SCHEMAS IN GERMAN PLURAL FORMATION*

Klaus-Michael KÖPCKE

Fachbereich Erziehungswissenschaften I, Universität Hannover, FRG

In a structural theory of morphology based on an 'Item-and-Process' model the plural marking system of German appears to be a complex series of unmotivated rules and lists of exceptions. Experimental data show that at a general level adult speakers of German make use of certain tendencies in the existing nominal lexicon when asked to assign the plural to nonce words. However, on a specific level subjects deviate substantially from existing patterns in the lexicon. These deviations are accounted for by a psychological model of the 'cue strength' of specific morphemes based on their salience frequency, and cue validity, and a process of plural schema matching. Additional support for the plural schema approach is drawn from plural assignment to recent loanwords and from historical changes in the plural marking system of German.

1. Introduction

During the latter part of the 20th century the morphological structure of languages, compared to phonology on one side and syntax on the other, has been relatively neglected within theoretical linguistics. The rapid developments of structuralism placed an emphasis on phenomena that could be captured by either Item-and-Arrangement or Item-and-Process (IP) statements (Hockett (1954); see Bybee (1986) for general critique). First phonology and then syntax yielded significant generalizations to the IP model, while morphology remained a domain of complex, inexplicable language-particular facts.[1] For example, older generative treatments of noun plural formation in

---

[1] Both the item-and-process and the item-and-arrangement models replaced the more traditional paradigm model, cf. Hockett (1954). They have in common that not all items in a paradigm have the same status. Item-and-arrangement stresses that some items have a wider distribution than others, and thus a higher type frequency in language use. Item-and-process assumes an

English contain an abstract plural morpheme 'item' (1a) and morphophonemic rewrite 'process' rules (1b) producing a set of alternants:

(1a) (+pl) → {-s}

(1b)　　　*alternant*　　　*phonological*　　　　*examples*
　　　　　　　　　　　　　environment

　　{-s}　→ /əz/　　　[+ sibilant]___　　noises
　　　　　→ /s/　　　　[− voice]___　　　books
　　　　　→ /z/　　　　[+ voice]___　　　boys

Finally, such traditional analyses contain a list of exceptions marked in the lexicon (1c):

(1c) ox:　　　　/aks/　　→　pl: /aksən/
　　　knife:　　/nayf/　　→　pl: /nayvz/
　　　goose:　 /gus/　　　→　pl: /gis/
　　　child:　　/čayld/　　→　pl: /čıldrən/
　　　person:　/pərsən/　→　pl: /pipəl/
　　　deer:　　/dir/　　　→　pl: -∅

Such a treatment thus regards the morphological realization of grammatical categories to be either categorically regular, as in (1a) and (1b), or to be arbitrarily exceptional, as in (1c) resulting in a dichotomy between absolute regularity and irregularity. During the past 10 or 15 years, that is in the period following the peak of the 'generative revolution' lin inguistics. linguists such as Bybee (1985), Dressler (1977), Mayerthaler (1981), and Wurzel (1984), have reawakened theoretical interest in morphology, particularly after the work by Stampe (1972) on natural phonology.[2] Currently, the most important and most general result of this 'natural' approach to morphology is that morpho-

---

underlying form for each paradigm which is not necessarily identical with any surface form. The item-and-process model was applied by American Structuralists to all domains of linguistic structure, so that Hockett (1954) could characterize it as one of the two basic descriptive models available to linguists. Description of morphological phenomena did not progress beyond the relatively concrete stage depicted in Joos (1957), whereas description and theory in phonology (cf. Chomsky and Halle (1968)) and syntax (cf. Chomsky (1965)) in this model quickly progressed to a high level of abstraction and universality.

[2] The 19th and early 20th centuries saw extensive theory and description of morphology in language change, e.g. Paul (1909, 1968); Kuryłowicz (1964), much of which is profitably assimilated by current 'natural' morphology, cf. section 6 of this paper.

logical phenomena are not ordered in an arbitrary way, but instead are governed by universal and very general cognitive principles. But, these can be found only by giving up an autonomous ..ructural approach and the absolute dichotomy of the IP model, and instead raising a series of functional and psycholinguistic questions.

The fundamental questions for which the IP model does not offer satisfactory explanations are (1) why certain morphological, and morpho-phonemic rules apply more productively than others, (2) what makes some rules more attractive than others for application to new items, e.g. loanwords and experimental nonce words, and finally, (3) why exceptions to regular patterns arise in historical change, i.e. why historical change does not gradually lead to absolute regularity.

These questions lead to a model of morphological representation containing not only IP rules, but also a schematic component in which morphological rules and lexical representations are not seperate. In this component, forms (both morphologically simplex and complex) in the lexicon are individually subsumed under SCHEMAS having a probabilistic, prototype structure (cf. Smith and Medin (1981), Lakoff (1982), Bybee and Moder (1983), and Köpcke and Zubin (1983)). This structure is determined by CUE STRENGTH of the schema's individual components, which is in turn determined by salience, frequency, and cue validity of these components, cf. section 4.2. For example, the singular form *das Haus* 'the house' and the plural form *die Häuser* 'the houses' belong to a singular and a plural schema, respectively. The singular schema consists of monosyllabicity and the determiner *das*, while the plural schema consists of the suffix *-er, umlaut*, and the determiner *die*. The plural form *die Häuser* is related in one direction to its corresponding singular form *das Haus* by an IP rule, and equally related, in another direction, to other members of its independently existing plural schema, such as *die Wälder* 'forests', *die Bücher* 'books', and *die Hörner* 'horns'. This reasoning places the present model somewhere between traditional IP formulations, in which morphologically complex forms have no independent representations, and the recent position of Bybee (1986), in which all forms simply have independent representations in the lexicon with membership in particular schemas, but no IP relationships.

The modified schema model presented in this paper will be shown to account for data which are recalcitrant in an IP approach. These data include the spontaneous formation of plurals in a nonce word experiment, the integration of recent loanwords into the lexicon, and finally, historical changes in the correspondence between singular and plural forms.

2. The plural marking system in German

Recent theoretical work in natural morphology has been primarily based either on limited examples drawn from a variety of languages (cf. Mayerthaler (1981), Wurzel (1984)) or on the analysis of recalcitrant 'exceptions' to IP rules in structural analyses of individual morphological systems (cf. Bybee and Slobin (1982), Bybee and Moder (1983)). By contrast the formation of plurals in Modern Standard German presents a considerable challenge to natural morphology, since it is a complex system composed of several phonologically unrelated alternants and no clearly dominant rule. That is, most plurals seem to be 'lexical exceptions' of the type (1c), rather than regular, as in (1b) above. German has six major plural allomorphs, the occurrence of which correlates with at least the following factors:

	examples
– the type of the derivational suffix	Frei-*heit* + -en 'freedom'
	Jüng-*ling* + -e 'young man'
– the final consonant or vowel of the stem	Kurv*e* + -n 'curve'
	Pizz*a* + -s 'pizza'
– the prefix of the stem noun	*Ge*-birg-e + -∅ 'mountains'
– the mutability of the stem vowel[3]	V*a*ter/V*ä*ter 'father'
– the gender-assignment of the noun	*der* Tisch/die __-e 'table'
	die Uhr/die __-en 'watch'
	das Kind/die __-er 'child'
– the animacy of the noun	der Herr/die __-en 'sir'

The fact that none of these patterns dominates is apparent in Mugdan's (1977) detailed description of plural marking in German: he tried to set up IP rules for this complex system and ended up with 15 distinct rules and 21 lists of exceptions.

Table 1 presents the plural morphemes in more detail. The first four are suffixes; the fifth is phonetically zero, and is analyzed as a zero morpheme, since it occurs in plural contexts completely parallel to the other plural suffixes. The sixth is an 'umlaut' mutation in the stem vowel of the singular form of the word, for example the change from [u] to [y] in *Bruder–Brüder* 'brother–brothers'. Some vowels have umlaut 'partners', while others do not.[3]

---

[3]   The morphologization of the vowel harmony process in Old High German known as 'umlaut' has led to vowel alternations which enter into a number of morphological paradigms. In Modern Standard German (spoken) the vowels /a/, /o/, /u/, and /au/ have alternants, while /i/, /e/, and /ai/ do not. The former will be referred to here as MUTABLE ('umlautfähig').

Thus some nouns can accept *umlaut* as a plural marker, while others cannot. *Umlaut* is the only morpheme which can combine with others. Leaving aside isolated instances (marked with an asterisk in table 1), four of the six morphemes are limited to two of the three gender classes. Thus while gender does not predict the plural morpheme, it does limit the choice.

Table 1

Overview of plural morphemes in German.

| pl.-morpheme | Gender | | |
	masculine	feminine	neuter
-e	Fisch/Fische (fish)	Kenntnis/Kenntnisse (knowledge)	Jahr/Jahre (year)
-(e)n[a]	Bauer/Bauern (farmer)	Tür/Türen (door)	Auge/Augen (eye)
-er	Geist/Geister (ghost)	—	Kind/Kinder (child)
-s	Park/Parks (park)	Mutti/Muttis (mom)	Auto/Autos (car)
-∅	Adler/Adler (eagle)	—	Fenster/Fenster (window)
umlaut	Bruder/Brüder (brother)	Tochter/Töchter[b] (daughter)	Kloster/Klöster[b] (monastery)
umlaut + -e	Sohn/Söhne (son)	Kuh/Kühe (cow)	Floß/Flöße[b] (raft)
umlaut + -er	Wald/Wälder (wood)	—	Volk/Völker (people)
def. article	der/die sing/plur	die/die sing/plur	das/die sing/plur

[a] There is no nominal German wordform that contains the phoneme-orders /əə/ or /əCə/, where 'C' stands for any consonant. This phenomenon is called 'Geminatentilgung', cf. Philipp (1974: 69). This means in the context of the plural morpheme -*(e)n* that the *schwa* will be deleted in exactly those cases, where the stem of a noun already ends in *schwa* or in a *schwa* + *consonant*, e.g. *die Kurve – die Kurven* 'curve – curves' or *der Bauer – die Bauern* 'farmer – farmers'. Therefore, and for ease of presentation I will write consistently -*(e)n*. The ending -*(e)n* in other environments is phonetically realized as [n]. In allegro speech the preceding stem consonant is typically nasally released, and the suffix homoorgenically articulated. For example, *Augen* 'eyes' = [ɔugæŋ] > [augŋ].

[b] Only one or two instances.

Although determiners are not viewed in structural analyses as plural markers, they will be included in the present analysis, since from a perceptual point of view they are an additional source of information in the NP about number, and when they co-occur with the zero suffix, they are the only source of information. When masculine nouns are marked for plural the article changes from *der* to *die*, and for neuter nouns from *das* to *die*. From this perceptual perspective it is clear why zero is never used as a plural suffix morpheme for feminine nouns: in this case the singular and plural articles are identical, both *die*, so that some other overt marker is needed.

Learning theory, cf. for example MacWhinney (1978), yields several possibilities for the native speaker's cognitive organization for this morphological system. First, native speakers could learn to use plural marking as a set of unrelated lexical facts about each noun stored in the mental lexicon. The natural experiment of linguistic borrowing speaks against an extreme form of this model, since native speakers often choose plural morphemes for borrowed nouns whose plural they have never heard, cf. also section 5.

The antipole to this model is one which claims that native speakers mechanically extract all generalizations and subgeneralizations which inhere in the lexicon of the language, and employ them in their mental organization of the lexicon. Under this model, a native speaker's mental lexicon would exactly mirror all the IP generalizations which a linguistic analysis is able to uncover. Naturally occurring counterevidence for this model is given by the existence of a substantial number of exceptions to any IP description, cf. Mugdan (1977), examples of which appear in table 1: *Auge* contradicts the generalization that neuter nouns do not take -*(e)n* as their plural morpheme, and *Tochter* the generalization that feminine nouns do not take *umlaut* combined with -$\emptyset$. Speakers using the second model would be incapable of learning such exceptions by rote, and would assimilate them to existing patterns.[4]

---

[4]   MacWhinney (1978) and others suggest a third model based on analogy, for which I would like to distinguish a weak and a strong type. A 'weak' analogy model would claim that a noun forms its plural by analogy to some other single noun. This model could account for any and all possible data (except for the case in which every plural is unique), and is thus vacuous. A 'strong' analogy model would incorporate statements about the relative strength of different analogies based on salience and frequency, and thus would tend to merge with the schema model presented here.

Further naturally occurring counterevidence against both of these models, the rote model and the IP model, is provided by the occurrence of overgeneralization in the speech community. For example, *-s* is overgeneralized in Northern Germany (*die Mädel* 'girls' > *die Mädels*), and *-(e)n* in the south (*Mädel* > *Mädeln*) at the expense of other plural marking, especially *-∅*, a point which will come up for fuller discussion in section 4.2. Such overgeneralizations suggest that native speakers may be making use of a third 'cognitive' model in which speakers reduce the complex system inherent in the existing lexicon by extracting major generalizations in accordance with general cognitive learning and communicative principles, akin to Slobin's (1973) Operating Principles. Such a model will be developed in section 4.

3. An experiment to test plurals in German

3.1. Experimental design

An initial hypothesis was established claiming that in forming the plural of 'new' nonce words, speakers will deviate from predictions based on an IP model using the real lexicon as a database, and that these deviations will reflect the predictable effects of general cognitive learning and communication principles. To test this hypothesis an experiment was designed with 40 subjects from northern Germany, all students in their first year of university with an average age of 21 years. None were speakers of *Plattdeutsch* (Low German) or another dialectal variety. Two lists totaling 50 nonce word nouns in random order were set up (see appendix). Half of the subjects got the lists in the order A–B, the other half in the reverse order. All nonce words conformed to the phonotactic patterns of Standard German.

Subjects were tested individually. Each nonce word was presented twice from a tape recorder to make sure that the experimental conditions for all subjects were more or less equal. After hearing each nonce word with its definite article in the nominative singular, the subjects had to respond orally in forming the nominative plural[5] for each item. There were no indications at all that the task was unclear to the subjects. Subject responses were recorded on a second tape recorder and transcribed later. Table 2 gives some examples of the nonce words used in the experiment and of typical responses of the subjects.

---

[5] The nominative is both grammatical subject form and citation form out of grammatical context, and thus most appropriate for such an experimental elicitation.

Table 2
Examples of nonce words and responses.

Singular	Plural
die Schrenkung	die Schrenkungen, die Schrenkunge
das Poftlein	die Poftlein, die Poftleine, die Poftleins
der Knumpe	die Knumpen, die Knumpes, die Knumpe
die Mafte	die Maften, die Maftes
das Siero	die Sieros, die Sieren, die Siero
der Treika	die Treikas, die Treika, die Treiken
der Knaffel	die Knaffel, die Knäffel, die Knaffeln, die Knaffels
die Bachter	die Bachtern, die Bachter, die Bächter, die Bachters
das Trilchel	die Trilchel, die Trilcheln, die Trilchels
der Knolck	die Knolcke, die Knölcke, die Knolcks
die Luhr	die Luhren, die Luhrn, die Luhre, die Luhrs
das Flett	die Flette, die Fletten, die Fletts

3.2. General results of the experiment

Table 3 gives the results in detail. The left-hand column gives the different morphological features of the nouns tested in the experiment. The far right-hand column gives the plural morpheme predicted by an IP analysis of the nominal lexicon. Note that in some cases these predictions reflect clear stochastic tendencies, but not absolute categorical rules. The columns in the middle of the table give the morphemes actually used by subject in the experiment, and their percentage of occurrence, summed horizontally.

Group (1) are nouns with a *derivational suffix*. For masculine nouns ending in the derivational suffix *-ling* in 1(a) the predicted plural morpheme is *-e*. This is confirmed in the experiment, since in 99% of the answers this suffix was chosen. In 1(b) feminine nouns ending in the suffixes *-ung* or *-schaft* should be assigned *-(e)n*. Again this is confirmed by the answers of the subjects. In 1(c) and 1(d) neuter nouns ending in the diminutive suffixes *-chen* or *-lein* have the predicted plural morpheme *-∅*. This is clearly confirmed for the suffix *-chen* but only partially for the suffix *-lein*.

The second group of nouns in table 3 have a stem-final *schwa*. The IP prediction would be *-(e)n* no matter what the gender of the noun is. This is generally confirmed, but there is a considerable difference between the masculine and neuter nouns on the one hand and the feminine nouns on the other, a point to be elaborated in section 4.2.

Table 3

Overview of experimental results (in percent); the use of *umlaut* in combination with other morphemes is given after a slash as a proportion of the responses using a particular suffix.

	N	-(e)n/U	-e/U	-∅/U	-s/U	-er/U	Predict.
1. nouns with suffix							
(a) masc. -ling	80		99%		1%		-e
(b) fem. -ung/-schaft	160	96%	3%		1%		-(e)n
(c) neut. -chen	80			90%	10%		-∅
(d) neut. -lein	80	6%	19%	51%	20%	3%	-∅
2. nouns ending in schwa							
(a) tot: masc./neut. -e	159	77%		17%	2%	4%	-(e)n
(b) fem. -e	80	94%		4%	2%		-(e)n
3. nouns ending in a full vowel							
(a) tot: masc./fem./neut.							
-a/o/u/i	319	20%	1%	6%	69%		-s
4. nouns with a pseudosuffix							
(a) tot: masc./neut. -el	159	22%	3%	69%/0.01	6%	1%	-∅
(b) tot: masc./neut. -er	160	16%	1%	77%/0.01	5%		-∅
(c) masc. -en	80	1%	1%	91%	4%		-∅
(d) fem. -el	80	59%		28%/0.04	13%	1%	-(e)n
(e) fem. -er	80	26%	1%	59%/0.1	8%	3%	-(e)n
5. monosyllabic nouns							
(a) masc.	160	21%	59%/0.1		14%	7%/0.7	-e
(b) fem.	160	66%	27%/0.1	1%	6%	1%	-(e)n
(c) neut.	160	31%	40%	1%	14%	14%	-e

The third group of nouns in table 3 end in a full vowel. Overall two thirds of the responses confirmed the predicted plural morpheme -*s*.

These first three groups of nouns are all polysyllabic. The next class, 4, also deals with polysyllabic nouns, which have the frequently occurring but non-segmentable endings -*el*, -*er*, and -*en* in their singular form, referred to in the literature as 'pseudosuffixes', cf. Augst (1979). The degree to which the predicted zero morpheme is assigned to masculine and neuter nouns differs quite a bit (cf. section 4.3 for discussion), although overall the subjects seemed quite aware of this generalization. However, the feminine nouns ending in -*el* or -*er*, cf. 4(d) and 4(e), show substantial deviation from the predicted plural marker -*(e)n*. Whereas for feminine nouns ending in -*el* almost 60% of the

answers confirmed the prediction, the corresponding figure for the noun
ending in -er went way down to only one fourth. These observations will be
elaborated in section 4.3.

The fifth group of nonce words are monosyllabic. The predicted plural
morpheme for masculine and neuter nouns is *schwa*. This is partially con-
firmed (60%) by the responses to masculine gender nouns in 5(a), whereas the
schwa responses to neuter gender nouns in 5(c) went down to 40%. For
feminine nouns in 5(b) the predicted plural suffix -*(e)n* was obtained in two
thirds of the responses. Overall, there is a substantial deviation from the
predicted plural morphemes.

The final data to be discussed involve the use of *umlaut* in combination with
other morphemes. For example in line 4(a), 69% of the plural responses to a
masculine or neuter noun with the ending -*el* were *zero*. Out of these responses
only about 1 in a hundred, or 0.01, used *umlaut* with the *zero marker*. The
only notable uses of *umlaut* occur in lines 5(a) and 5(b). Masculine and
feminine monosyllabic nouns received *umlaut* combined with the suffix -*e*
about 1 out of 10 times and masculine nouns combined *umlaut* with -*er* about
7 out of 10 times.

4. Discussion of the results

4.1. The role of umlaut

The use of *umlaut* is a particularly clear case. Although there are certain
structural environments in the real lexicon in which *umlaut* is clearly obliga-
tory, the experimental results show little use of *umlaut*: see table 4. *Umlaut* is
obligatory: (a) when the plural morpheme -*er* is used with masculine and
neuter nouns, and (b) when the plural morpheme -*e* is used with feminine
nouns. The experimental subjects nonetheless umlauted the stem vowel in
these environments only a quarter of the time (part 1 of table 4). In other
words, they clearly undergeneralized the use of *umlaut* in obligatory environ-
ments.

Part 2 of table 4 shows environments in which *umlaut* is possible, but not
obligatory in the real lexicon. Mugdan (1977) lists 239 masculine nouns which
form their plurals with -*e* and add *umlaut*. There is thus a substantial basis in
the real lexicon from which speakers could generalize the use of *umlaut* in this
environment. Subjects used *umlaut* approximately 1 out of 10 times in this
environment. Finally, in environments where *umlaut* is excluded, *umlaut* was

Table 4
Results for *umlaut* in combination with a suffixed plural marker.

	Mutable vowel	Umlaut used	Proportion
1. environments in which umlaut *is obligatory*			
(a) masc./neut. nouns,			
-*er* plural suffix	14	6	0.4
(b) feminine nouns,			
-*e* plural suffix	30	5	0.2
total	44	11	0.25
2. environments in which umlaut *is possible*			
masculine nouns,			
-*e* plural suffix	94	11	0.1
3. environments in which umlaut *is excluded*			
plural suffixes -*(e)n, -s*;			
neut. nouns with plural			
suffix -*e*; and masculine			
nouns with suffix -*ling*	551	1	0

not used with any measurable frequency. These results show that subjects have some general sensitivity to the occurrence of *umlaut* as a *redundant* marker of plural in the real lexicon, but undergeneralize its use. These results, when compared with actual patterns in the lexicon, show a clear tendency to select a single, rather than multiple markers for plural, in harmony with a one form/one meaning cognitive economy principle (cf. Slobin (1973)). Furthermore, *umlaut* seems to be sacrificed in favor of perceptually more viable markers (see discussion of table 6). The situation is different when *umlaut* is not redundant, i.e. when the subjects used a *zero* suffix. Table 5 gives the results for pseudosuffix nouns, which provide the suitable environment.

For neuter pseudosuffix nouns (1) *umlaut* is excluded in the real lexicon, and the subjects never used it. For masculine pseudosuffix nouns (2) *umlaut* is possible; Mugdan (1977) lists 33 such nouns which do take *umlaut* as their plural form. Nonetheless, the subjects barely used *umlaut* at all, even though plural was *not* additionally marked with a suffix.

Thus the subjects did not call upon *umlaut* as a plural marker, even when the noun had no plural-marking suffix. Here the definite article as a plural marker comes into play. For masculine and neuter nouns (1 and 2 of table 5), the article changes its form in the plural: *der* becomes *die* for masculine nouns,

Table 5
Results for *umlaut* in combination with a *zero* suffix on pseudosuffix nouns.

	Mutable vowel	Umlaut used	Proportion
1. neuter nouns, *umlaut* excluded	22	0	0
2. masculine nouns, *umlaut* possible	103	3	0.03
3. feminine nouns, *umlaut* marginally possible	25	5	0.2

examples for (1) and (2)		examples for (3)	
singular	*plural*	*singular*	*plural*
das Tralpel	die Tralpel	die Bachter	die Bachter (die Bächter)
der Knaffel	die Knaffel	die Toftel	die Toftel (die Töftel)

and *das* becomes *die* for neuter nouns. The examples at the bottom of the table illustrate this. Thus the subjects were marking plural with the article, rather than using *umlaut*. However, feminine nouns do *not* change their article form in the plural, and *umlaut* was used in five out of 25 possible instances. Examples of subject responses are to right at the bottom of the table. The data are few, but they suggest that the subjects may have increased their use of *umlaut* in precisely those instances in which no other functional plural marking device is present in the noun phrase. The only possible basis in the real lexicon for this increased use of *umlaut* are the two nouns *die Mutter* 'mother' and *die Tochter* 'daughter', which have *umlaut* as their plural form; all other feminine pseudosuffix nouns take the suffix -*(e)n*, and no *umlaut*. It is not likely that the subjects were generalizing their responses from these two nouns, in light of the fact that they did not do this elsewhere when they had a substantial basis in hundreds of nouns in the real lexicon. More plausibly, they found themselves in a functional 'trap'. They had decided not to use -*(e)n* to mark plural, and the article did not help them out. The only possibility left was *umlaut*. Thus the data do suggest that the subjects have a 'feel' for *umlaut* as a plural marker, but only when all other possibilities have been eliminated.

In general, then, it seems that *umlaut* is strongly *undergeneralized* in the nonce word experiment. it was used extremely infrequently in the environments where it is possible as a plural marker. Even in the environments which

require *umlaut*, there is no evidence that it is consistently used. A clearly increased tendency to use *umlaut* appears just in those instances in which all other possibilities for marking plural have been excluded.

4.2. Overgeneralization and undergeneralization of plural morphemes

The observations above lead to a set of hypotheses concerning general tendencies to *undergeneralize*, or to *overgeneralize* particular plural markers. (The basis for determining *under-* and *overgeneralization* is explicated in table 7.) These hypotheses are based on an estimation of the perceptual characteristics of these markers, following psychological principles of categorization as in MacWhinney (1978), McDonald (1984,1986), and Smith and Medin (1981). Table 6 elaborates these hypotheses in terms of the salience, frequency, and cue validity[6] of individual grammatical markers. The term 'cue strength' is used to refer to the sum effect of these individual factors on the functional strength of a marker.

Table 6
Cue strength of plural markers.

Marker	Salience	(Type) frequency	Cue validity
-(e)n	+	+	+
-s	+	−	+
-e	+	+/−	−
-er	+	−	−
umlaut	−	−	+/−

'Salience' here is a rough estimation of the degree to which a marker is perceptually detectable by a listener, in other words, its acoustic prominence. Following two of Slobin's (1973) operating principles -*(e)n*, *-s*, *-e*, and *-er* can be characterized as salient, because they are all separable segments and suffixes. In contrast, *umlaut* is neither a separate segment nor stem-final and is thus less salient.

'Type frequency' refers to the number of lexical items that bear a particular feature, in particular, the number of nouns that take a particular plural

---

[6] McDonald (1984,1986), and MacWhinney, Pleh and Bates (1985) introduce the terms 'detectability', 'availability', and 'reliability' for salience, frequency, and cue validity, respectively. I use the older terms because at this point they seem to be more established in the psychological literature.

morpheme. The most frequent morpheme is -*(e)n* and the next most frequent is -*e*. In comparison, -*s*, -*er*, and *umlaut* have low frequency.

'Cue validity' is used in its restricted sense as the complement of frequency, i.e. the frequency with which a particular feature occurs in the categories which contrast with the target category.[7] In the context of plural morphology -*(e)n* has high cue validity, because there are relatively few singular nouns that end in -*en*. Next, -*s* has high cue validity, because there are few singular nouns that end in -*s*. In contrast, -*e* has low cue validity as a plural marker, because there are many *e*- stem feminine nouns. In fact, -*e* is as good a marker of feminine singular as it is of plural. Next, -*er* has low cue validity, because many singular nouns end in -*er*. In fact, -*er* is a productive derivational suffix for agentive nouns just as it is in English.[8] Finally, the situation with *umlaut* is complex: some low-frequency umlauted vowels have moderate cue validity as plural markers, but the high frequency vowel 'ä' (= /e/) does not. In sum, *umlaut* has relativly low cue validity as a plural marker.[9]

---

[7]   An analogy will illustrate these concepts: birds have wings, in other words, wings are a feature for the concept *bird*. Wings are salient, because we notice them when a bird is flying. Wings are frequent, because almost all birds have wings. When we come to cue validity, however, wings are not as good, because e.g. airplanes and insects also have wings.

[8]   Selecting the relevant contrast set for determining cue validity may be problematical. I take the narrow position that only forms within the same morphological paradigm (e.g. *number* or *case*) are relevant. For example, the high frequency of -*s* as a genitive singular marker could theoretically lower the cue validity of -*s* as a plural marker. But genitive marking is always contextually disambiguated by a preceding article, or construction with another noun, or both, and is thus at least plausibly irrelevant to the contrast set for -*s* as a plural marker. Mater (1970) lists about 170 masculine or neuter nouns and no feminine nouns at all ending in -*en* or -*s*; in comparison, the number of nouns forming their plural with the morpheme -*(e)n* is considerably higher. Furthermore, -*(e)n* as a case-marker is found almost exclusively in the plural paradigm of nouns. Only the relatively small group of the so called 'weak' masculine nouns mark the genitive, dative, and accusative with -*(e)n* in the singular paradigm, e.g. *der Mensch - 'es Menschen - dem Menschen - den Menschen*. J. Bybee (personal communication) pointed out to me that the cognitive viability of -*(e)n* may be further supported by the fact that this form is also associated with plurality in the finite verb paradigms, specifically 1st and 3rd person plural. This observation is strengthened by the fact that a plural noun in sentence subject function will always co-occur with a 3rd person marker on the finite verb. The tendency to overgeneralize -*(e)n* as a nominal plural marker thus results in a repetitive pattern characteristic of agglutinative languages. For example:

        die Student*en* studier*en*   'the students study'
        die Flieg*en* stör*en*   'the flies are annoying'
Such patterns maximize morphemic transparancy.

[9]   For *umlaut* the situation is relatively complex: the mutable forms of the vowels /o/, /u/, and /au/ are relatively rare in the singular with monomorphemic nouns. Thus *umlaut* has for these vowels a middle range cue validity as a plural marker. On the other hand, the mutable form of

Of the three criteria for determining the cue strength of morphological markers, -(e)n satisfies all three, -s satisfies two, -e satisfies one fully and another only partially, -er satisfies only one, and finally, umlaut only one of them only partially. The three citeria thus provide a rank order of plural markers in terms of their overall cue strength.[10]

Table 7 summarizes the experimental results in terms of word environments which favor or disfavor particular plural markers in the real lexicon. Environment types (1) and (2) include word types which always occur with a particular plural marker. For example, in the real lexicon all derived nouns with the derivational suffix -ung and all singular nouns with stem-final -e take the plural marker -(e)n. Types (3), (4). and (5) include word environments which have high, medium, and low co-occurrence with particular suffixes in the real lexicon, respectively. Finally, type (6) includes environments which categorically exlude particular suffixes in the real lexicon. A dash in the table indicates that the environment does not exist for a particular suffix, or that no relevant environment was tested in the experiment.

The experimental results are complex, but seem to indicate the following trends: (1) and (2) show that -(e)n and -e were used close to 100 percent of the time in obligatory environments. There does appear to be undergeneralization of -(e)n with masc./neut. nonce words ending in schwa (77 percent) since the IP model predicts 100 percent. But this could be due to the extremely low type frequency of such nouns in the real lexicon.[11] In favored

---

the high-frequency vowel /a/ has only low cue validity, because it is quite frequent in the singular. Furthermore, umlaut is not only found in the context of number, but also in the context of some nominal derivational suffixes, e.g. -lein, -chen, and -ling (cf. Wurzel (1984a) for an extensive discussion of this phenomenon).

[10] This rank order is based on theoretical estimates, and is thus provisional. A quantification of cue strength would require (a) quantitative measures of frequency and cue validity; (b) a strong theoretical basis for determining the relevant contrast set for the calculation of cue validity; and (c) an experimental procedure for determining perceptual salience. For the latter, lexical decision methodology could be used in which subjects are first visually primed with the singular form of a noun, and then auditorily presented with either the singular or the plural form of the same noun. Both the error rate in deciding singular or plural and the reaction time would provide measures of the plural marker's perceptual salience.

[11] Only a few such neuter nouns exist, notably das Auge 'eye' and das Ende 'end'. Although there is a considerable number of human and animate schwa-final masculine nouns, such as der Knabe 'youth', der Beamte 'official', and der Falke 'hawk', these could have served as a basis of generalization only if the subjects had been thinking of animate beings during the experiment, which was not part of the instruction. Beyond these, there are no schwa-final masculine nouns. With this exclusion in mind, -(e)n has very low frequency in the lexicon with masc./neut. schwa-final nouns, although it is obligatory for the few that exist. It can thus be argued that the subjects strongly generalized -(e)n in a context in which it barely exists in the real lexicon.

Table 7

Overgeneralization and undergeneralization of plural suffixes. Data are recalculated from table 3. Environment types are explained in the text.[a]

Environment type	-(e)n		-s		-e		-er	
	N	perc.	N	perc.	N	perc.	N	perc.
1. obligatory environments with derivational suffix	155	96%		—	79	99%		—
2. obligatory phonetic environments[b]	75	94%		—		—		—
	122	77%		—		—		—
3. favored environments	105	66%	219	69%	201	42%		—
4. possible environments	146	23%		—		—	34	11%
5. marginally possible environments		—	97	9%		—		—
6. excluded environments	63	10%	23	4%	31	2%	14	᷉1%

[a] N = number of times that the suffix was used in the specific environment type. Percent = percent of total token occurrences of that environment type.

[b] N = 75 for feminine gender nouns ending in *schwa*; N = 122 for masculine and neuter nouns ending in *schwa*. See text for discussion.

environments (3), -*(e)n* and -*s* were used two-thirds of the time, but -*e* was used less than one-half of the time, suggesting an undergeneralization of -*e* compared to -*(e)n* and -*s*. In possible environments (4), -*er* was used only about 1 out of 10 times, suggesting an undergeneralization of this suffix. In marginal environments (5), -*s* was used nine percent of the time, suggesting overgeneralization. Finally, in excluded environments (6), -*(e)n* and -*s* appear to have been overgeneralized. -*e* less so, and -*er* not at all. These details are summed up in figure 1, which contains idealized curves averaging the available data points. The curve for -*(e)n* lies over the curve for -*e*, and the curve for -*e* lies over the curve for -*er*, as expected from the hypotheses in table 6.

The only exception is the curve for -*s*, which lies above the curve for -*(e)n* in the middle range of environments. This unexpectedly frequent use of -*s* probably reflects the fact that -*s* is overall the favored plural marker for foreign words. Since the experiment was based on nonce words which were of course unfamiliar to the subjects, some no doubt tended to perceive them as newly borrowed words, thus prompting them to use -*s* more often (cf. section 5 for further discussion).

The final plural marker not appearing in figure 1 is *umlaut*. Previous discussion indicated that it is strongly undergeneralized. Table 5 shows that in
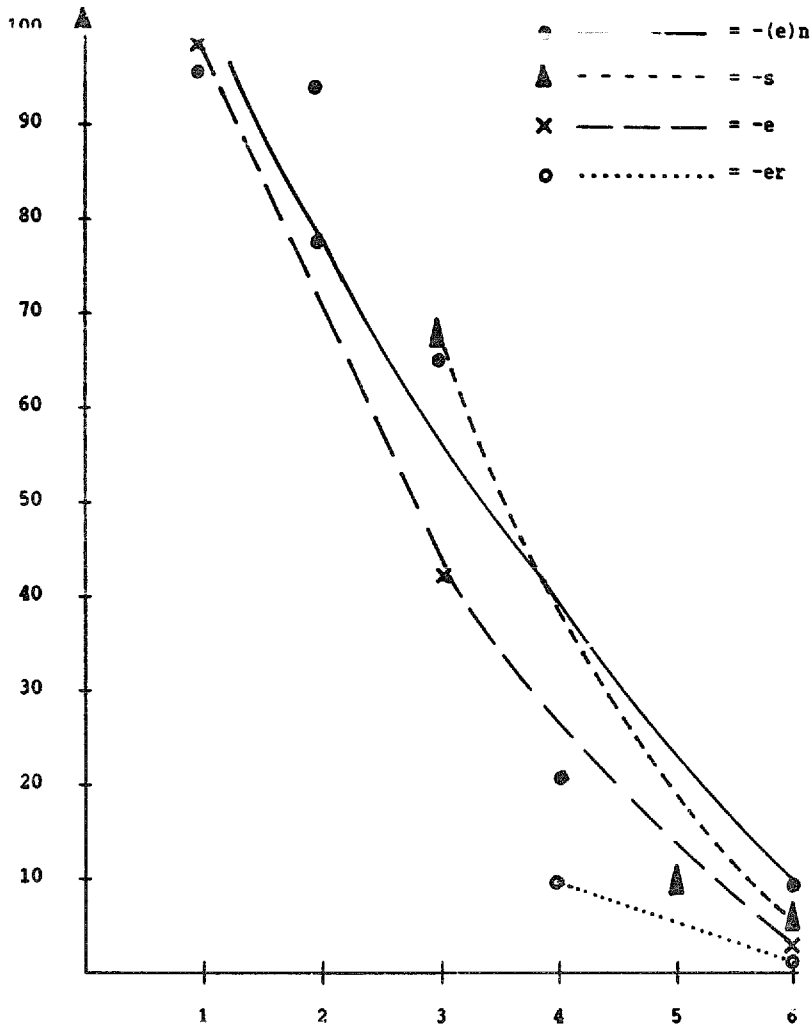
Figure 1

a possible environment *umlaut* was used only three percent of the time. Furthermore, the only environment in which the use of *umlaut* increases is where all other forms of plural marking are excluded, cf. table 5, line 3.

In sum, the experimental data provide little support for either the 'rote' model or the IP model as psycholinguistic constructs. On the one hand, the subjects showed a strong tendency to base their decisions on real patterns in the nominal lexicon, whereas the 'rote' model provides no basis for generalizations to nonce words. On the other hand, the subjects showed marked deviations from real lexical patterns, speaking against the IP model. For example, they almost totally neglected *umlaut*, even where real lexical patterns

require it. Finally, the good fit provided by a model based on major patterns
in combination with the principle of cue strength suggests that the speakers'
mental representation of morphological knowledge simplifies immanent pat-
terns in the lexicon in accordance with general cognitive principles.

4.3. Plural schemas

The third point to be raised is whether speakers generate singular and
plural forms of a noun from a single base form (in accordance with the IP
model), or whether singular and plural forms have separate representations.
The strong version of the hypothesis that plural nouns are simply indepen-
dent forms is not supported by the results of this experiment. Speakers would
have no basis for creating the plurals of new nouns in a principled way,
predicting random behavior in the experiment. A modified version of the
seperate representation hypothesis claims that speakers have abstract schemas
for possible singular and possible plural nouns, and that they create plurals
by matching a plural schema. Likewise, if a noun in its singular form already
matches a plural schema, they will consider it already plural. This account
has been already brought up by Linell (1976: 21) when he argues that

> 'there is plenty of evidence that languages strive for matching certain canonical (surface)
> patterns for the various morphological categories rather than deriving the forms by simply
> adding some invariant material to the input forms of the corresponding morphological
> operations.'

Menn and MacWhinney (1984) give extensive evidence that many languages
avoid repetition of morphemes (cf. also Stemberger (1981) and Stemberger
and MacWhinney (1986)). There is strong support for this view in the data.
Menn and MacWhinney (1984: 529) even propose a weak morphological
universal which they term 'repeated morph constraint', formally expressed as
follows:

> '*XY, where X and Y are adjacent surface strings such that both could be interpreted as
> manifesting the same underlying morpheme through regular phonological rules, and where
> either
>   (a) X and Y are both affixes, or
>   (b) either X or Y is an affix, and the other is a (proper subpart of a) stem.'

Furthermore, language acquisitional data support the schema approach.
MacWhinney (1978) reports that German children tend to omit plural

morphemes from nouns that already sound plural, e.g. *Hammer* 'hammer', *Pfeife* 'pipe', and *Glas* 'glass'. MacWhinney suggests that children apply a principle to the noun they retrieve from their lexicon that he terms 'affix-checking'. These observations are in accordance with experimental data on the acquisition of plural morphemes in English (cf. for example Berko (1958), Derwing and Baker (1979), and Solomon (1972)). These authors have suggested that the English plural morpheme /-z/ is omitted in cases where the nonce word already ends in /z/ or /s/, e.g. *niz* or *tass* respectively.

A prototypical singular noun would be one that does not have any features of a plural schema. Occasional features of singular nouns that could be interpreted as devices marking a 'plural' include the definite article *die* of feminine nouns, the stem endings *-en, -s, -er,* and *-e,* and, finally, *umlaut.* A prototypical singular noun would show none of these, whereas a prototypical plural noun would show a maximal number of them. Since this distinction is best reflected in nonce words ending with the pseudosuffixes *-el, -er,* and *-en,* this group of words will be examined more closely. Table 8 contrasts the assignment of the plural morphemes *-(e)n* and *zero* to this group of items by the subjects.

Table 8

Degree of prototypicality of plural forms.

	Example	-(e)n	-∅
a. For masc./neut. stimulus nonce words (change of article occurs, expected plural is -∅)			
masc./neut. + -el	der Knaffel	22%	69%
masc./neut. + -er	das Zirfer	16%	77%
masc. + -en	der Süßen	1%	91%
b. For fem. stimulus nonce words (no change of article, expected plural is -(e)n)			
1. monosyllabic nouns: not possible as a plural	die Luhr	66%	1%
2. pseudosuffix -el: 1 plural feature	*die* Toftel	59%	28%
3. pseudosuffix -er: 2 plural features	*die* Bachter	40%	43%
4. pseudosuffix + U + -er: 3 plural features	*die* Wührer	13%	75%

Table 8 (a) takes into consideration the masculine and neuter nouns ending in a pseudosuffix. For all of these nonce words the predicted plural is *zero.*

The results confirm this prediction best for masculine nouns ending in *-en*, less so for nouns ending in *-er*, and worst for nouns ending in *-el*. Taking into consideration that the pseudosuffix *-en* also has high cue strength as a plural marker, that *-er* has low cue strength, and that *-el* is not a plural marker at all, we can argue that nonce words were perceived as being already plural in form, and therefore left unchanged in the experiment, just to the extent that they approximated a plural schema. That is, the subjects left forms alone if they already sounded plural. Or inversely, they *avoided* the creation of plural forms that sound doubly marked, in accordance with Menn and MacWhinney (1984). Double plural marking, as in English *children* 'child-er-en', does not occur at all in Standard German.

The expected plural marker for feminine pseudosuffixed nouns is *-(e)n*, yet table 8(b) shows that the subjects often used *zero*, i.e. they quite surprisingly seemed to be undergeneralizing the use of *-(e)n*. But a detailed examination shows their responses to be consistent with the hypothezised marking strategy: they avoided *-(e)n* and used *-∅* to the extent that the nonce word already appeared to be plural in form. Line 1 in table 8(b) gives a base line for the subjects' use of *-(e)n* vs. *-∅*. A monosyllabic nonce word such as *die Luhr* cannot be plural in form, and such nouns in the real lexicon always add a suffix. For such nonce words, the subjects used *-(e)n* 66% of the time, and *-∅* almost never. By contrast, pseudosuffixed nouns in general can take *-∅* as a plural marker. Lines 2, 3, and 4 show that as the number of plural features increases from 1 to 3 the tendency to use *-(e)n* goes down and the tendency to use *-∅* goes up. A nonce word such as *die Toftel* has one feature of a plural noun: the definite article *die*. The nonce word *die Bachter* has two plural features: the article and the pseudosuffix *-er*. Finally, the nonce word *die Wührer* has three plural features: the article, the pseudosuffix *-er*, and *umlaut*. The results are thus not compatible with the hypothesis that speakers simply apply rules based on co-occurrence patterns in the real lexicon to a single base form when forming the plural of new nouns. On the other hand, the results are strikingly compatible with the alternative hypothesis that speakers apply abstract schemas for the distinctive morphophonemic structures of singular and plural nouns.

Four other results of the experiment support this conclusion. The first concerns the unexpectedly low use of *-(e)n* for masc./neut. *schwa*-final nouns in table 7 (line 2). Table 3 (line 2(a)) shows that when subjects did not use the predicted *-(e)n*, they almost always used *zero*. Although this pattern of plural marking is impossible in the real lexicon, it did create highly prototypical plurals for masc./neut. monosyllabic nouns, e.g. *der Tisch-die Tische* 'table'.

The zero-base of these subjects is inexplicable in a model which insists that plurals are derived from the singular form. But it is completely consonant with the schema model, which would allow the subjects to pick a good-sounding plural for a masc./neut. gender noun, regardless of its singular form. The next point bears that out.

The second source of additional support for the schema model concerns nouns ending in full vowels. Table 9 summarizes these results.

Table 9
Plural responses for nonce words ending in a full vowel. Expected plural morpheme is -s

	N	-(e)n substitution	Example	-s	Example
masculine e.g. *der Treika*	80	25%	die Treiken.	60%	die Treikas
feminine e.g. *die Kafti*	159	15%	die Kaften	68%	die Kaftis
neuter e.g. *das Siero*	80	16%	die Sieren	79%	die Sieros
Total	319	18%		68%	

In a majority of instances the expected plural morpheme -s was used. But in a surprisingly large number of instances the subjects deleted the final vowel and substituted -*(e)n* when forming the plural. For example, 25% of the plural responses to masculine nouns like *der Treika* was *die Treiken*. A model which assumes that plural forms are rule-generated from singulars can generate such forms, but it cannot account for why the deletion occurs, neither can it account for why -*(e)n* is the substituted morpheme. On the other hand, a model based on plural schemas would predict the vowel deletion, since final full vowels are infrequent in German and occur mostly in recent loanwords, i.e. full vowel + -*(e)n* is not a plural schema. Furthermore, the schema model would predict -*(e)n* as the substitution morpheme, since it has the greatest overall cue strength of the plural markers. To put this simply, the subjects took a relatively unnatural-sounding singular, and in some cases created a highly natural-sounding plural form from it. It should be noted here that this substitution process has begun in the real lexicon, and is rapidly gaining ground (cf. Köpcke (forthcoming)).

The third source of support for the schema model concerns nouns ending in *schwa*. A comparison between *schwa*-final nouns in table 3 (lines 2a and 2b) and monosyllabic nouns in table 3 (lines 5a–5c) shows that subjects used

zero frequently for the former one, although this pattern of plural marking is impossible in the real lexicon, but almost never for the latter one. Obviously, subjects tended to perceive the final *schwa* of the singular forms in lines 2a and 2b as a match with a plural schema, since for monosyllabic masc./neut. nouns -*e* would be the predicted plural marker.

Table 10
Plural responses for neuter monosyllabic nonce words.

	-(e)n	-e	Other
1. das Kett	58%	15%	27%
2. das Grett, das Flett, das Kier	22%	48%	30%

The fourth piece of evidence supporting the schema hypothesis concerns the plural responses to the nonce word *das Kett*, compared to other neuter monosyllabic nouns, depicted in table 10.

The preferred plural in the real lexicon in this environment is -*e*. Line 2 of the table shows that the subjects did use this suffix more than the others, but line 1 shows that for the nonce word *das Kett* they preferred -*(e)n*. This discrepancy can be explained by the fact that *die Ketten* is the plural of a real noun, *die Kette* meaning 'chain'. It was not possible to produce the plural of a real noun from any other nonce word in the experiment. This suggests that the subjects were not blindly generating plural forms from a singular base, but rather were searching in the lexicon for independent plural schemas which could be related to particular singular nonce words. In this instance some subjects hit on the most concrete of schemas: the lexical schema for an actual plural noun.

5. Assignment of plural morphemes to recent loanwords

The assignment of plural morphemes to recent loans can be considered as a *natural* test case for the observations mentioned above, in the sense that individuals, and institutions such as DUDEN and German radio, make decisions about plural assignment with no metalinguistic awareness of the hypotheses presented here. Of particular interest are monosyllabic nouns, since they offer no information, except their gender assignment, about which

plural morpheme should be chosen. Köpcke (1982) lists 1466 monosyllabic nouns out of which 182 are recent loanwords of widespread origin (Arabic, English, French, Greek, Latin, Malaysian, etc.). Out of these, 33 have two competing plural morphemes, yielding a total of 215 plural assignments, summarized in table 11.

Table 11
Assignment of plural morphemes to recent monosyllabic loanwords in the real lexicon.

	N	-(e)n/U	-e/U	-∅/U	-s/U	-er/U
masculine	140	1%	39%/0.02	2%	56%	<1%
feminine	35	49%	14%	—	37%	—
neuter	40	5%	23%	5%	68%	—

The following general conclusions can be drawn from table 11.

First, -s is the preferred plural morpheme for masculine and neuter monosyllabic nouns, and -s is strongly represented for feminine nouns.

Second, -e has roughly maintained its representation for masculine and neuter monosyllabic nouns in comparison to the experimental data, and to native German nouns.

Third, -er and umlaut are strongly undergeneralized, in accordance with the experimental results. The ending -er is used for only one loanword as an alternative to zero, i.e. der Ski 'ski' — die Skier or die Ski. The undergeneralization of umlaut is most striking in the context of the plural morpheme -e. None of the feminine loans take umlaut (e.g. die Hulk 'hulk' — die Hulke not *Hülke), although umlaut is obligatory in the native lexicon, and only one of the masculine nouns does so as an option (der Pasch 'doubles when rolling dice' — die Päsche or die Pasche), although in the native lexicon umlaut is strongly represented (Mugdan (1977) lists 219).

Fourth, zero surprisingly appears to be overgeneralized, since this morpheme is not possible for monosyllabic nouns in the native lexicon. Drops 'gum drops', Keks 'cake', and Quiz 'quiz', which take the zero plural in alternation with a plural suffix, all match the plural schema based on -s in their singular form, a situation in which the experimental subjects frequently used zero in the nonce word experiment. This finding is thus in full accord with the schema model.[12] Furthermore, note that in these cases plural

---

[12]   One could argue that the low cue strength of zero (no salience, no cue validity) makes this finding contradictory. But from a perceptual point of view, it is not at all surprising. The claim that these (singular) nouns fulfil a plural schema means that speakers perceive the stem-final -s as a plural 'marker', one which has high salience and cue validity. This creates problems for a theory of morphological segmentation, but apparently not for speakers of German.

marking is still accomplished by the determiner, since these nouns with *zero* plurals are all masculine or neuter gender. There are six feminine nouns in the sample which in their singular form fulfil a plural schema (e.g. *die Fenz* 'fence'), all of which take a plural suffix (*die Fenz-en*), since the determiner does not mark number. In other words, the perceptual fact that these feminine nouns match a plural schema is overridden by the functional need to clearly distinguish singular from plural forms by one means.

Fifth, *-(e)n* seems to be a problem at first sight, since its undergeneralized use with the loanwords is not compatible with the experimental results. However, a closer look reveals that there are a few masculine and neuter instances in the sample, whereas this morpheme cannot be expected on the basis of the native lexicon. This is in particular true for the neuter nouns. On the other hand, with feminine monosyllabic loans *-(e)n* is undergeneralized in favor of *-s*.

In general, the results for plural assignment to loanwords reveal compatibility with the predictions made from the schema model based on cue strength, cf. section 4.2. The only exception to this prediction is that *-s* dominates the use of *-(e)n*, which is also reflected in the experimental results, cf. figure 1. Furthermore, for all three genders the morpheme *-s* is in competition with the predicted morpheme, i.e. with *-e* for masculine and neuter nouns and *-(e)n* for feminine nouns. The strength of *-s* is probably due to the fact that German bilingual speakers of English and French borrowed not only the lexeme from the source language into German, but also the plural morpheme. This grammatical borrowing is supported by two other factors:

(i) Even before the influx of French and then English nouns with *s*-plurals into German a small number of native *s*-plurals already existed in the language (cf. Öhmann (1961–62)). Thus *-s* was a low frequency but already recognizable plural morpheme in German. In comparison other foreign plurals lacking a basis in the native German lexicon, have made no inroads whatever. Foreign plural markers such as Greek *-ta* as in *Thema — Themata*, Hebrew *-im* as in *Cherub — Cherubim*, or Italian *-i* in *Tempo — Tempi* are limited to the small number of stems with which they were borrowed and almost inevitably have a primary or secondary germanicized plural, *Themen, Cherubinen*, and *Tempos*.

(ii) Even before the major influx of foreign *s*-plurals, *-s* already had good cognitive viability as a plural marker due to its high salience and cue validity. It lacked only a frequency basis to make it a favorite plural marker, and this was provided by the influx of foreign *s*-plurals. Consequently, as soon as

nouns with s-plurals were no longer used exclusively by bilingual speakers, -s attained the status of a preferred morpheme for 'foreign' nouns in the monolingual speech community. This explains the strength of -s in the experimental results.

6. Historical change

Finally, a psychologically based theory of morphological marking can provide substantial insights into historical change in the plural marking system of German, which a purely structural theory is not able to do.

The experimental results (table 8(b)) showed an increase in *zero* responses to feminine gender pseudo-suffix nouns moving from -el to -er to -en, in accord with the increasing cue strength of these stem-final syllables as a possible plural marking. This would predict an increasing disfavoring of -el, -er, and -en as singular stem formatives for feminine nouns. In the real lexicon there are more than 100 feminine nouns with stem-final -el, only about 40 (mostly frequently occurring) with -er, and none at all with -en (cf. Köpcke (forthcoming)).

Historically a number of feminine *n*-final nouns arose through phonetic erosion, but the final -*n* was quickly dropped. Paul (1968: 87–88) lists the instances shown in table 12.

Table 12

OHG	MHG	late MHG/ early NHG [a]	NHG
butinna	> hutin	> bütten	> Bütte 'wooden tub'
chutina	> chutin	> chuten	> Quitte 'quince'
fërs(a)na	> fërsen	> fersen	> Ferse 'heel'
kestinna	> kestin	> kesten	> Keste (= Kastanie) '(horse) chestnut'
ketina	> ketin	> ketten	> Kette 'chain'
kuchina	> kuchin	> küchen	> Küche 'kitchen'
lugina	> lugin	> lügen	> Lüge 'lie'
lunginna	> lungin	> lungen	> Lunge 'lung'
mettina	> mettin	> metten	> Mette 'mass'
redina	> redin	> reden	> Rede 'speech'
woustinna	> woustin	> wüsten	> Wüste 'dessert'

[a] Note that at this point the evolving singular forms have become identical with their corresponding plurals.

The development of these nouns can be described briefly as follows: From OHG to MHG the final vowel /a/ was lost via phonetic erosion, in the next stage, the vowel /i/ of the final syllable weakened to *schwa*. At this point in their development, these feminine nouns match in their nominative singular a plural schema. A back formation took place in which the stem-final *-(e)n* was reinterpreted as a plural marker, forcing the formation of a new singular parallel to the already existing pattern of *die Zunge — die Zungen* 'tongue'. This reestablished distinctiveness between the singular and plural forms. Corresponding masculines (e.g. *Becken* 'basin' < Vulgar Latin *baccinum*) and neuters (e.g. *Kissen* 'pillow' < Old French *coissin*) did not exactly match a plural schema because of their gender, and did not drop their stem-final *-(e)n*.

The opposite direction in change can also be observed: by the late middle-ages many masculine and feminine nouns adopted the marker *-n* from the oblique cases to the nominative singular, in particular in the Bavarian dialect form of German. Paul (1968: 38 and 87) lists among others the instances shown in table 13.

Table 13

Masculine	Feminine
Balken 'beam'	Kirche(n) 'church'
Bogen 'bow'	Erde(n) 'earth'
Braten 'roast'	Sonne(n) 'sun'
Fetzen 'scrap'	Wunde(n) 'wound'
Kasten 'box'	Zunge(n) 'tongue'
Kragen 'collar'	Witwe(n) 'widow'
Magen 'stomach'	Feder(n) 'feather'
Schinken 'ham'	Buchse(n) 'can'
etc.	etc.

This change did not cause any problem for the plural marking of the masculine nouns, since the change of the article form serves as a sufficient marker. However, the feminine nouns were in danger of being interpreted as plurals. The new *n*-ending in the case of the feminine nouns was dropped ag.   ' favor of the earlier *schwa*-ending, but not so in the case of the masc.. nouns.

Finally, it can be shown that the application of the plural morpheme *-(e)n* has expanded in the course of time. For example, it spread to all feminine nouns which had formed their plural with *-e*, e.g. *die Pflicht — die Pflichte > Pflichten* 'duty', and to many feminines that had formed their plural with

umlaut + *-e*, e.g. *die Flut* — *die Flüte* > *Fluten* 'flood' (cf. Paul (1968: 88–89)).

The low cue strength of the plural schema based on *-e* for feminine nouns, and the greater cue strength of the schema based on *-(e)n*, is particularly salient in the fact, that many plural forms based on the *e*-schema were reinterpreted as singulars, leading to the formation of new plurals based on *-(e)n*. Paul (1968: 90) gives the feminine examples listed in table 14, except for the last one, which is just now in the process of changing.

Table 14

MHG		NHG	
Singular	Plural	Singular	Plural
biht	> bihte	Beichte	> Beichten 'confession'
eich	> eiche	Eiche	> Eichen 'oak tree'
arweiz	> arweize	Erbse	> Erbsen 'pea'
lich	> liche	Leiche	> Leichen 'corpse'
geschiht	> geschichte	Geschichte	> Geschichten 'story'
bluot	> blüete	Blüte	> Blüten 'blossom'
druos	> drüse	Drüse	> Drüsen 'gland'
ant	> ente	Ente	> Enten 'duck'
huf	> hüfte	Hüfte	> Hüften 'hip'
hurt	> hürte	Hürde	> Hürden 'hurdle'
sul	> süle	Säule	> Säulen 'column'
furch	> fürche	Furche	> Furchen 'furrow'
stuot	> stüete	Stute	> Stuten 'mare'
niß	> niße	Nisse	> Nissen 'nit'

Overall then the following trend can be seen from the historical data: *(e)n* is the plural morpheme that substitutes those morphemes that gradually move out of the system. This is in particular true for *-e*, which has only medium cue validity (cf. section 4.2) and which will loose its strength as a plural marker even more the more feminine nouns will form their nominative singular in *-e*.

7. Conclusion and a theoretical proposal[13]

The results of the experimental study indicate that speakers of German show a number of highly consistent tendencies in choosing a plural form for

novel words. At a general level, these tendencies are based on patterns in the existing nominal lexicon. In the case of forms with the derivational suffixes *-ling*, *-heit/keit*, and *-schaft*, and feminine gender nouns with stemfinal *-e* these tendencies reach near categorical assignment of a plural suffix based on the singular form of the noun. These instances thus lend themselves to an input-oriented Item-and-Process model.

At a more specific level, however, the experimental data deviate substantially from predictions based on an IP model, and lend themselves rather to the formulation of a psycholinguistic model of plural marking based on abstract lexical schemas. This Schema Model gains additional support from the conventionalized assignment of plural to recent loanwords, and from patterns of historical change in plural formation. The two sources can be characterized as 'experiments of nature' in the sense that they reflect the productive application of linguistic competence in natural communicative situations in the speech community, rather than in the constrained rarefied conditions of the laboratory. Thus the possibility of experimental artifact is removed by the correspondence with naturally occurring phenomena.

The Schema Model of plural formation could contain at least the following. Some points are substantially supported by experimental, loanword, and historical data, others are suggested by one or another of these sources:

(1) Plural marking is *output (product) oriented*, cf. Zager (1980); Stemberger and MacWhinney (1986). Speakers form the plural of a noun by matching it to one (or more) abstract plural schemas residing in the mental lexicon, rather than by blindly generating the plural form with an IP rule applied to the (input) singular form.

(2) Plural marking consists not of individual morphemes, but rather of abstract schemas drawing on at least several of the following components:

(a) *Additivity*. This consists of a number of psycholinguistically distinguishable steps of increasing cue strength for signalling plural. The initial step is extremely weak by itself, while the final step is, by itself, sufficient to force an interpretation of plurality:

(i)   *Polysyllabicity*. A polysyllabic form has (slightly) greater probability of being interpreted as plural than a monosyllabic form, e.g. *Schema* 'schema' vs. *Tisch* 'table'.

(ii) The final syllable/segment is *en* > *s* > *e* > *er* in decreasing order of cue strength (but *not* analytically segmentable), e.g. *Fenster* 'window'.

(iii) A lexical partner without the final syllable/segment exists. i.e. a form

which corresponds phonologically but not semantically, e.g. *Splitt* 'gravel' — *Splitter* 'splinter'.

(iv) The form and its lexical partner have concept-identity, i.e. the final syllable is analytically segmentable, e.g. *Brett* 'board' — *Bretter* 'boards'.

Note that the relative cue strength of the final syllables/segments *en* > *s* > *e* > *er* remains constant, although their absolute cue strength increases as they approach segmentability.

(*b*) *Vowel mutation* (umlaut). Forms with a mutated vowel (e.g. *Leuchte* 'lamp') have (slightly) higher plural cue strength than forms with an unmutated vowel, e.g. *Raupe* 'caterpillar'. This cue strength is increased if the mutated form has a lexical partner without vowel mutation, e.g. *Mütter* 'mothers' vs. *Mutter* 'mother'.

(*c*) *Determiner*. Forms which take *die* as their determiner class (i.e. feminine-gender nouns) have (slightly) higher plural cue strength than forms taking *der* (masc.) or *das* (neut.). This cue strength is increased if the form has a lexical partner taking *der* or *das*, e.g. *die Kiefer* 'pine tree' vs. *der Kiefer* 'jaw', and is further increased if the lexical partner has concept identity, e.g. *die Wagen* 'cars' vs. *der Wagen* 'car'.

(*d*) *Token frequency*. If a form has lower token frequency than its concept-identical partner, then it has a heightened conceptual strength (nb: *not* cue strength) as plural form. Many of the reinterpreted plural forms listed by Paul (1968), cf. section 6 table 14, violate this principle, i.e. they are more frequent than their singular forms. This factor in combination with the fact that these plural forms fit a plural schema having equal cue validity as a singular schema, was apparently strong enough to stimulate their reanalysis as singular forms, a process which is currently taking place for *Niß* 'nit (louse egg)': *der Niß* (masc. singular) – *die Nisse* (plural) > *die Nisse* (fem. singular) > *die Nissen* (plural).

The Schema Model, as outlined above, could be strengthened by incorporating singular schemas into it, thereby recognizing that the language user makes decisions about whether a particular form is singular or plural, rather than evaluating a form as a possible plural. This would result in a *Continuum* of schemas ranging from an ideal *singular* schema on the left to an ideal *plural* schema on the right. An ideal singular schema would be monosyllabic, have a final stop consonant, and be in the *der* (masc.) or *das* (neut.) determiner class. An ideal plural schema would be polysyllabic with the final syllable/segment *-(e)n* and have a determiner from the *die* class.

singular   *plural*

☆ ——————— ☆ ——————— ☆ ——————— ☆ ——————— ☆

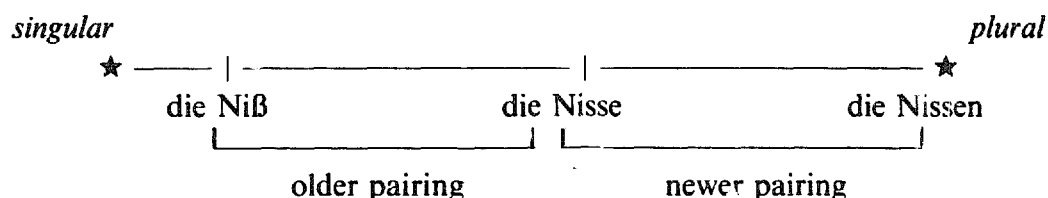| mono- syllabic final stop der/das	poly- syllabic final -*er* der/das	poly- syllabic final -*e* die	poly- syllabic final -*er* die	poly- syllabic final -*(e)n* die

A schema such as [*der/das* + polysyllabic + -*er*] would have greater cue strength as singular than as plural, while a schema such as [*die* + polysyllabic + -*er*] would have greater cue strength as a plural than as a singular. Finally, the schema with the components [*die* + polysyllabic + -*e*] might have equal cue strength as singular and plural. The language user's decisions about the singularity or plurality of a particular form (X) would be based on two factors:

(i) Position on the continuum of the schema to which the form (X) conforms.

(ii) The existence of a (concept-identical) lexical partner (Y) conforming to a schema to the right or to the left of (X) on the continuum.

The first factor suggests that a particular schema has an *absolute* cue strength for signalling singular or plural, while the second suggests that it has a cue strength *relative* to other schemas on the continuum. The latter is based on the notion of *relational invariance* explicited in Zubin's (1978) dissertation on case marking and emanates from the Jakobsonian school. The relational factor makes it possible for a form to function as a plural, even though it has slightly higher cue strength as a singular and vice versa. For example, *die Knie* [kni:] 'knees' can function as the plural of *das Knie* 'knee' even though its schema is to the left of the center. *Die Drüse* 'gland' can function as the singular of *die Drüsen* 'glands', even though its schema is to the right of the center because of the mutated vowel. Note the overlapping of singular vs. plural interpretation of schemas illustrated by *die Brust* 'breast' vs. *die Brüste* 'breasts'.

monosyllabic final stop der/das	polysyllabic final -*e* die	polysyllabic final -*(e)n* die

☆——|————————————|——— ☆ ——— |————————————— ☆

das Knie (sg) ——— die Knie (pl)   die Drüse (sg) ——— die Drüsen (pl)

die Brust (sg)—die Brüste (pl)

This model could provide a powerful basis for predicting both experimental results and historical change. For example, the reinterpretation for a large number of lexical items depicted in table 14 corresponds to the fact that the original plural forms conform to a schema at the exact middle of the continuum. The additional factor of high token frequency is enough to stimulate their reinterpretation as singulars, and the formation of new plurals:

singular   *plural*

☆ ——— | ———————————— | ———————————— ☆

die Niß   die Nisse   die Nissen

‖—————————————‖ ‖—————————————‖

older pairing   newer pairing

Appendix

List A

1. der /knafəl/
2. die /šet/
3. der /trayka:/
4. die /šerguŋ/
5. die /toftəl/
6. das /zi:ro:/
7. der /knawklin/
8. die /mu:rə/
9. der /štisən/
10. das /gret/
11. der /trox/
12. die /kaftu:/
13. der /knumpə/
14. die /trawxšaft/
15. das /kvetçən/
16. die /baxtər/
17. das /zi:rər/
18. die /puxt/
19. das /pri:rə/
20. das /ket/
21. die /kafti:/
22. das /šwirklayn/
23. das /trilçəl/
24. der /trunt/
25. der /knawkər/

List B

1. die /maftə/
2. das /tralpəl/
3. der /knolk/
4. das /li:kçən/
5. der /traygə/
6. der /špoyçəl/
7. die /jeçtu:/
8. die /knisəl/
9. der /knumpa:/
10. das /flet/
11. das /tsirfər/
12. die /lu:r/
13. die /šrenkuŋ/
14. der /trawkən/
15. der /šlas/
16. die /vy:rər/
17. die /grolçšaft/
18. das /bi:ro:/
19. das /fli:rə/
20. der /kninkər/
21. die /goxt/
22. der /klirmliŋ/
23. die /myçti:/
24. das /ki:r/
25. das /poftlayn/

References

Augst, Gerhard, 1979. Neuere Forschungen zur Substantivflexion. Zeitschrift für germanistische Linguistik 7, 220–244.

Berko, Jean, 1958. The child's learning of English morphology. Word 14, 150–177.

Bybee, Joan L., 1985. Morphology: A study of the relation between meaning and form. Amsterdam: Benjamins.

Bybee, Joan L., 1986. Morphology as lexical organization. State University of New York at Buffalo. (Unpublished paper.)

Bybee, Joan L. and Dan I. Slobin, 1982. Rules and schemas in the development and use of the English Past Tense. Language 58, 265–289.

Bybee, Joan L. and Carol Lynn Moder, 1983. Morphological classes as natural categories. Language 59, 251–270.

Chomsky, Noam, 1965. Aspects of the theory of syntax. Cambridge, MA: MIT Press.

Chomsky, Noam and Morris Halle, 1968. The sound pattern of English. New York: Harper & Row.

Derwing, Bruce L. and William J. Baker, 1979. Recent research on the acquisition of English morphology. In: Paul Fletcher and Michael Garman (eds.), Language Acquisition, 209–224. Cambridge: Cambridge University Press.

Dressler, Wolfgang U., 1977. Phono-morphological dissimilation. Innsbrucker Beiträge zur Sprachwissenschaft 19, 41–48.

Hockett, Charles F., 1954. Two models of grammatical description. Word 10, 210–231.

Joos, Martin (ed.), 1957. Readings in linguistics. Chicago, IL: University of Chicago Press.

Köpcke, Klaus-Michael, 1982. Untersuchungen zum Genussystem der deutschen Gegenwartssprache. Tubingen: Niemeyer.

Köpcke, Klaus-Michael. forthcoming. Die Entwicklung der deutschen Pluralmorphologie aus psycholinguistischer Sicht.

Köpcke, Klaus-Michael and David Zubin, 1983. Die kognitive Organisation der Genuszuweisung zu den einsilbigen Nomen der deutschen Gegenwartssprache. Zeitschrift für germanistische Linguistik 11, 166–182.

Kuryłowicz, Jerzy, 1964. The inflectional categories of Indo-European. Heidelberg: Winter.

Lakoff, George, 1982. Categories and Cognitive Models. Berkeley Cognitive Science Report No. 2.

Linell, Per, 1976. On the structure of morphological relations. Linguistische Berichte 44, 1–29.

McDonald, Janet L., 1984. The mapping of semantic and syntactic processing cues by first and second language learners of English, Dutch, and German. Carnegie-Mellon University, Pittsburgh. (Unpublished doctoral dissertation.)

McDonald, Janet L., 1986. The development of sentence comprehension strategies in English and Dutch. Journal of experimental child psychology 41, 317–335.

MacWhinney, Brian, 1978. The acquisition of morphophonology. Monographs of the Society for Research in Child Development 43, No. 1.

MacWhinney, Brian, Csaba Pleh and Elisabeth Bates, 1985. The development of sentence interpretation in Hungarian. Cognitive Psychology 17, 178–209.

Mater, Erich, 1970. Rückläufiges Wörterbuch der deutschen Gegenwartssprache. Leipzig: VEB Verlag Enzyklopädie.

Mayerthaler, Willi, 1981. Morphologische Natürlichkeit. Wiesbaden: Athenaion.

Menn, Lise and Brian MacWhinney, 1984. The repeated morph constraint: Toward an explanation. Language 60, 519–541.

Mugdan, Joachim, 1977. Flexionsmorphologie und Psycholinguistik. Tübingen: Narr.

Öhmann, Emil, 1961–62. Die Pluralformen auf -s in der deutschen Substantivflexion. Zeitschrift für deutsches Altertum und deutsche Literatur 91, 228–236.

Paul, Hermann, 1909. Prinzipien der Sprachgeschichte. Halle (Saale): Niemeyer.

Paul, Hermann, 1968. Deutsche Grammatik. Vol. II. Tübingen: Niemeyer. (Original edition 1917.)

Philipp, Marthe, 1974. Phonologie des Deutschen. Stuttgart: Kohlhammer.

Smith, Edward E. and Douglas L. Medin, 1981. Categories and concepts. Cambridge, MA: Harvard University Press.

Slobin, Dan I., 1973. Cognitive prerequisites for the development of grammar. in: Charles Ferguson and Dan Slobin (eds.), Studies of child language development, 175–276. New York: Holt, Rinehart & Winston.

Solomon, Martha Bellamy, 1972. Stem endings and the acquisition of inflections. Language Learning 22, 43–50.

Stampe, David, 1972. How I spent my summer vacation. Ohio State University. (Unpublished doctoral dissertation.)

Stemberger, Joseph P., 1981. Morphological haplology. Language 57, 791–817.

Stemberger, Joseph P. and Brian MacWhinney, 1986. Form-oriented inflectional errors in language processing. Cognitive Psychology 18, 329–354.

Wurzel, Wolfgang Ullrich, 1984. Flexionsmorphologie und Natürlichkeit. Ein Beitrag zur morphologischen Theoriebildung. Berlin: Akademie-Verlag.

Wurzel, Wolfgang Ullrich, 1984a. Was bezeichnet der Umlaut im Deutschen? Zeitschrift für Phonetik, Sprachwissenschaft und Kommunikationsforschung 37: 6, 647–663.

Zager, David, 1980. A real time process model of morphological change. State University of New York at Buffalo. (Unpublished doctoral dissertation.)

Zubin, David, A., 1978. The German case system. Columbia University, New York. (Unpublished doctoral dissertation.)