The Acquisition of German Plurals
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Abstract
This article intends to show that the acquisition of German noun plurals is best understood by way of an approach that combines the idea of network processing and functionalist approaches. The data support the view that multiple cues determine the selection of a marker and that there are plural schemata. Inflectional morphology is not based on rules but rather on pattern association.

Introduction
In German, there are several endings for plural formation: *-(e)n* (*Auge/Augen* 'eye'), *-e* (*Hund/Hunde* 'dog'), *-e* +UL (*Kuh/Kühe* 'cow'), *-er* (*Kind/Kinder* 'child'), *-er* + UL (*Mann / Männer* 'man'), 0 (*Adler/Adler* 'eagle'), UL (*Vater/Väter* 'father'), *-s* (*Auto/Autos* 'car'). For approx. 85% of the nouns, masculine and neuter nouns take the plural *-e* or 0, masculine nouns ending in *-e* and feminine nouns take *-(e)n*. Further plurals are irregular, e.g. *Lexikon/Lexika* 'lexicon', *Kaktus/Kakteen* 'cactus', *Atlas/Atlanten* 'atlas', etc. New nouns first take the *-s*, later one of the other productive plural endings:

(1) *Pizza* / *Pizzas* → *Pizzen* 'pizza'
Kiosk / *Kiosks* → *Kioske* 'kiosk'
Birkenstock / *Birkenstocks* → *Birkenstöcke* 'extremely healthy sandal'
Modem / *Modems* → *Modeme* 'modem'
Balkon / *Balkons* → *Balkone* 'balcony'

Traditionally, the main tendencies of plural formation are stated as rules, and exceptions are added in long lists. Another possibility is paradigms. There are several declension types for singular and plural forms in various combinations. They are listed in tables and most nouns can be assigned to one of these paradigms. However, there are more or less frequent endings. The schema-model (e.g., Köpcke 1993, 1998) assumes a continuum of more or less prototypical plural schemata. The best singular (the worst plural) is monosyllabic, ends in a plosive and has the article *der* or *das*. The best plural is polysyllabic, ends in *-(e)n* and has the article *die.* The better the form, the more frequent, the more resistant against change it will be, and it will be acquired early on by the child. Furthermore, there are several cues with different degrees of importance which are relevant for the choice of a plural marker, phonological, morphological, semantic and lexical ones (Köpcke 1998, Wurzel 1998). One of these cues is 'non-native'. A foreign word will form its plural with *-s*. When it is integrated into the German lexicon, it will receive a different marker according to gender, form etc.

Method
The findings reported here are based on the diary data of a German speaking girl, A., collected continuously up to the age of 2 years, 5 months. All new words, word forms and novel pronunciations of established items were documented in IPA. Striking facts about situation and referents, comments on frequency and obsolescence of individual lexical items and notes on morphology and syntax were recorded. Imitations were distinguished from deferred imitations and spontaneous productions (cf. Elsen 1991 ff.). Here, only

spontaneous productions are considered. Further data on the acquisition of plurals can be found in Mugdan (1977), Park (1978), Schaner-Wolles (1988), Clahsen et al. (1992), Gawlitzek-Maiwald (1994), Vollmann et al. (1997), Ewers (1999).

Results

From around 1;3, the child started to differentiate between one / more than one. First plural *forms* did not represent plural meaning, but were probably mere formal reproductions. The first instances of the concept 'more than one' were expressed with the help of the number *two* /tsvaɪ/ or *three* /draɪ/: [baɪ], [vaɪ], without plural ending on the noun. First plural forms with plural meaning appeared at 1;5. At 1;6/1;7, the girl did not differentiate consistently between singular and plural forms. At 1;8/1;9, she usually produced correct singular vs. plural forms. - Numbers mean the age in years; months, days. For a detailed discussion cf. Elsen (1999b).

(2) [bamə] 1;2,29 *Bäume* 'trees', probably no plural meaning
[vɯs̄ə] 1;3,0 *Füße* 'feet', probably no plural meaning
[baɪ] 1;3,24 'two', for two stones
[da vaʷau, vavau] - [vaɪ vaɪ] - [baɪ baɪ] *da Wauwau*, ..., 1;4,0, 'there doggy, ...', for two dogs
[ɛi̯ə] - [baɪ baɪ baɪ] *Ente*,... 1;4,5 ´duck, two two two´, for three ducks
[tɪn̈a, vaɪ vaɪ] *Kinder*, ... 1;4,24 ´children, ...´, for several children
[baɪ baɪ] 1;5,0 breaks a piece of potato chip into two halves
[baɪ baɪ] 1;5,1 for two socks
[baɪ dē] *zwei Zeh*, 1;5,2 'two toe‘, for two toes
[baɪ, vaɪ] 1;5,3 for two bottles
[baɪ, vaɪ] 1;5,3 for two shovels
Büche 1;5,5 'books', plural intended
zwei Bulli 1;5,8 'two VW-vans', plural intended
Füße kalt 1;5,25 'feet cold'
Bücher 1;6,1 'books'
Bälle 1;6,4 'balls'

In the corpora studied in the literature, the children produced first *e*- and *(e)n*-plurals, later *-s* (e.g., Schaner-Wolles 1988, Vollmann et al. 1997). There were always *e*-over-generalizations, and the most frequent plural marker was *-(e)n* (e.g., Mugdan 1977, Park 1978, Mills 1985, Russ 1989, Schaner-Wolles 1988, Gawlitzek-Maiwald 1994, Vollmann et al. 1997, Ewers 1999, Behrens/Kiekhoefer 2000). It is the most frequent marker in adult language (tab. 1). Less frequent are *-e* and *-s*, for children as well as adults. This holds true for the diary data, too (tab. 1). The relatively high number of A.‘s words with *s*-plural results from words typical of the children’s environment, such as *Mama* ‘mummy‘, *Papa* ‘daddy‘, *Oma* ‘granny‘, *Teddy* ‘teddy bear‘, *Buggy* ‘buggy‘, *Lego* ‘lego‘, all taking the *-s*.
A’s. rate of the acquisition of words with the plural ending *-(e)n*, (UL)-*e* and (UL)-0 was nonlinear, that of words with *-s* and (UL)-*er* as well as others (other plural endings, singularia-, pluraliatantum) was linear (fig. 1; for nonlinearity in learning cf. e.g., Stadler et al. 1996, Elman et al. 1996). Whereas the growth of the last three groups remained relatively stable over time – there were none, one, two, three, hardly ever more new nouns in a group within ten days –, the first three showed an acceleration at 1;8. For the group

with *-(e)n*, there were about 11 new nouns in ten days at 1;8 and 1;9 (after three or five new ones before). After up to four, seldom more new words taking *-e*, there were 7, 9 or 13 new nouns at the end of 1;7, at 1;8 and 1;9. And for zero plural nouns, there were up to three new ones, but at 1;8 and 1;9 there were 6, 8 and ten new nouns in ten days.
In her overregularizations, the girl used mainly *-(e)n* (for a complete list cf. Elsen 1999b) in addition to (UL)-*e*, (UL)-*er*, and *-s*, even UL-*en* and UL-*s*, e.g., *Tüchen* 'cloths', *Vögels* 'birds', *Bäums* 'trees' (1;8 – B 2;1). For a short time (1;9,12-1;9,19), no *(e)n*-overregularizations were noted, but only three with *-e* (*Kruke* 'jugs', *Balongse* 'balloons', *Nusse* 'nuts') and two with *-s* (*viele Mannis, Männer, Männis* 'many men' (three different forms), 1;9,19). Afterwards, *-(e)n* dominated over the other markers. Only during the middle of 2,1, A. used mainly *-s* (eight times in ten days in contrast to once or, exceptionally, twice otherwise), e.g., *Fensters* 'windows', *Schokolades* 'chocolates',

Table 1: Distribution of plural groups in various corpora, in types, in %

	AD/AD° Janda*	AD/CH Wagner*	CH Elsen
-(e)n	42	53	31
-e	35	33	25
-0	12	/+	24
-er	10	8	6
-s	1	5	9
others	/+	/+	5

° AD/AD Adult to adult, AD/CH Adult to child, CH A.'s output
* from Clahsen et al. 1996: 121
+ not counted / not given

Figure 1: A.'s acquisition of nouns, in plural groups, word types

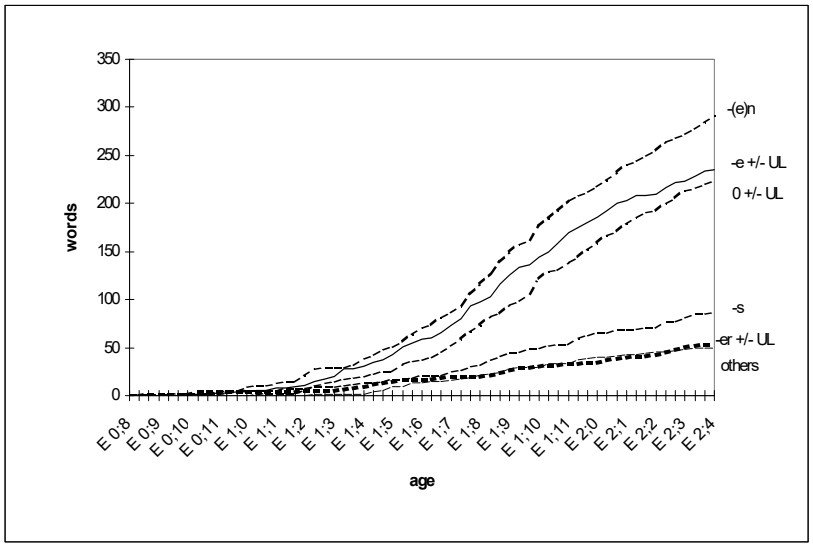

Table 2: A.'s incorrect plurals, word types

Age	(UL) -(e)n	(UL) -e	(UL) -er	(UL)-s	total
E* 1;2		(1)			
B 1;3		(1)			
M 1;3					
E 1;3					
B 1;4					
M 1;4					
E 1;4					
B 1;5		1			1
M 1;5					
E 1;5					
B 1;6					
M 1;6					
E 1;6					
B 1;7		1			1
M 1;7					
E 1;7		1		1	2
B 1;8	5			2	7
M 1;8					
E 1;8					
B 1;9	1				1
M 1;9		3		2	5
E 1;9	7		1		8
B 1;10	9	1		1	11
M 1;10	5	1			6
E 1;10	6		1	1	8
B 1;11	3			1	4
M 1;11	8			1	9
E 1;11	10	1			12
B 2;0	1				1
M 2;0	1				1
E 2;0	5	1			6
B 2;1	1	2		1	4
M 2;1	3	2		8	13
E 2;1	6	2			8
B 2;2	4				4
M 2;2				1	1
E 2;2		1		1	2
B 2;3	2	1			3
M 2;3	4	1		1	6
E 2;3	3	2		1	6
B 2;4	4	2			6
M 2;4	1	1			2
E 2;4	4	1			5
total	**93**	**25**	**2**	**22**	**142**

* *B* means the first third of a month, *M* the second third and *E* the last third.

Affens 'monkeys', *Wursts* 'sausages'), then again mainly -*(e)n*, cf. tab. 2. No 0-plurals were included because there was not always an explicit indication of plurality such as *more* or *two*.

The various plural affixes in the diary study of A. show differences in the rate of acquisition and overregularization behaviour. The most frequent incorrect, i.e. overgeneralized, plural marker, for A. as well as for the other children, was -*en.* Initially, A. chose (UL)-*e* and 0 (1;3 - 1;7). From 1;8 to 2;1, mostly -*(e)n*, hardly (UL)-*s*, -*er*, -*e* appeared as incorrect plural suffixes. During the middle of 2;1, the number of *s*-overregularizations increased. There were only a few examples with -*(e)n*. Then again forms with -*(e)n* dominated.

Discussion

One way to deal with acquisition data is to assume inborn symbolic rules and parameters (e.g., Clahsen et al. 1992, 1996). In such an approach, a qualitative difference between regular (or *default*, i.e. -*s*, according to a generative approach) and irregular inflection (all others, according to such an approach) is assumed – regulars are learnt with the help of a morphological rule, irregulars are lexically represented and learnt associatively or by rote. The development of inflection is independent of the lexicon. Steps of development are irreversible. After the acquisition of the default ending -*s*, there is no regression to a non-default marker. Irregular endings such as -*e* or -*er* should not be overgeneralized, as irregular forms are learnt by rote. In this light, it is difficult to account for the high frequency of *(e)n*-plurals in all the data, the oscillation between various dominating endings, the overgeneralized use of -*e* and -*er* and, especially, the abandoning of -*s* as dominant plural in favour of -*(e)n*. Instead, we should expect a relatively quick and steady acquisition of the default -*s*. There should be no frequency effects of lexical items on morphological marking, nor a regression to -*(e*)n after the dominant use of -*s* (for the use of 'plurals' in compounds cf. Elsen 1999b).

However, we can understand the development, if we assume a single associative learning mechanism, the basic principle of network processing. With the help of computer simulations of language processing, a lot can be learnt about developments resulting from the system per se. We can investigate how learning is possible with a given network architecture as well as input material but without rules, without negative input, merely with the ability to recognize patterns, to abstract and generalize them. Artificial networks are based on the neural networks of the brain (cf. e.g., Elman et al. 1996, Lamb 1999, Kochendörfer 2000). Information is not stored in the form of symbols and rules. It is coded in units and/or connections between the units in the form of activation patterns. Activation energy spreads through the system in a cascade-like way. In principle, the same basic processing mechanisms operate everywhere in the system. There are multiple subsystems. Language is one of many cognitive skills. When information is processed in such a system, automatic consequences are generalizing via pattern association, interaction of linguistic levels, interaction of linguistic and non-linguistic information, variation, transitions, a prototypical structure of items and concepts, the gradual emergence of structure and concepts and effects arising from the distribution of forms in the target language.

In our case, we might assume that A.'s early forms with -*e* were influenced by the most frequent German word shape. At the beginning of the acquisition process, a child does not yet differentiate between word classes and plural and singular forms. Thus, the frequency of word forms (patterns) in general is an influential factor for associative learning. In

German, two-syllable words with initial stress and schwa in the second syllable are the most frequent pattern (Ortmann [2]1975). Up to 1;6, A.'s articulatory capacities did not allow for words ending in [-ən] or [-ŋ]. All target words, such as *Mädchen* 'girl', *lesen* 'to read', *Lätzchen* 'bib', ended in a schwa-like vowel. Therefore, most of her words corresponded to the dominant German word shape, influenced by her articulatory capacities. The very first overregularizations were probably phonetically motivated schemata or word-patterns, independent of plural meanings. As the child was articulatorily not able to produce *(e)n*-endings, overgeneralizations with a vowel were to be expected. In simulations, the overproduction of the most frequent syllabic structure can also be found (e.g., Cottrell/Plunkett 1994).

When the child differentiated actively between singular and plural forms, she used mainly *-(e)n*, and the number of overgeneralizations increased (cf. B 1;8, table 2). Here, we might assume an influence of the cognitive discovery 'plural' on the increased production of plurals. Although there is only a temporal relationship in the data, we might nevertheless suppose that, as the girl now differentiated between singular and plural forms, the high frequency of the *(e)n*-plurals was specifically responsible for the dominance of *(e)-n* in overregularizations. This might have been inforced by her ability to pronounce this syllable correctly. Higher numbers of nouns may also have been an additional influence. But although they increased throughout the study, the use of overregularization did not. The dominant use of *-(e)n* was not consistent. Gradual learning in this case might be explained as a transient phase leading to a clear *(e)n*-dominance from E 1;9 on, just as variation between several endings accentuates the instability of the still developing system (cf. *Bälle*, *Bäller*, *Bällen*, *Balle*, *Ballen* 'balls'). Gradual development is an automatic consequence of processing in a network, as are times of over- and underproduction of target patterns till the distribution of the target language is reached. Thus, the switch to the *s*-endings as dominant plural marker could be explained as a result of the dynamics of learning. When a learning system has processed a certain amount of patterns, these become established, and the output behaviour may change suddenly due to a subsequent reorganization of the processing system. In network-terminology, there may be an abrupt change in development when the system passes a threshold value and a new problem space can be entered (Elman et al.: 1996: 205). For A., a critical mass in the processing of *s*-plurals was probably reached – the child had processed a sufficient number of examples ending in *-s*, so that this pattern could be generalized now. This new achievement led to overgeneralization.

The plural with *-s* was the prominent pattern for ten days. This short time of overshoot in production was very quickly repaired, possibly due to frequency factors. For the same reasons, the use of *-e* and *-s* continued, but *-(e)n* remained most prominent.

Network simulations produce a similar development. As a preliminary result, a recent pilot study of the acquisition of German plurals showed a clear preference to overgeneralize novel items with the help of *-(e)n.* There were different kinds of deviations at different points in time, *-(e)n* as well as *-e* and (for a while 27 % of) *-s* overgeneralizations (Kiekhoefer, pers. comm.). As only system-internal influences and frequency factors can be responsible for such a development, it remains to be seen in how far cognitive aspects mean an additional interacting parameter for the acquisition process in children.

The development of noun plurals is influenced by various factors, system-internal ones as well as number of words and nouns in general and number of nouns in a plural group. Up to 2,5, other relevant factors for the choice of the plural marker, like gender, derivational

suffix, animacy or foreign word, have not yet been realized as being decisive. For this early period of development, phonological form and frequency (the most obvious and handy information) in building the patterns of plural words are the crucial factors (and cf. Behrens/Kiekhoefer 2000).
The formation of plurals is output-oriented (cf. Köpcke 1993), as it shows the use of schemata/patterns. There are frequency effects. The development was probably influenced by the cognitive realization that there are more than one of the same kind. The gradual acquisition with oscillation between correct and various incorrect forms and the influence of frequent patterns point to an associative learning mechanism. Differences in overregularization behaviour indicate a shift of determining criteria. At different points in time, different patterns, or, more generally, different information for the choice of the marker are decisive. It must be emphasized that not only A.'s nominal lexicon and plural formation, but also her acquisition of verb vocabulary, inflection and lexico-semantic development are consistent with network simulations (Elsen 1998, in press b).
The relevance of frequency factors, gradual changes as well as system-internal reorganizations due to accumulating a critical mass, the interaction of linguistic levels and discourse factors, the oscillation between coding levels, the co-existence of old and new forms and, finally, a prototypical organization of concepts and structures are developmental aspects that result automatically from the way the system processes information and that can be found in acquisition, synchronic variation, diachronic change and even language contact (cf. Elsen 2000, in press a). Several of these factors were relevant to A.'s acquisition of plurals.

Conclusion

Plurals form a continuum of more or less prototypical schemata, showing more or less relevant phonological, morphological etc. features. The child became aware of the different criteria which determine the choice of a marker at different points in time. Accordingly, she used different linguistic cues at different times to form plurals, i.e. to choose a schema, so that the pattern of overregularizations changed over a period of time: There was a shift in the emphasis of the decisive criteria for the plural ending. Frequency effects point to an interaction between lexicon and inflectional behaviour. The data call into question the claim of a qualitative distinction between regular and irregular inflection. Inflectional morphology is not based on rules (symbolically represented), but rather on pattern association.
The present results are compatible with network simulations. They are in line with a one-mechanism approach. The idea of learning by pattern association is also compatible with ideas by Dressler, Karpf, Kilani-Schoch and others, who see ‚morphological operations' as rote-learned precursors of later grammatical formations (Kilani-Schoch / Dressler 2000): holistic patterns develop into analytical grammatical ones. Finally, data on the acquisition of German plurals, of verb morphology (Elsen 1998, 1999b) and syntax (Elsen 1999b) are consistent with the psycholinguistic predictions of connectionists as well as with functionally motivated concepts of change such as grammaticalization, language economy, invisible hand phenomena and naturalness (Elsen 2000, in press a). Results from network processing will thus provide us with a psychological foundation for linguistic models.

References

Behrens, H. / Kiekhoefer, K. 2000. "Identification of inflectional paradigms: the acquisition of the German plural". Paper presented at the 9th International Morphology Meeting, Vienna, 25. – 27. February, 2000.

Clahsen, H., Marcus, G., Bartke, S. & Wiese, R. 1996. "Compounding and inflection in German child language". *Yearbook of Morphology* 1995. 115-142.

Clahsen, H., Rothweiler, M., Woest, A. & Marcus, G. F. 1992. "Regular and irregular inflection in the acquisition of German noun plurals". Cognition 45. 225-255.

Cottrell, G. W. & Plunkett, K. 1994. "Acquiring the mapping from meaning to sound". *Connection Science* 6.4. 379-412.

Elman, J. L., Bates, E. A., Johnson, M. H., Karmiloff-Smith, A., Parisi, D. & Plunkett, K. 1996. *Rethinking Innateness. A Connectionist Perspective on Development.* Cambridge, Mass./London: MIT.

Elsen, H. 1991. *Erstspracherwerb. Der Erwerb des deutschen Lautsystems*. Wiesbaden: DUV.

- 1995. "Der Aufbau von Wortfeldern". *Lexicology* 1.2. 219-242.
- 1996. "Linguistic team-work. The interaction of linguistic modules in first language acquisition". *The Proceedings of the 27th Annual Child Language Research Forum* ed. by E. Clark. Stanford: CSLI.
- 1998. "The acquisition of past participles: One or two mechanisms?" *Models of Inflection* ed. by R. Fabri, A. Ortmann & T. Parodi. Tübingen: Niemeyer. 134-151.
- 1999a. "Auswirkungen des Lautsystems auf den Erwerb des Lexikons - Eine funktionalistisch-kognitive Perspektive". *Das Lexikon im Spracherwerb* ed. by J. Meibauer & M. Rothweiler. Tübingen: Francke. 88-105
- 1999b. *Ansätze zu einer funktionalistisch-kognitiven Grammatik. Konsequenzen aus Regularitäten des Erstspracherwerbs.* Tübingen: Niemeyer.
- 1999c. "Interrelations between phonological and lexico-semantic development". *Issues in Normal and Disordered Child Language: from Phonology to Narrative* ed. by M. Garman, B. Richards, C. Schelletter, C. Letts & S. Edwards. Reading: The University of Reading. 1-10.
- 2000. "Formen, Konzepte und Faktoren der Sprachveränderung". *Zeitschrift für Germanistische Linguistik* 28. 377-398.
- (in press a) "Acquisition & Change. Principles, concepts, explanations". *Proceedings of the 34th Colloquium of Linguistics1999* ed. by R. Rapp. Peter Lang.
- (in press b) "The structure of meaning: Semasiological and onomasiological aspects of development". *Onomasiology Online*.

Ewers, H. 1999. "Schemata im mentalen Lexikon: Empirische Untersuchungen zum Erwerb der deutschen Pluralbildung". *Das Lexikon im Spracherwerb* ed. by J. Meibauer & M. Rothweiler. Tübingen: Francke. 106-127.

Gawlitzek-Maiwald, I. 1994. "How do children cope with variation in the input? The case of German plurals and compounding". *How Tolerant is Universal Grammar?: Essays on Language Learnability and Language Variation* ed. by R. Tracy & E. Lattey. Tübingen: Niemeyer. 225-266.

Kilani-Schoch, M. & Dressler, W. U. 2000. "The emergence of verb paradigms in two French corpora as an illustration of general problems of pre- and protomorphology". Poster presented at the 9th International Morphology Meeting, Vienna, 25. – 27. February, 2000.

Kochendörfer, G. 2000. *Simulation neuronaler Strukturen der Sprache*. Tübingen: Narr.
Köpcke, K.-M. 1993. *Schemata bei der Pluralbildung im Deutschen*. Tübingen: Narr.
Köpcke, K.-M. 1998. "The acquisition of plural marking in English and German revisited. Schemata vs. Rules". *Journal of Child Language* 25. 293-319.
Lamb, S. 1999. *Pathways of the Brain: The Neurocognitive Basis of Language*. Amsterdam / Philadelphia: John Benjamins.
Mills, A. E. 1985. "The acquisition of German". *The Crosslinguistic Study of Language Acquisition* I. *The Data* ed. by D. Slobin. Hillsdale, N. J.: Lawrence Erlbaum. 141-254.
Mugdan, J. 1977. *Flexionsmorphologie und Psycholinguistik*. Tübingen: Narr.
Ortmann, W. D. [2]1975. *Beispielwörter für deutsche Ausspracheübungen. 7952 hochfrequente Wortformen der KAEDING-Zählung, rechnersortiert nach Einzellauten, Lautverbindungen, Silbenzahl und Akzentposition.* München: Goethe-Institut.
Park, T.-Z. 1978. "Plurals in child speech". *Journal of Child Language* 5. 237-250.
Russ, C. V. J. 1989. "Die Pluralbildung im Deutschen". *Zeitschrift für Germanistische Linguistik* 17.1. 58-67.
Schaner-Wolles, C. 1989. "Plural- vs. Komparativerwerb im Deutschen – Von der Diskrepanz zwischen konzeptueller und morphologischer Entwicklung". *Experimentelle Studien zur deutschen Flexionsmorphologie* ed. by H. Günther. Hamburg: Helmut Buske. 155- 186.
Stadler, M., Vetter, G., Haynes, J.D. & Kruse, P. 1996. "Nonlinear phenomena in learning processes". *Learning as Self-Organization* ed. by K. H. Pribram & J. King. Mahwah, N. .J.: Lawrence Erlbaum. 157-169.
Vollmann, R., Sedlak, M., Müller, B. & Vassilakou, M. 1997. "Early verb inflection and noun plural formation in 4 Austrian children: The demarcation of phases and interindividual variation". *Papers and Studies in Contrastive Linguistics* ed. by K. Dziubalska-Kolaczyk. Poznan. 59-78.
Wurzel, W. U. 1998. "Drei Ebenen der Struktur von Flexionsparadigmen". *Models of Inflection* ed. by R. Fabri, A. Ortmann & T. Parodi. Tübingen: Niemeyer. 244-265.