluwe 1990: 17, Booij & Van Santen 1998: 37, Booij 2002: 314, Hüning 2004: 162-163).

- 1) The adjective and the noun of lexicalized phrases cannot be separated.

General phrase	<i>the red hard brush</i> <i>the hard red brush</i>
Lexicalized phrase	<i>the red hard disk</i> <i>*the hard red disk</i>

- 2) The adjectives in lexicalized phrases are not gradable.

General phrase	<i>the high salary</i> <i>the highest salary</i>
Lexicalized phrase	<i>the high season</i> <i>*the highest season</i>

- 3) Lexicalized phrases are not semantically compositional.

General phrase	<i>a small car</i> = a car that is small
Lexicalized phrase	<i>small change</i> ≠ change that is small

- 4) Lexicalized phrases have single stress on the noun.

General phrase	<i>We are putting réd cárpet in our living room.</i>
Lexicalized phrase	<i>Congress should cut the red tápe.</i>

In Dutch, the special status of lexicalized phrases also shows in the inflection of adjectives used with nouns with neuter gender. Normally, these adjectives show compulsory differences in inflection for definite and indefinite use:

- 5) a. *het dikke boek* ‘the big book’  
b. *een dik boek* ‘a big book’

For lexicalized phrases, this difference in inflection of the adjective is much less straightforward. Hüning (2004: 166) shows that there is great variability in the use of this type:

form	Google hits (January 2004)
<i>het stoffelijk overschot</i>	4050
<i>een stoffelijk overschot</i>	552
<i>het stoffelijke overschot</i>	169
<i>een stoffelijke overschot</i>	0

**Table 1.** The frequencies of different uses of *stoffelijk overschot* ('mortal remains') (source: Hüning 2004: 166). The 'correct' inflection is highlighted in grey.

The data in table 1 shows that the compulsory inflectional differences in (5) are not present in a lexicalized phrase like *stoffelijk overschot*. For the definite use of the phrase, two variants occur, with the 'incorrect' one having the highest frequency. According to Hüning, the reason for this is that speakers have a preference for names to have a fixed form (Hüning 2004: 165). In this case, the uninflected form of the definite use is preferred over the inflected form. This tendency for a fixed form makes it possible to distinguish lexicalized phrases from 'ordinary' phrases:

- 6) a. Ordinary phrase: *het centrale station*  
'the station that is centrally located'
- b. Lexicalized phrase: *het centraal station*  
'the main station in a city'
- 7) a. Ordinary phrase: *het oude papier*  
'the paper that is old'
- b. Lexicalized phrase: *het oud papier*  
'the old paper used for recycling'

Another indication that lexicalized phrases are treated as units is that they are often spelled as a single word. Hüning (2004: 167) shows this for *oudpapier*, but it can also be shown with phrases like *rode kool* 'red cabbage' and *blinde darm* 'blind gut'. As can be seen in table 2, both single-word forms are used quite frequently, and the single-word form *blindedarm* is even used more frequently than its two-word counterpart.<sup>4</sup>

<sup>4</sup> The Dutch dictionary *Van Dale* (1999) even uses the single-word *rodekool* as its lemma.

form	Google hits (February 2007)
<i>rodekool</i>	27,700
<i>rode kool</i>	170,000
<i>blindedarm</i>	43,300
<i>blinde darm</i>	28,000

**Table 2.** The frequencies of different uses of Dutch *rode kool* and *blinde darm*. The ‘correct’ spelling is highlighted in grey.

Despite this complication, Dutch phrases can typically be distinguished from compounds by their orthography, and the same holds for German. Although there will inevitably be certain exceptions to this generalization, it holds for the characterization of most compounds and I will therefore use it in the categorization following below. For English, however, spelling cannot always be used as a decisive factor. The Longman reference grammar states that ‘practice varies as to whether to represent a compound as two orthographic words, one unbroken orthographic word, or a hyphenated word.’ (Biber, Johansson, Leech, Conrad & Finegan 1999: 326). Because of this, stress is often proposed as deciding factor (cf. Marchand 1969: 22, Booij 2002: 313): compounds have stress on the adjective (*highway*, *blackbird*), phrases on the noun (*cold war*, *black box*). This means that *hard disk* is defined as a compound, because of its stress on *hard*, and not as a phrase because it is written as two separate words. As for orthography in Dutch and German, it should be noted that the use of stress to categorize certain English compounds is a generalization that will also have its exceptions. However, it is useful for the purpose of obtaining a general classification of compounds and phrases as I do in this study.

AN-phrases do not seem to have any a priori restrictions on the adjectives and nouns that can be used. In this sense they differ from compounds, that have a very strong preference for monomorphemic or even monosyllabic adjectives (Marchand 1969: 64, Bauer 1983: 91, Erben 2000: 43, Donalies 2002: 70, both cited in Hüning 2004: 161-162). Still, Dutch allows comparative forms like *Lagerhuis* ‘House of Commons, lit. ‘lower house’, and *meerwaarde* ‘surplus value’ lit. ‘more value’ (Haesereyn, Romijn, Geerts, De Rooij & Van den Toorn 1997: 691), and German allows superlative forms like *Schwerstarbeit* ‘very heavy work’ lit. ‘heaviest work’, *Höchstpreis* ‘very high price’ lit. ‘highest price’ (Hüning 2004: 162). According to Marchand (1969: 64), the adjectives in English compounds typically denote color, dimension, taste or touch. Although it is hard to prove, it seems that this tendency holds for phrases as well, and can be generalized to Dutch and German.

*Semantic subtypes among AN-combinations*

So far, I have considered AN-compounds and -phrases as a uniform type, without addressing the question whether any variation is present among them. On the semantic level, this indeed seems to be the case. Example (8) lists a few Dutch compounds and phrases to illustrate this.

- 8) a. *sneltrein* ‘fast train’, *volle melk* ‘whole milk’  
 b. *blauwe maandag* ‘very short period’ (lit. ‘blue monday’), *linke soep* ‘risky business’ (lit. ‘risky soup’)  
 c. *dwarskop* ‘stubborn person’ (lit. ‘stubborn head’), *wijsneus* ‘know-it-all’ (lit. ‘wise nose’)

The ‘standard’ AN-names I have discussed are those in (8a), with a noun with a specifying adjective: a *sneltrein* is a kind of *trein*, and *volle melk* is a kind of *melk*. Although these combinations are semantically transparent with respect to their heads, this is not the case for the specifying adjective; a *sneltrein* is not a *trein* (‘train’) that is just *snel* (‘fast’), but a particular type of train service (serving only major stations). *Volle melk* is not *melk* (‘milk’) that is *vol* (‘full’), but a special type of milk (with a relatively high percentage of fat). I will refer to this type of name as ‘endocentric’ in the usual definition found in e.g. Bloomfield (1933: 235), Bauer (1983: 30) and Van Sterkenburg (1993: 132-133).<sup>5</sup> Note that endocentric names as a whole can also be used metaphorically, as in *heilige koe* ‘car’ (lit. ‘sacred cow’) and *koude douche* ‘rude awakening’ (lit. ‘cold shower’). I will consider these examples endocentric as well, because they are endocentric in their literal interpretation.

The examples in (8b) differ from those in the first group in that their meaning is semantically opaque. A *blauwe maandag* is not a kind of Monday, and *linke soep* is not a kind of soup. It is also not the case that the phrase as a whole has a metaphorical meaning, like in the endocentric *koude douche*, because literally, *blauwe maandag* and *linke soep* do not mean anything. Although it is possible that some interspeaker variation might occur in these cases, it can generally be stated that for most users, these phrases are (no longer) semantically transparent, and I will refer to this type as ‘exocentric’ (see citations above).

The third group is similar to the second group with regards to the head, which is semantically opaque: A *wijsneus* is not a *neus* (‘nose’) that is *wijs* (‘wise’), but a person who is (too) wise, and a *dwarskop* is not a *kop* (‘head’) that is *dwars* (‘stubborn’). For this reason, this type is usually grouped together with the exocentric examples, and is often referred to as a *bahuvrihi compound* (Quirk,

<sup>5</sup> Van Sterkenburg refers to ‘endosemantic’ instead of ‘endocentric’, and ‘exosemantic’ instead of ‘exocentric’.

Greenbaum, Leech & Svartvik 1972: 1026). However, the reason I distinguish this type from the group of exocentric combinations is that their meaning, albeit opaque, is not completely unpredictable: they always refer to a person with a specific property. The noun has a metonymical meaning; instead of referring to a person, a body part is used. I will refer to these combinations as ‘metonymic’.

All three subtypes, endocentric, exocentric and metonymic, appear in the AN-combinations of the three languages, German, Dutch and English. Examples of Dutch were given above, and (9) lists some examples in German and English.

9) Examples of semantic subtypes in German and English

endocentric:	<i>Dunkelkammer</i> ‘dark room’ <i>cold war</i>
exocentric:	<i>grüne Welle</i> ‘phased traffic lights’ (lit. ‘green wave’) <i>cold turkey</i>
metonymic:	<i>Dummkopf</i> ‘dumb person’ (lit. ‘dumb head’) <i>fatass</i>

There do seem to be both certain tendencies in the distribution of the two forms across these semantic subtypes, and different distributions across the three languages, which I will discuss next.

*Differences in productivity across German, Dutch and English*

As for both forms, compounds and phrases, there is general consensus for German that they are fully productive (De Caluwe 1990: 16, Booij 2002: 315, Hüning 2004: 161-162). This is also the case for Dutch phrases, but there is sometimes doubt about the status of Dutch compounds because they are believed to be ‘germanisms’ (loan words from German, e.g. Van Lessen 1928: 63). The general view, however, is that Dutch compounds, like phrases, are productive (De Caluwe 1990: 14, Haesereyn et al. 1997: 691) and I will follow this view in this study. The status of compounds in English is not totally clear. According to Longman’s reference grammar (Biber et al. 1999: 327), compounding is productive. On the other hand, Marchand (1969: 63) claims that this form ‘has probably ceased to be productive’, and Booij (2002: 315) follows this view. So, what is correct? Longman’s reference grammar (Biber et al. 1999: 227) gives some results of a corpus study of spoken and written English, to show that the form is productive. However, the examples given are *highway* and *grandmother*, and these words date back from earlier times, according to Marchand (1969: 63). He states that ‘in the last 100 years there appear to be only the words *strongpoint* (a military term) and *strongman* (chiefly political)’ (Marchand 1969: 64). The word *software* could be added here, since its first

attestation in the Oxford English Dictionary is from 1960. Its counterpart *hardware* is first found in the sixteenth century (Marchand 1969: 63), with the meaning ‘small ware or goods of metal’ and *software* could have been created by analogy. The question is, however, if creation by analogy should be interpreted differently from productivity, because both processes describe the creation of a new form based on existing forms with the same structure. Apart from *software*, other recently added compounds are *high definition* and *flatscreen*. Taken all this in consideration, I assume compounding to be productive in English, yet only marginally when compared to phrases.

Turning to the semantic subtypes, I mentioned earlier that all three of them (endocentric, exocentric, metonymic) are present in the three languages, but that there seem to be certain tendencies in their distributions. A first tendency is that exocentric meaning seems to be restricted to phrases in all three languages: *grüne Welle*, *böses Blut* ‘bad blood’ (lit. ‘angry blood’) (German), *blauwe maandag*, *rode draad* ‘connecting theme’ (lit. ‘red thread’) (Dutch), *cold turkey*, *red tape* (English). The only exception that I have found in the studies mentioned throughout this chapter is the Dutch exocentric compound *koudvuur* ‘gangrene’ (lit. ‘cold fire’). This compound dates back to at least 1557 (*WNT*).<sup>6</sup> Of course, I do not rule out the existence of exocentric compounds in English and German, but I do believe it is safe to say there is at least a very strong preference for exocentric meaning to appear in phrases. An explanation for this tendency could be that the adjective and the noun that together constitute the name both have their own separate semantics, and that this is not possible when they are part of a compound.

Similarly, metonymic meaning seems to be restricted to compounds: *Bleichgesicht* ‘paleface’, *Dummkopf* ‘stupid person’ (lit. ‘stupid head’) (German), *bleekneus* ‘paleface’ (lit. ‘pale nose’), *dwarskop* ‘stubborn person’ (lit. ‘stubborn head’) (Dutch), *egghead*, *loudmouth* (English). Again, it is impossible to claim that no metonymic phrases exist, mainly because there are currently no exhaustive lists of lexicalized (AN-)phrases in the three languages. Still, it is safe to say that there is at least a strong tendency for metonymic compounding.

---

<sup>6</sup> Interestingly, the *WNT* also mentions that, prior to the compound *koudvuur*, the phrase *dat quade vier* was used in Middle Dutch.

	<i>Compounds</i>	<i>Phrases</i>
<i>German</i>	Altpapier Breitbild Dickdarm Doppeltür Edelgas Fremdsprache Geheimschrift Hartholz Hochsaison Kleingeld Neumond Rotwein Schnellzug Vollmilch	freier Markt gelbes Trikot kalter Krieg saure Sahne
<i>Dutch</i>	breedbeeld edelgas geheimschrift hardhout hoogseizoen kleingeld sneltrein	oud papier dikke darm dubbele deur vreemde taal nieuwe maan rode wijn volle melk vrije markt gele trui koude oorlog zure room
<i>English</i>	wide-screen hardwood small change fast train	old paper large intestine double door noble gas foreign language secret code high season new moon red wine whole milk free market yellow jersey cold war sour cream

**Table 3.** A list of 18 endocentric compounds and phrases in German, and their translations in Dutch and English.

Endocentric meaning can be considered to be the ‘basic’ semantic subtype, not only because it is regular but also because it outnumbers metonymic and exocentric names. Contrary to these last two subtypes, there does not seem to be a clear tendency in the distribution of compounds and phrases for endocentric meaning. Table 3 lists examples of both forms in the three languages. The first conclusion that can be drawn on the basis of this table is that endocentric meaning indeed appears in both forms across German, Dutch and English. Second, as to the relative distribution of both forms in the three languages, this is not so easy to determine from the table alone; eighteen examples of German compounds and phrases are listed, and their respective translations in Dutch and English. While the table shows that both Dutch and English use phrases for some of the German compounds, it also suggests a stronger preference for phrases in English when compared to Dutch. Although this picture is based on a low number of examples, it is in fact supported by the image that emerges from reference grammars and different studies on the topic (cf. De Caluwe 1990, Haesereyn et al. 1997, Biber et al. 1999, Booij 2002, Hüning 2004).

Thus, while the *exact* distributions of both forms might not have been determined for any of the three languages, it is evident *that* their distributions differ. And the question how this is possible, is the topic of this chapter.

#### *Selection pressures at work across compounds and phrases*

Whereas compounds only have a naming function, phrases exist both as descriptions (as in ‘the red car’) and as names. It might seem strange that, in a system in which the naming function is already performed by compounds, how phrases can acquire a naming function altogether. However, there are a number of possible reasons, and I will discuss these here in short.

A first reason is given by Hüning (2004: 168). He argues for German that phrases such as *kleine Zeh* ‘little toe’ and *grüne Welle* ‘phased traffic lights’ (lit. ‘green wave’) can serve as names and continue to serve as such, because they are ‘protected’ by their frequency and their semantics respectively. *Kleiner* and *Zeh* occur together with such a high frequency that this makes the combination sufficiently recognizable as a name. In the case of *grüne Welle*, we are dealing with a combination of A and N that does not make much sense when interpreted literally. This means that the concept is sufficiently recognizable as a name because of its semantics, despite its lack of a fixed form. Other examples of such phrases are *Heilige Kuh* ‘car’ (lit. ‘sacred cow’, *Doppelter Boden* ‘hidden meaning’ (lit. ‘double bottom’) and *Kalter Krieg* ‘cold war’.

A second reason is that a group of phrases exists that has a ‘protected status’. The reason is that AN-compounds (at least in the West-Germanic languages) only allow for monomorphemic adjectives; consequently, combinations such as

*brennende Frage* ‘burning question’ and *generative Grammatik* ‘generative grammar’ have to appear as phrases, and do not compete with compounds.

The above can be described as mechanisms that allow for a steady addition of phrases to the class of AN-names besides compounds, and as such as a selection pressure for phrases, at least under certain conditions. However, there is another possible selection pressure that is working against phrases. This selection pressure has to do with the presence of a case system and the resulting variability of the phrase form.

Hüning (2004: 165) argues that names are characterized as fixed form-meaning combinations. When a combination starts to become used more and more commonly as a name, the ‘need’ to give this combination a fixed form increases. In German, compounds have a fixed form, while phrases do not because of the case system. Hüning (*ibid.*) illustrates this by means of the compound *Dünndarm* (‘small intestine’); as a phrase, this would have to exhibit a considerable amount of formal variation in different cases, as shown in the following example:

- 10) a. der *dünne Darm* machte ihm Schwierigkeiten  
 b. ihm wurde sein *dünnere Darm* entfernt  
 c. er wurde an seinem *dünnen Darm* operiert  
 d. die Entfernung seines *dünnen Darms*

According to Hüning, this variability in form of phrases in German is the reason that for names, compounds are generally preferred over phrases. Because phrases have no such variability in English, there is no preference to use compounds. Dutch takes a middle position in this respect, in that phrase forms are mostly, yet not always, invariable. Only adjectives that are combined with neuter nouns show an inflectional difference between definite and indefinite use, as shown in (11), while the form of the adjective with common gender nouns is constant (cf. (12)):

- 11) a. Het wilde zwijn                    ‘the wild boar’  
 b. Een wild zwijn
- 12) a. De gele kaart                    ‘the yellow card’  
 b. Een gele kaart

In summary, there are opposing selection pressures present in the system of AN-names: on the one hand, phrases can acquire and retain a naming function because of frequency and special semantics, as well as allowing multi-morphemic adjectives. On the other hand, phrases may be selected against because of greater variability in its form.

Above, I have described the contours of a system in which two forms, compounds and phrases occur in a single niche, that of category naming. Within this niche, three semantic sub-niches can be distinguished. Finally, there are two opposing selection pressures at work within the system. The next question is whether this system can indeed lead to the different equilibria that are found in German, Dutch and English. This can be tested by using a computer model that simulates such a system, which I will do in the next two sections.

### 3.3 The model

The dynamics of two kinds of AN-combinations, compounds and phrases, can be studied with an agent-based computer model. Such a model is able to simulate a complex system at the population level by reducing it to a series of algorithms that direct the behavior of the individuals, or agents, within that population. Thus, it is possible to study the unintended effects of intentional, individual behavior (cf. Keller 1994), and therefore, these models are generally used in different fields of historical linguistics (e.g. De Boer 2001, Steels 2003, Brighton, Smith & Kirby 2003 on the transition to language, Niyogi & Berwick 1997 on language change, Nettle 1999 on language variation).

In the model I present here, the linguistic knowledge of a population of agents consists of AN-names. These names correspond to the category names that I have described in the previous section: combinations of an adjective and a noun, such as *full moon* and *hardwood* in English. Each name is represented by a unique random number in the model, and there are 10.000 different names in the ‘name pool’. Each of these names can have either of two forms: compound (c) or phrase (p). This form is not assigned to a name right away; the agents themselves ‘choose’ a form for a name when they bring a new name in the simulation (called the innovation process), and this ‘choice’ depends on their knowledge of compounds and phrases at the time of innovation. Apart from this, the assignment of form to a name that enters the simulation at any particular time also depends on two other mechanisms, which I will explain later. In short, the relative number of compounds and phrases in the population will vary throughout the simulation, and we can explore what factors affect this number.

#### *Initialization and basic set-up of the model*

The population consists of a group of 100 agents and this group does not change throughout the simulation. Agents do not reproduce or die: this factor is left out of the simulation in order to keep the model simple. The changes in the model appear

as changes within the knowledge of a non-changing population. In other words, the knowledge of agents is continuously prone to change, as it is based on their actual linguistic experience.

At the start of the simulation, all agents in the population are given the same initial 100 names. These names are all compounds: I take compounds as the default form for names (since words have compulsory name function, and phrases do not).

Agents are involved in a series of communication acts, in which a randomly selected speaker utters an AN-name to a randomly selected hearer. The hearer, in turn, stores the perceived AN-name in its memory. This process is then iterated. In total, the simulation is run for 10,000 iterations, and in each iteration, each agent is involved as the speaker in 100 communication acts on average.

An agent who is selected as speaker in a communication act will have to select a name to transmit to the hearer. By default, the speaker will select a random name from its memory. This memory consists of 100 slots in which the most recently perceived names are stored. When an agent is the hearer, the oldest name in memory is removed and replaced by the new name (as a result, more frequent names have a higher chance of remaining in memory for a long time). This representation of memory is, of course, a simplification. However, it remains a fairly realistic way to simulate one of the main axioms of usage-based approaches to language, namely that individuals are continuously sensitive to linguistic experience (e.g. Pierrehumbert 2001, Baxter et al. 2006, Bybee 2006, Wedel 2006, Baxter et al. to appear).

### *The three main parameters of the model*

The model has three main parameters that can all have a possible effect on the relative number of compounds and phrases in the population, and whose effect I will discuss in the results section. These parameters are the probability of innovation ( $m$ ), the probability that descriptive phrases turn into lexicalized phrases ( $\varphi$ ) and variability in form of phrases ( $\nu$ ).

Innovation in the model is the creation of a new name by a speaking agent. The parameter  $m$  gives the probability that, in communication, a speaker will create a new name instead of selecting an existing name from memory. For example, if  $m = 0.05$ , this means that in each communication act, there is a chance of 0.05 that a speaker will not select a name from memory, but create a new one.

In the creation process, the speaker uses its present knowledge to decide on the form (compound or phrase) of the new name. The probability of each form is simply based on its type frequency in the speaker's knowledge. In other words, the relative number of instances of a form is a measure for the probability that a newly created name will have that particular form. For example, if a speaker has 80

compounds and 20 phrases in its memory, the probability  $p_f(c)$  of creating a compound name is  $80 / (20+80) = 0.8$ , while the probability of creating a phrase  $p_f(p)$  is  $20 / (80+20) = 0.2 (= 1 - 0.8)$ . This is shown in equation 1.

$$p_f(c) = \frac{\sum c}{\sum c + \sum p}$$

$$p_f(p) = 1 - p_f(c)$$

**Equation 1.**

As for the other two parameters, I mentioned in the previous section that there are opposing selection pressures at work in the system of AN-compounds and -phrases. First, descriptive phrases can turn into lexicalized phrases with name function (such as *kleine Zeh* ‘little toe’). This process is represented in the model by a parameter  $\varphi$ , which gives the probability that a new name with phrase form is introduced in the population. The introduction of such a new phrase is done by a speaker during communication. For example, if  $\varphi = 0.001$ , this means that during each communication act, there is a probability of 0.001 that a speaker will be assigned a new name with phrase form and utter this to the hearer.

The second selection pressure in the system of AN-names that I discussed above has to do with the variability in form. This variability occurs in phrases as a consequence of the case system, and is said to be acting as a pressure against phrases, in favor of compounds. It is represented in the model by a parameter  $\nu$ . This parameter gives the probability that, when a speaker creates a new name and this name is a phrase, it will change its form into a compound. A language with an elaborate case system like German will arguably have a higher value for  $\nu$  than a language like English, in which the case system has disappeared completely when it comes to form variability of adjectives. Note that these are *relative* differences with regard to this parameter: in order to assign absolute values to a parameter such as  $\nu$ , a much more elaborate study of each language would be required.

A restriction to the parameter  $\nu$  is that an agent must have compounds in its memory in order to be able to change a newly created phrase into a compound. After all, it must have the knowledge that compounds can also be names. Thus, the parameter  $\nu$  only applies when the type frequency of compounds in the speaker’s memory is greater than 0.

The preference to create compounds over phrases is not solely dependent on the amount of phrase variability; it also partially dependent on the knowledge of compounds and phrases of the agent who is to create a new name. In the model, the

‘strength’ with which a particular form is linked to the function of being an AN-name is based on the relative number of that form within the agent’s memory. Therefore, the relative number of phrases in an agent’s memory should affect the probability of creating a compound over a phrase. This is modeled by linking the parameter  $\nu$  to the type frequency of phrases in the agent’s knowledge: the greater the relative number of phrases ( $f_p$ ), the smaller the impact of parameter  $\nu$ . The parameter  $\nu'$  gives the actual probability of a newly created phrase to turn into a compound.

$$\nu' = (1 - f_p) \cdot \nu$$

**Equation 2.**

### *Enabling semantic subtypes*

In the basic model described above, agents only have knowledge of the *form* of the names in their memory. The model can be extended with the addition of meaning, in which case a particular type of meaning is assigned to each name. There are three possible meaning types,  $m_1$ ,  $m_2$ , and  $m_3$ , which represent the subtypes endocentric, exocentric and metonymic that were discussed in the previous section.

The addition of meaning affects three aspects of the model: initialization, the addition of phrases and the creation of a new name. During initialization, 100 random compounds are assigned to the agents, which now also have to be assigned one of the three meanings. As I discussed in the previous section, I assume compounds to be excluded from exocentric meaning. As far as endocentric and metonymic meaning are concerned, there is no reason to assume any initial preference for one of the two. Therefore, 50 of the initial compounds get endocentric meaning, and the other 50 compounds get metonymic meaning.

As for the addition of phrases, I discussed in the previous section how I assume these phrases to be excluded from metonymic meaning. Similar to initialization, there is no reason to assume any preference for one of the two other meanings. Therefore, phrases that are added both have a probability of 0.5 to get endocentric or exocentric meaning.

When a new name has to be created with the addition of meaning, an agent first selects one of the three meaning types at random, with the restriction that it can only select a meaning that is present in its memory. After a meaning has been selected in the name creation process, the agent has to choose the proper form to go with the selected meaning. Two kinds of type frequency are used to determine each form’s probability: the general type frequency of each form, and the type frequency of each form for the particular meaning. The general type frequency is a measure of

the overall occurrence of a form, which will affect a form's productivity. But the type frequency of a subset of each form can also be assumed to affect productivity, namely of those forms that have the same meaning as the name that must be created. Therefore, the average of both kinds of type frequency is used. The measure for both forms is shown in equation 3: the probability of creating a compound given a particular meaning ( $p_{f(m)}(c|m)$ ) is calculated as the sum of the relative number of compounds and the relative number of compounds with that particular meaning, divided by two. Naturally, the calculation for the probability of phrases is similar.

$$p_{f(m)}(c|m) = \frac{1}{2} \cdot \left( \frac{\sum c}{\sum c + \sum p} + \frac{\sum (c|m)}{\sum (c|m) + \sum (p|m)} \right)$$

$$p_{f(m)}(p|m) = \frac{1}{2} \cdot \left( \frac{\sum p}{\sum c + \sum p} + \frac{\sum (p|m)}{\sum (c|m) + \sum (p|m)} \right)$$

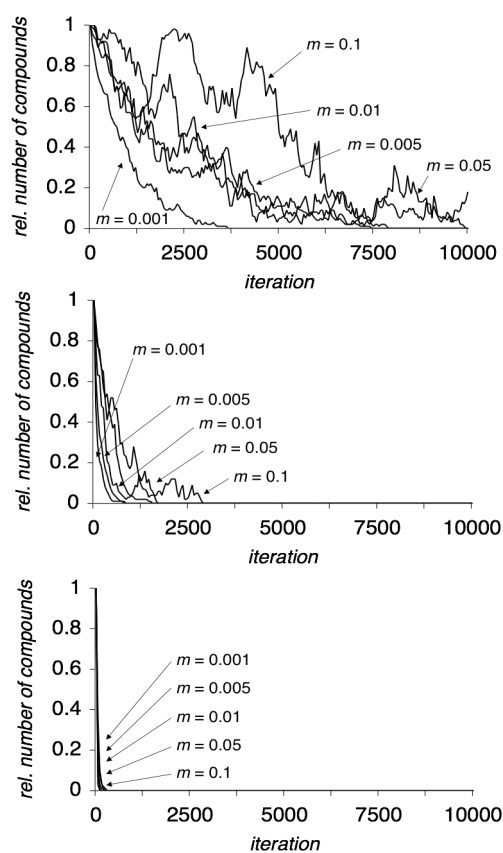
**Equation 3.**

### 3.4 Results

#### *The basic model*

Let us first look how the main parameters in the model behave in the absence of meaning. As I mentioned in the previous section, the simulation starts with all agents having the same 100 names as their knowledge, and all these names are compounds. This means that it is not meaningful to test the effect of parameter  $m$  in isolation: this parameter simulates name innovation, but since a speaker will base the form of the new name on its knowledge of names, only new compounds will be created and there will be no change in the relative number of compounds and phrases. I therefore start by testing the effects of both parameters  $m$  and  $\varphi$  together. The parameter  $\varphi$  regulates the number of phrases that enter the system and using this parameter thus leads to a steady addition of phrases into the population. Because agents choose the form of a new name on the basis of their knowledge of the relative number of compounds and phrases, it is interesting to see how different values of both  $m$  and  $\varphi$  affect the system. Figure 1 shows the results of a set of different values for these parameters. In this figure (and the other figures in this section, unless otherwise indicated), the development of the relative number of compounds

in the population over 10,000 iterations is plotted.<sup>7</sup> This means that the lines in the graph are a representation of the proportion of compounds and phrases in the population: a value of 0.4 means that 40 percent of the names in the population are compounds, and 60 percent of the names are phrases.



**Figure 1.** Development of compounds in a system of compounds and phrases with different values for  $m$  and  $\varphi$ . Top:  $\varphi = 0.0001$ , middle:  $\varphi = 0.001$ , bottom:  $\varphi = 0.01$ .

As the different graphs clearly show, all tested parameter values lead to a system in which the number of compounds steadily decreases over time, until they eventually

<sup>7</sup> Although the result of only one run is shown, I have performed 20 runs for each setting. Unless otherwise mentioned, the results of these runs were always similar in that all 20 runs roughly had the same outcome.

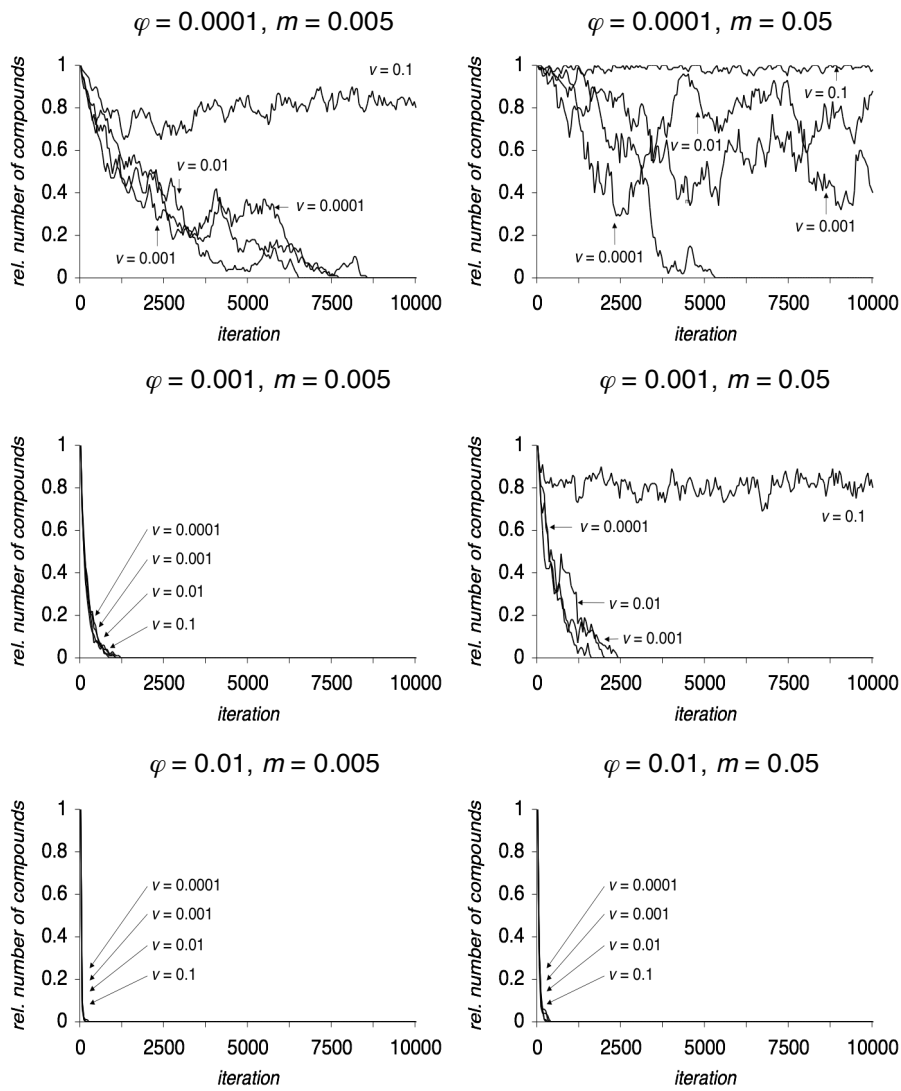
disappear completely from the system, and fixation of phrases has taken place: in none of the runs with these parameter values a system develops in which both compounds and phrases co-exist in some sort of stable equilibrium.

The main force in this development is the pressure  $\varphi$ , of which a low value of  $\varphi = 0.0001$  turns out to be already sufficient to lead to fixation of phrases. As figure 1 shows for  $\varphi = 0.0001$ , a higher innovation rate (parameter  $m$ ) can slow down this process, but not stop it: at first, innovation will add only compounds to the system, but as the number of phrases increases, phrases will also start to be added to the system by innovation, hence increasing their number. Figure 1 also shows that for higher values of  $\varphi$  ( $\varphi = 0.001$  and  $\varphi = 0.01$ ), the fixation of phrases occurs at a very rapid rate.

In the above simulations, there was no pressure against phrases ( $\nu = 0$ ). It seems probable that the presence of such a pressure will lower the speed with which phrases take over the system. Figure 2 shows the results of a series of simulations in which this pressure is added to the system together with three different values for parameter  $\varphi$  and two values for parameter  $m$ .

The results in figure 2 show that the addition of the selection pressure  $\nu$  in some cases can slow down the increase and eventual fixation of phrases, and that it can even lead to a system in which phrases and compounds coexist in a seemingly stable equilibrium (shown in the graph by a more or less straight line). In general, the value of parameter  $\nu$  has to be sufficiently large compared to the value of parameter  $\varphi$  for such an equilibrium to evolve. With  $\varphi = 0.0001$  and  $\nu = 0.1$ , equilibria develop for both tested settings of  $m$  ( $m = 0.005$  and  $m = 0.05$ ): these settings apparently lead to a system in which the one selection pressure ‘in favor’ of phrases ( $\varphi$ ) is successfully opposed by the selection pressure ‘against’ phrases ( $\nu$ ).

The innovation rate  $m$  turns out to be a factor working against phrases in this respect. A higher value of  $m$  ( $m = 0.05$  as opposed to  $m = 0.005$ ) makes it harder for phrases to take over the system, because new names with compound form are added to the system at a relatively high rate. This either means an equilibrium with a higher percentage of compounds (the top two graphs in figure 2) or the difference between absence or presence of an equilibrium (the middle two graphs in figure 2).



**Figure 2.** Development of compounds for different values of  $\nu$  and  $\phi$ .  $m = 0.005$  (left) and  $m = 0.05$  (right).

### *The addition of meaning*

In a second series of simulations, ‘meaning’ is added to the model. Agents start with a set of 100 compounds and these compounds either have ‘endocentric’ ( $m_1$ ) or

‘metonymic’ ( $m_3$ ) meaning, with a 0.5 : 0.5 distribution. When phrases enter the system, they either have ‘endocentric’ ( $m_1$ ) or ‘exocentric’ ( $m_2$ ) meaning, also with a 0.5 : 0.5 distribution.

These distributions have the effect that, throughout the entire simulation, compounds are blocked from having exocentric meaning, and phrases are blocked from having metonymic meaning. In other words, the addition of meaning leads to a division of the main niche of AN-names into three, semantically based, sub-niches, of which only one is accessible to both forms. With this in mind, the question is how the distribution of compounds and phrases develops in the system as a whole, and in the niche of endocentric meaning in particular.

Let us first look at the runs with meaning in which the selection pressure against phrases is absent ( $\nu = 0$ ) for the same range of values for  $m$  and  $\varphi$  that I discussed above in the first set of runs without meaning. Figure 3 on the next page shows the development of compounds in the endocentric meaning niche.

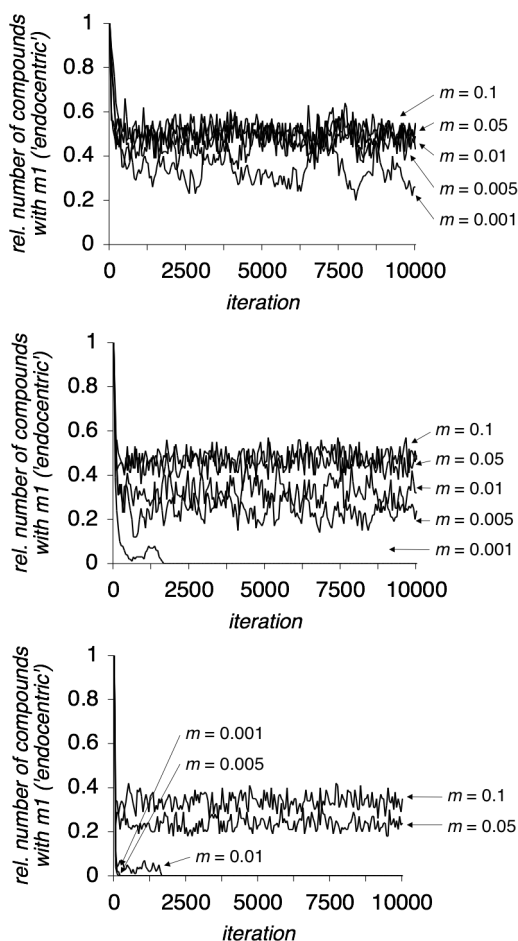
The main difference between these results and those from the runs without meaning is that the current runs show a much more stable system: in the majority of runs, an apparently steady equilibrium develops. However, these equilibria differ with respect to the relative distribution of compounds and phrases. For all settings, table 4 shows the average relative number of compounds with endocentric meaning between iteration  $t = 1000$  (when the equilibrium state has been reached in all runs) and  $t = 10,000$ .

<i>average relative number of endocentric compounds</i>			
<i>creation rate</i>	$\varphi = 0.0001$	$\varphi = 0.001$	$\varphi = 0.01$
$m = 0.001$	0.35	0.01	0
$m = 0.005$	0.47	0.24	0
$m = 0.01$	0.47	0.33	0.03
$m = 0.05$	0.50	0.46	0.24
$m = 0.1$	0.50	0.48	0.34

**Table 4.** Average relative number of endocentric compounds for different values of  $\varphi$  and  $m$ .

Both parameters  $\varphi$  and  $m$  turn out to affect the occurrence and, if so, the value of the equilibrium. The higher the value of  $\varphi$ , which controls the entrance of phrases into the system, the lower the amount of compounds in the equilibrium. The higher the value of  $m$ , the higher this amount of compounds. In fact, the only settings in which no equilibrium develops are those with a very low value for  $m$ . Apparently, the

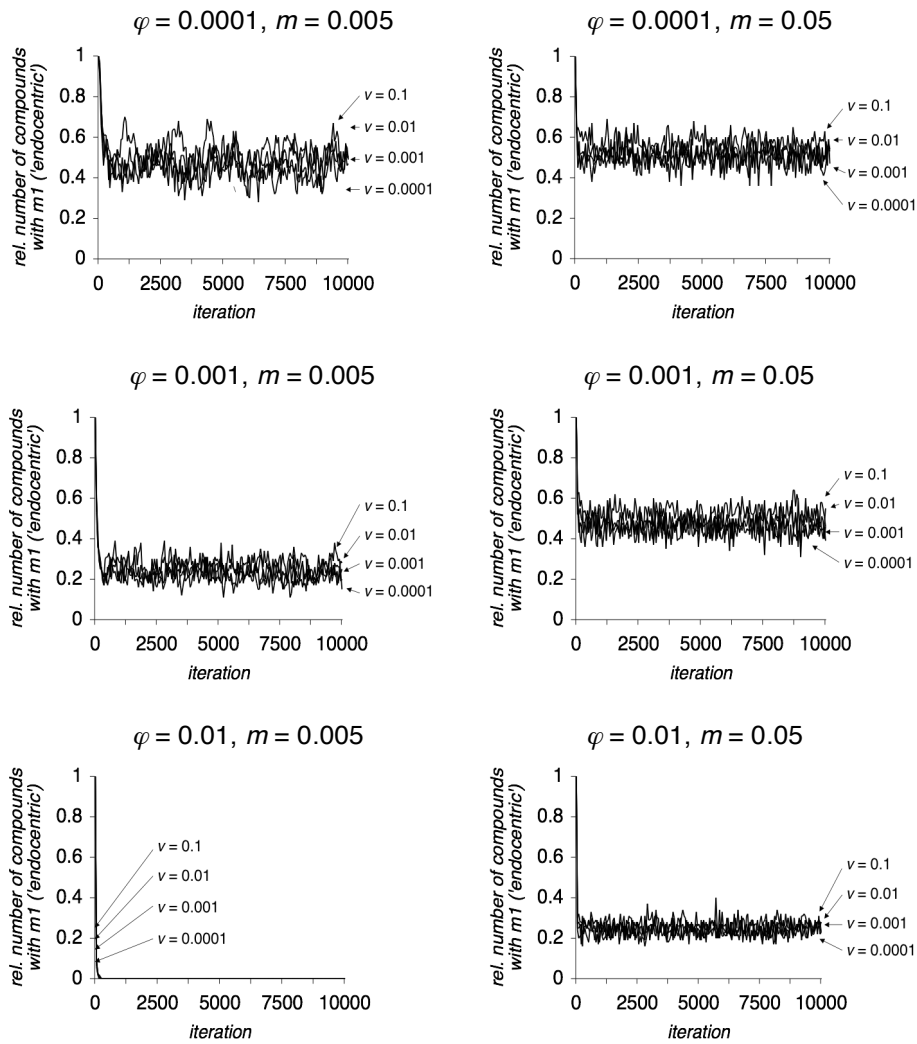
process of name creation ‘supports’ the compounds in this case, by adding more (metonymic) compounds to the system.



**Figure 3.** Development of compounds with endocentric meaning in a system of compounds and phrases with different values for  $m$  and  $\varphi$ . Top:  $\varphi = 0.0001$ , middle:  $\varphi = 0.001$ , bottom:  $\varphi = 0.01$ .  $\nu = 0$ .

These results contrast sharply with those from the runs without meaning. In these runs, it was impossible for an equilibrium to develop without the presence of the selection pressure against phrases ( $\nu$ ), even for high values of  $m$ . In the current runs in which the three meanings are added to the system, equilibria develop in most runs, without this selection pressure against phrases needed. Even though phrases

are continuously added to the system through parameter  $\varphi$ , the continuous presence of metonymic compounds brings a stable number of compounds to the system as a whole. This leads to a sufficient number of endocentric compounds being created, because the name creation process is partly based on the general type frequency of both compounds and phrases.



**Figure 4.** Development of compounds with endocentric meaning for different values of  $\nu$  and  $\varphi$ .  $m = 0.005$  (left) and  $m = 0.05$  (right).

So what effect does the addition of the third parameter, the selection against phrases ( $\nu$ ), have in the model with meaning? I have tested the same settings for the three main parameters  $\nu$ ,  $m$  and  $\varphi$ , as in the model without meaning, and the results are shown in figure 4. Parameter  $\nu$  adds a selection pressure against phrases to the system and it is therefore not surprising that the results show equilibria for almost all settings. The only exception is the case in which a relatively high value of  $\varphi$  is combined with a relatively low value of  $m$ : phrases are entering the system at too high a rate, and neither the creation of new names nor any tested value of selection pressure  $\nu$  is sufficient to stop endocentric compounds from going extinct.

As a matter of fact, the value of  $\nu$  does not seem to have a significant effect on the value of the occurring equilibria for any of the settings. For all tested values of  $\varphi$  and  $m$ , the different values of  $\nu$  all show very similar results: it is hard to distinct the outcomes of the different settings in the graphs. The average values of the equilibria are shown in table 5, to which I have added the relevant values for  $\nu = 0$  from the previous table.

		<i>average relative number of endocentric compounds</i>	
		<i>m = 0.005</i>	<i>m = 0.05</i>
$\varphi = 0.0001$	$\nu = 0$	0.47	0.50
	$\nu = 0.001$	0.46	0.50
	$\nu = 0.005$	0.46	0.50
	$\nu = 0.01$	0.46	0.51
	$\nu = 0.05$	0.53	0.57
$\varphi = 0.001$	$\nu = 0$	0.24	0.46
	$\nu = 0.001$	0.23	0.46
	$\nu = 0.005$	0.23	0.46
	$\nu = 0.01$	0.23	0.47
	$\nu = 0.05$	0.27	0.53
$\varphi = 0.01$	$\nu = 0$	0	0.24
	$\nu = 0.001$	0	0.24
	$\nu = 0.005$	0	0.24
	$\nu = 0.01$	0	0.24
	$\nu = 0.05$	0	0.27

**Table 5.** Average relative number of endocentric compounds for different values of  $\varphi$ ,  $m$  and  $\nu$ .

As table 5 shows, the tested values of  $\nu$  give very similar results with regards to the height of the equilibrium. Only a sufficiently high value for  $\nu$  ( $\nu=0.05$ ) is capable of increasing the relative number of endocentric compounds in the system.

So why is the effect of parameter  $\nu$  more limited in the model with meaning than in the model without meaning? The reason seems to be that the parameter only functions for a subset of all the names that enter the system. If a metonymic name is created, it will get a compound form and if an exocentric meaning is created, it will get a phrase form. In the latter case, phrases will never turn into compounds because of parameter  $\nu$ , because no compounds exist in this niche. Thus, parameter  $\nu$  is only effective in the niche of endocentric meaning and therefore has a limited effect on the system as a whole. Importantly, equilibria can develop without  $\nu$ , and with meaning, indicating that meaning itself is a resource for which forms compete, and thus provide a selection pressure for the reproduction of forms.

In summary, I have tested the effect of the three main parameters on the existence of compounds in the system. When meaning is absent, it turns out to be very hard for compounds to remain present. Phrases are constantly added to the model, and because the choice of type (compound or phrase) during name creation depends on the type frequency of compounds and phrases, more and more phrases are being added, until compounds become extinct. Compounds can only remain present in the system with a sufficiently large pressure against phrases (parameter  $\nu$ ), in combination with a low value of  $\varphi$  (addition of phrases) and a relatively high name creation rate.

When meaning is added to the model, the system becomes much more stable. Both types have one of the meaning niches exclusively to themselves, so that they only have to share one meaning niche. This gives each type a strong base of names that prevents them from easily going extinct in the shared niche, and an equilibrium develops for most of the tested settings of the main parameters. Parameter  $\nu$ , representing phrase variability, turns out not to have a very strong effect in the runs with meaning, because its scope is limited to the subset of endocentric meaning. Whether or not an equilibrium develops depends mainly on the interplay between the innovation rate and the addition of phrases.

However, in both simulations with and without meaning, compounds are the 'weaker' name type of the two: they can still go extinct in the endocentric meaning niche with a sufficient addition of phrases. Generally though, the existence of meaning niches gives compounds a sufficiently strong buffer against the invasion of phrases.

### 3.5 Discussion and conclusions

In this chapter, I have discussed the phenomenon of free variation in the domain of AN-names in three West-Germanic languages. Although the domain of category naming is typically the territory of words, compounds in this case, we find that this function is performed by lexicalized phrases as well. Hence, there are two forms ‘competing’ for the same function, or meaning in a broad sense.

This phenomenon has a biological parallel in the case of species competing for the same ecological niche. A principle in the field of ecology known as the ‘principle of competitive exclusion’ states that this situation cannot lead to an equilibrium. Due to stochastic processes, one of the two species will eventually take over the niche completely, unless some sort of differentiation or specialization takes place. Only in the latter case can the two species co-exist in a state of equilibrium, because they have ceased to compete for the same niche.

I have proposed to consider the domain of AN-names as a ‘niche’ for which the two linguistic variants compete, and discussed two main selection pressures that are at work in this system. A first selection pressure is a factor, or complex of factors, that leads to phrases steadily entering the system. A second selection pressure is that, due to the presence of a case system, phrases show variability in their appearance, which results in a preference for compounds over phrases.

Using an agent-based computer model, I have shown that a system with two forms competing for the same niche is indeed a very unstable system. Compounding is the ‘basic’ form for category names, but phrases enter the system at a slow but steady rate, and as a result, eventually take over this function completely. The presence of a selection pressure against phrases can slow down this process but not stop it, unless the pressure is very strong. This means that the preservation of compounds in a language like German, with its elaborate case system, might be explained in this way, but the fact that compounds are also preserved in Dutch and English, which exhibit little or no phrase variability, cannot.

However, the case of AN-names turns out to be more complex. I have shown how three semantic subtypes of AN-names can be distinguished: those with endocentric, exocentric and metonymic meaning. This means that the two forms have the possibility for semantic specialization, and such specialization has indeed taken place. The metonymic sub-niche is the exclusive domain of compounds, and the exocentric sub-niche that of phrases, while both forms are present in the endocentric sub-niche.

With the computer model, I have shown that this particular distribution might be the actual cause of the equilibria in the three languages. The fact that both forms have an exclusive presence in one sub-niche gives them a basic frequency, which leads to preservation in the shared niche of endocentric meaning. Thus, it can

be claimed that the possibility for niche specialization leads to linguistic preservation.

Some points should be added to this finding. First, I have assumed that the exclusiveness of the metonymic and exocentric domain is a *cause* and not an *effect*. I have made this assumption partly for linguistic reasons, but also partly as a demonstration of the effect of such a scenario. The second point is related to this issue, and concerns the simplicity of the model. It was my goal to show varying dynamics of two linguistic variants in a simple system, not to have a truly realistic representation of the complexities of language. One simplification was the construction of the agents' memory: only the 100 most recently perceived names were stored. Because new names were constantly added to the model, it was impossible for names to remain present in the system for a longer period of time. This, of course, is a simplification of reality: as we have seen, various names have been around for centuries. It might very well be the case that the presence of these 'relic' names affects the system as a whole, in that compounds are able to remain around for longer. Coming back to the first point, this might mean that, even with a less strict separation of meanings for the forms as I have used in the model, equilibria could be possible. In general, it should be noted that the way an agent's memory and behavior is modeled has a significant effect on the outcome of the model.

A third point is the linking of the findings of the model to the actual languages German, Dutch and English. In the model without meaning, phrases eventually take over the system because of the parameter  $\varphi$ , which represents the steady addition of phrases to the system. This process can only be countered by high values of the parameter  $\nu$  (which represents phrase variability). It certainly seems plausible that German has a higher value for phrase variability than Dutch (and English), because of its elaborate case system. On the other hand, there is no reason to assume that phrases enter the system at very different rates in the two languages. So it could be the case that the reason why German differs from Dutch and English in the presence of compound forms can be explained by these parameters. However, to conclude this, we would have to know the actual ratio of these parameters in these languages.

In the runs with meaning, the value of parameter  $\nu$  had no significant effect on the relative number of endocentric compounds. This outcome means that the pressure that this parameter represents – phrase variability – cannot be used to explain the differences in the number of endocentric compounds between Dutch and German. Instead, these differences would have to be explained by differences in innovation rate and the addition of phrases. Again, to conclude whether this is actually the case, we would have to know the ratio of both parameters in Dutch and German.

A conclusion that can be drawn from this chapter is that the isomorphism principle might be better reinterpreted as an exclusion principle. The isomorphism principle states that language has a tendency for a one-to-one mapping between form and meaning. However, this principle seems to be violated often, for example in the case of polysemy (cf. chapters 2 and 5). It is mostly in cases of competition that a one-to-one mapping of form and meaning occurs; ‘the non-survival of one of them may simply be the negative aspect of the survival of the other’, as Hockett (1958: 399) puts it. In other words, one-to-one mappings of form and meaning seem to be the product of competition of forms for the same resource: meaning. Polysemy, on the other hand, consists of a multiplicity of meanings (or ‘senses’) associated with a single form; this violates isomorphism (one-to-one mapping), but it is compatible with the exclusion principle as presented here. In the case of polysemy, meanings could be construed as competing for the same form, but this would be a wrong kind of construal. The communicative power of a system is not diminished if it can still express multiple meanings with the same form, and therefore, polysemy should not be regarded as a competition between meanings. This actually seems to follow from the way a form’s ‘meaning’ is constructed in the usage-based approach: as a collection of multiple, very specific form-meaning combinations. This leads to a notion of meaning that is almost necessarily polysemous, but in which the specific form-meaning combinations do not ‘compete’ with each other but co-exist ‘peacefully’ instead.