

**Max-Planck-Institut für Psycholinguistik**

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**Editors: Henriëtte Hendriks and James McQueen  
With assistance from Sylvia Aal**

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Wundtlaan 1, 6525 XD Nijmegen, The Netherlands  
Telephone: 024-3521911 (International: 3124-3521911)  
Telefax: 024-3521213 – e-mail: @mpi.nl  
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# Preface

The year 1995 has shown remarkable continuity in the Institute's research endeavors. There were very few changes in the composition of research staff and all ten Institute Projects continued according to schedule. The present Annual Report is, again organized in terms of these projects. It further includes a report from the Max Planck Research Group on Structural Grammar at the Humboldt University in Berlin; asterisks are used to mark persons and publications from that Group. Although Institute Projects receive priority funding within the Institute, we are always on the alert for promising new research directions. Some of this appears in the section on "Other Research".

It is tempting for the Institute to catch the reflections of scientific awards granted to its researchers. Shanley Allen received the 1995 Book Award of the Society for the Study of Indigenous Languages of the Americas for her work on the acquisition of Inuktitut. Wolfgang Klein received the Leibnitz Prize – 1.5 million DM in research funds – from the German Research Council, for outstanding scientific achievement. Congratulations!

Willem Levelt



# Organization of the Institute and the Cognitive Anthropology Research Group in 1995

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W. Klein  
W. Levelt, managing director  
S. Levinson

## External scientific member and head of the Research Group on Structural Grammar (members indicated with a \*):

\*M. Bierwisch

## Scientific research staff:

S. Allen	G. Desserjer
H. Baayen	*J. Dölling
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J. van Berkum	K. Drozd
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R. Coolen	A. van Hout
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 K. Remmerswaal

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 W. Vonk  
 M. Wassenaar  
 \*C. Wilder  
 D. Wilkins

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R. van Hout  
 P. Jordens  
 A. Kelly  
 J. Nuyts

KUB Tilburg  
 F.U. Amsterdam  
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Visiting Research Fellows:

K. Bock  
 M. Böttner  
 U. Brinkmann  
 C. Burani  
 H. Chen  
 J. Christiansen  
 B. Comrie

U. Illinois, Champaign  
 Stanford U.  
 F.U. Amsterdam  
 Inst. di Psicologia, Rome  
 Chinese U., Hong Kong  
 Boston V.A. Medical Center  
 U. Southern California, Los Angeles

M. Crago

School of Comm. Sciences,  
 Montreal

\*D. Wang  
 S. Duncan  
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U. Amsterdam  
 U. Chicago  
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U. Oslo

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U. Massachusetts, Amherst  
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 Boston U.

M. Hickmann

U. René Descartes, Paris

P. Jusczyk

State U. New York, Buffalo

E. Keating

U. California, Los Angeles



A. Kendon	U. Pennsylvania, Philadelphia
H. Kubozono	Osaka U. of Foreign Studies
D.R. Ladd	U. Edinburgh
L. de León	Reed College, Portland, Oregon
K. Lindner	Ludwig-Maximilians U.,
Li Ping	Chinese U., Hong Kong
N. Martin	Center Cognitive Neuroscience, Philadelphia
*R. Musan	MIT, Cambridge, USA
J. Myers	U. Massachusetts, Amherst
D. Norris	MRC APU, Cambridge, UK
T. Otake	Dokkyo U., Saitama
T. Pechmann	U. des Saarlandes, Saarbrücken
C. Perdue	U. Paris VIII
R. Radach	RWTH, Aachen
*T. Roeper	U. Massachusetts, Amherst
*R. van der Sandt	U. Nijmegen
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D. Slobin	U. California, Berkeley
T. Stolz	U. Bremen
K. Suomi	U. Oulu
H. Vater	U. Köln
*H. Zeevat	U. Amsterdam

Ph.D. Students:

M. Baumann	M. Koster
K. Behnke	I. Krämer
G. Bennardo	I. Lasser
J. Bohnemeyer	A. van der Lugt
*A. Demjanow	R. Nüse
J. Essegbey	J.-P. de Ruiter
*H. Gärtner	N. Schiller
E. Grabe	B. Schmitt
A. Haveman	E. Schultze-Berndt
*G. Jäger	*M. Starke
A. Keusen	*M. Steinbach

S. Stoll  
C. Stolz  
M. van Turennot

J. van de Weijer  
A. Wittek

Technical Staff:

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H. Baumann  
D. van de Born  
D. Broeder  
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R. Dirksmeyer  
I. Doehring  
H. Drexler  
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M. Zondervan

# **Project Descriptions**



# 1. Phonological Structure in Comprehension

The Phonological Structure in Comprehension project investigates the ways in which the processing of spoken and written language input is constrained by the phonological structure of the input language. Research on this project in 1995 included the investigation and modeling of infants' acquisition of native phonology, studies of the role of phonological structure in the segmentation of continuous speech and in written and spoken word recognition (in large part as joint research with the Spoken Word Recognition project), and cross-linguistic studies of prosodic structure and its role in processing.

## 1.1 Development of phonological structure perception

The PSC project's perceptual development interests were furthered during 1995 by the visit of SUNY collaborator P. Jusczyk in June and July. During the visit Jusczyk worked on joint research with R. Coolen, C. Kuijpers and A. Cutler and also completed work on a manuscript for a book, entitled *The discovery of spoken language* (to be published by MIT Press). This volume reviews progress in the field of infant speech perception research during the past 25 years, highlighting important research findings and considering their implications with respect to the way in which a native language is acquired; it devotes special attention to the way that word recognition skills develop from the interaction of basic speech perception capacities and input from a particular native language. This last issue is also the focus of the joint research, on infants' detection of words in fluent speech, which was described in the 1994 Annual Report. The new experimental set-up necessary for these studies has been optimized through pilot experiments during 1995 and comparative Dutch-English studies are now in progress.

### **1.1.1 Syllable frequency in infants' speech segmentation**

Also described in the 1994 Report was the syllable frequency investigations by Coolen and W. Levelt. An initial experiment had suggested that nine-month old Dutch-acquiring infants could distinguish high frequency syllables from low frequency syllables, but post-hoc analyses of the stimulus materials had shown that syllable frequency had been confounded with transitional probabilities of the phonemes within the syllables. In a subsequent experiment high and low frequency syllables were therefore matched for phoneme-to-phoneme transitional probability and positional phoneme probability. Under these controlled conditions, no effect of syllable frequency was observed: infants did not listen longer to the high-frequency syllables than to the low-frequency syllables. This finding is in accord with recent results from the laboratory of our American collaborator Jusczyk which show sensitivity to phoneme transition probabilities by English-learning infants.

### **1.1.2 Speech input to a prelinguistic infant**

In J. van de Weijer's dissertation project, outlined in the 1994 Report, all the language input to a child between six and nine months was recorded. More than 100 hours of the corpus have been classified. Utterances were coded for speaker and addressee. During the days analyzed so far, there was on the average about three hours of spoken language per day, of which about 12 percent was addressed directly to the baby. Acoustic analyses of the speech of one of the adults revealed a higher mean pitch, and more pitch variation, in infant-directed speech compared to adult-directed speech. Further analyses of the orthographically transcribed utterances from this same speaker to the baby and to other adults indicated shorter MLU in infant-directed speech, lower type-token ratio and lower speech rate. In a collaborative study with M. Brent (Johns Hopkins U.), these transcriptions were used as input to Brent's computational model of vocabulary-less continuous speech segmentation. The segmentation of the infant-directed speech yielded better (more accurate and more complete) results than the segmentation of adult-directed speech. In further collaboration with Brent, an experiment is be-

ing prepared to test whether subjects will react to stimuli in an artificial language in the same way as the model would predict.

### **1.1.3 Modeling the acquisition of a phonetic repertoire**

K. Behnke's dissertation project investigates the development of the system of phonetic categorization in infants. According to the theoretical model, infants' capabilities in discriminating non-native phonetic contrasts decrease as phonetic categories, memory representations of the distributional properties of the input language, develop. The category developmental process has been implemented in a neural network incorporating two main assumptions: (1) that the initial process is only dependent on distributional characteristics of the input, and (2) that these distributional properties change over time. The underlying self-organizing learning rule depends on two terms: (a) an adaptation term in the direction of the current input vector, and (b) an adaptation term in a random direction. An afferent weight vector of a unit is only adapted in the direction of the current input vector if the afferent weight vector of the unit is close to the current input vector and if the afferent weight vectors of the current unit and its neighbors are close to each other. The neural network has now been tested with words produced by a female speaker. The words had a CVCV structure in which consonant and vowel remain constant within a word. Simulation results show that the network was able to represent the three vowels in the input set (/a/, /e/, /u/) to different clusters in the map of units. Further investigations will assess whether this result is extendible to a more complex input set which contains the seven long vowels of the Dutch vowel system.

## **1.2 Phonological structure in word recognition**

The work described in this section addresses both written and spoken word recognition, but in both the focus is on the contribution of (usually language-specific) phonological information in the recognition process. Especially the studies 1.2.1, 1.2.2 and 1.2.3 constitute joint research with the Spoken-Word Recognition project.

### 1.2.1 Phonological cues to word class

The dissertation research of A. Haveman addresses processing and storage distinctions between open and closed class words (i.e., nouns, verbs, adjectives, adverbs vs. grammatical words), and in particular whether differences in phonological realizations play a role in the lexical access process. Word-spotting experiments described in the 1994 report showed that closed class items were easier to perceive in an unstressed realization. In contrast, stress facilitated perception of open class items. However, both frequency of occurrence and item position (first or second syllable of the word) interfered with this effect of stress. In a subsequent series of lexical decision experiments, the interaction between stress and context was investigated. No effect of stress could be shown when open and closed class items were combined in two-word phrases (e.g. *het kind*, the child). Furthermore, stress did not facilitate decisions on homophones like *haar*, which have both open and closed class meanings (hair/her), when these items were used with open class meanings (e.g., *rood haar*, red hair). Neither were these homophones recognized faster when they were unstressed and used in a closed class meaning (e.g., *geef haar*, give her). However, the homophones did show an effect of frequency of occurrence, suggesting that these homophones have separate open and closed class representation in the mental lexicon.

Representation and access of open/closed class homophones was further studied in both a phonological priming and a semantic priming experiment. In these experiments, subjects listened to short phrases ending with a homophonous or a non-homophonous open or closed class prime (e.g., *knal groen haar*, bright green hair; *vraag het haar*, literally, ask it her; and *een scherp mes*, a sharp knife). In the phonological priming study, subjects were asked to make a lexical decision on open or closed class targets sharing their initial phonemes with the prime. Although the differences were not significant, some tendency to phonological priming was observed for both the closed class homophones and the closed class non-homophones; open class items, on the other hand, tended to be recognized more slowly when the initial phonemes of prime and target were identical. For the semantic priming experiment, semantic associates of both the open and closed



class meaning of the homophone were used as targets. Results showed that when the context determined whether the homophone had either an open or a closed meaning, only the decision on the associate of the intended meaning was facilitated.

### 1.2.2 Lexical stress

The dissertation research of M. Koster investigates the consequences for recognition of the differences in phonological structure between Dutch and Spanish. The role of lexical stress and vowel quality in Dutch word recognition was examined in a semantic decision task with visual prime words and correctly or incorrectly pronounced auditory words. Responses from word onset indicated a stress bias for Dutch: changing stress from the first to the second syllable of a word (*KONing*, king, to *koNING*) impeded recognition less than changing stress from the second to the first syllable (*forNUIIS*, oven, to *FORnuis*). However, when the reaction times were corrected for target duration this difference disappeared. (A subsequent experiment with misstressed word-pairs with identical initial syllables – e.g. *MAtrAs*, *maTRIX*, mattress, matrix – aims to explore further the effect that stress shifts have in word recognition).

With respect to vowel quality, the experiment showed a larger effect of changing full vowel to schwa than the other way around. This confirms the fact that full vowels are important for recognition of Dutch words. In addition, it raises the question whether the use of schwa in Dutch words is maybe not as comparable as we might expect to obligatory vowel reduction in, for example, many English words.

Upcoming experiments will concentrate on direct comparisons between Dutch and Spanish. In Spanish, phoneme monitoring (PM) experiments have revealed an interaction between stress and lexical status: word-initial phonemes were detected faster in words than in nonwords when stress was borne by the second syllable, but there was no such word-nonword difference when stress fell on the first syllable. In the same type of PM task with word-nonword pairs (e.g., *kieviet*, peewit, and *kievuut*; *tabak*, tobacco, and *tabek*) this lexical stress effect will be investigated in Dutch.

### 1.2.3 Vowel epenthesis

In Dutch, words such as *balk* (beam) may be pronounced with epenthetic schwa (i.e. as [balək]). The processing and lexical representation of such phonological variants of the “standard” realizations that do not diverge from the orthography (e.g., [balk]) has been investigated by W. van Donselaar, Kuijpers, and Cutler. In a lexical decision experiment it was found that words with epenthetic schwa were processed faster than the ‘standard’ realizations. The opposite effect was found for schwa-deletion. Responses to the “standard” realizations (e.g., *referaat*, lecture) were faster than responses to words with schwa deletion (e.g., *refraat*). It seems that listeners prefer words with consonant-vowel alternations over words with consonantal sequences.

In a word-spotting experiment “standard” realizations and epenthetic variants were embedded in nonwords (e.g., *berg*, mountain, in *berglap*). Listeners were instructed to detect words in the auditorily presented nonwords. The word boundary following the target was either ambiguous in that it fell within a cluster which could constitute a legal onset (e.g., /gl/ in *berglap/berr@glap*) or unambiguous in that the corresponding cluster could not be an onset (e.g., /gt/ in *bergtap/berr@gtap*). Overall, unambiguous word boundaries facilitated the detection of target words. Words with epenthetic schwa were also detected faster and more accurately than their “standard” counterparts, especially in the ambiguous context, suggesting that schwa epenthesis facilitates segmentation.

The lexical representation of epenthetic schwa was explored using a syllable monitoring task. Subjects listened to targets (e.g., *BAL*, *BALK*) followed by carrier words (e.g. *balk* and *ball@k*), and decided as quickly as possible whether the target was in the carrier or not. The words with optional epenthetic schwa (type 1) were compared to pseudowords (type 2 *golk/goll@k*), to words that do not allow epenthesis (type 3 *vers/verr@s*, fresh), and to bisyllabic words with underlying schwa (type 4 *bilk/billijk*, fair). In type 1 the target *BAL* was detected equally fast in both carrier words, and *BALK* was detected faster in *balk* than in *ball@k*. The pseudowords (type 2) were processed in a highly similar way. This suggests application of phonological rules rather than lexical storage of schwa epenthesis. In type 3 the target *VERS* was

hardly ever detected in the carrier word *verr@s* since epenthesis is not allowed. In type 4 the target *BIL* was detected fastest in *billijk* which is in agreement with the bisyllabic structure of the word. This contrasts with the findings in type 1 and indicates that words with epenthetic schwa are not processed as bisyllabic words.

In a current experiment (in collaboration with T. Otake, Dokkyo U.) schwa epenthesis in Dutch is contrasted with reduced-vowel epenthesis in Japanese, a language in which vowel epenthesis is frequent and fully consistent. Further studies in progress address the relation between schwa-epenthesis and rhythmic structure in speech production.

#### 1.2.4 Nasal consonant assimilation

Nasal consonants in syllabic coda position in Japanese assimilate to the place of articulation of a following consonant. The resulting forms may be perceived as different realizations of a single underlying unit, and indeed the *kana* orthographies represent them with a single character. In experiments by Otake, Cutler and A. van der Lugt, together with K. Yoneyama (Ohio State U.), Japanese listeners' response time to detect nasal consonants was measured; see the 1994 Report for an initial description of this study. Nasals in coda position, that is, moraic nasals, were detected faster and more accurately than nonmoraic nasals, and there was no difference in response time or accuracy as a function of the place of articulation with which moraic nasals were realised. Dutch listeners who knew no Japanese did not respond under the same instructions to moraic nasals realised bilabially. In the next set of experiments, the nasals were cross-spliced across place of articulation contexts. The Japanese listeners still showed no significant place of articulation effects, suggesting that these listeners are capable of very rapid abstraction from phonetic realization to a unitary representation of moraic nasals. Responses were, however, faster and more accurate to unspliced than to cross-spliced nasals. Moreover, when Japanese listeners were asked to detect the phoneme following the (cross-spliced) moraic nasal, their responses were adversely affected by mismatch between nasal and context, suggesting that they can use the phonetic realization of a moraic nasal effectively to obtain an-

ticipatory information about following phonemes. Dutch control subjects, presented with the same materials, did not show such effects, suggesting that at least with foreign input these listeners failed to use the potential anticipatory information.

### **1.2.5 Processing of lexical tone**

Further experiments by H. Chen (Chinese U. of Hong Kong) and Cutler examined the processing of lexical tone in Cantonese (see also 1994 Report). In a same-different judgement task, Cantonese listeners could detect the difference between two CV syllables with the same onset and the same tone but a different vowel more rapidly than they could detect the difference between two CV syllables with the same onset and the same vowel but a different tone. This was true whether the F<sub>0</sub> onset difference between the two tones was large or small. Dutch listeners, with no knowledge of Cantonese, produced essentially the same same-different judgement pattern as the native listeners, suggesting that the results display the effects of simple perceptual processing rather than of linguistic knowledge. In speeded response tasks, lexical tone distinctions thus seem more likely to be misprocessed than segmental distinctions.

### **1.2.6 Phonological factors in the recognition of Chinese characters**

Previous studies by G. Flores d'Arcais and Chen (see, e.g., the 1994 Report) showed that phonological recoding of a Chinese character during word recognition is not obligatory, but can be dependent on the type of task in which the reader is involved. Thus with semantic tasks, such as comparing two words on the basis of their semantic similarity, no phonological effects appear. This work was continued with Chinese speakers of different literacy history than the Hong Kong students, namely Mandarin speakers of Beijing, who learned to read Chinese characters essentially with a phonologically based method, and the results indicated some variance with respect to the Cantonese speakers of Hong Kong. The work is continuing with subjects of other reading acquisition history, to reach a definitive conclusion about the effect of reading acquisition and of the writing system on the

type and level of obligatory phonological recoding during reading.

### 1.2.7 Orthographic and phonological factors in representation of Japanese names

Two projects on the orthographic and phonological factors involved in recoding non-existent geographic words are in progress (Flores d'Arcais, with G. Hatano (Dokkyo U.) and K. Tokimoto (Keio U.)). The first examines which factors are involved in the choice between alternative possibilities for writing geographical or personal name words in *kanji* characters (thus one can, at least in principle, write Tokimoto with two Kanji – *toki, moto* – or with three or four – *to ki mo to*). The project has already shown a number of interesting differences in the choice made by writers, mostly based on principles such as analogy with already existing words, strong phonological tradition and word frequency.

The second project concerns the activation effect of the “on” (Chinese) and “kun” (Japanese) pronunciation of kanji characters, using tasks in which subjects judged similarity or identity of pronunciation of two characters or two words. In crucial cases a “rejected” identical pronunciation was involved; for example, the subject would be given two words with different “on” pronunciation but identical “kun” pronunciation, and would have to decide as fast as possible whether the two characters were read identically or differently. The first experiments have shown a very clear and strong activation effect of the “rejected” pronunciation: when two words can have one identical pronunciation, even if it is not the one used in practice, this affects subjects’ responses.

### 1.2.8 Listeners’ representations of within-word structure in Japanese and English

In a study carried out by Otake and Cutler together with S. Davis (U. of Pennsylvania), Japanese, British English and American English listeners were presented with spoken words in their native language, and asked to mark on a written transcript of each word the first natural division point in the word. The results showed clear and strong patterns of consensus, indicating that

listeners have available to them conscious representations of within-word structure. Orthography did not play a strongly deciding role in the results. The patterns of response were at variance with results from on-line studies of speech segmentation, suggesting that the present task taps not those representations used in on-line listening, but levels of representation which may involve much richer knowledge of word-internal structure.

### **1.3 Phonological structure and the segmentation of continuous speech**

#### **1.3.1 Segmentation of speech in a foreign language**

To segment continuous speech into its component words it may be necessary for listeners to draw on language-specific sources of information. In English, for instance, evidence suggests that the pattern of strong and weak syllables provides listeners with information which is of use in segmentation; but French and Japanese, for example, exhibit no equivalent opposition, and here other sources of information prevail. Part of the difficulty of apprehending continuous speech in a non-native language may well reflect attempts to locate the sources of segmentation information characteristic of listeners' native language even when the foreign language does not provide such information. Recent studies in Dutch have suggested that Dutch, like English, encourages use of strong/weak syllable differences in segmentation. Of course, Dutch and English are also closely related languages. But there are other languages which have been claimed to exhibit similar structure; thus traditional accounts of stress-timing in English have grouped major Arabic dialects in the same phonological class. A series of experiments undertaken by D. Swingley (Stanford U., visiting the MPI during the first half of 1995) in collaboration with D. Dahan, Cutler and J. McQueen used a probe recognition task to investigate the perception of continuous speech in Egyptian Arabic by listeners from differing language backgrounds.

The listeners in these experiments heard naturally spoken Arabic sentences, and their task was to judge whether a subsequently spoken word had occurred in the sentence or not. Probe words were bisyllabic and could be stressed on the first or second

syllable, and the unstressed syllable could further have a full vowel or a reduced vowel. Dutch listeners found probes beginning with an unstressed and reduced syllable harder than any of the other three probe types; this is the only probe type that requires segmentation of the signal at a weak syllable onset, so that this result is consistent with the application by Dutch listeners of the strong/weak syllable procedure to this non-native input. Comparable studies with English listeners are currently in progress. French listeners produced a completely different pattern of results; for these listeners, one probe type proved easier than the other three, namely probes with two full syllables with the second syllable bearing stress. This is the probe type which is most similar to the accentual pattern of French bisyllabic words, again suggesting that native language experience was exploited in coping with the problem of segmenting input in an unfamiliar language.

### **1.3.2 Stress and vowel quality in the segmentation of Dutch**

The results of a word spotting experiment (a replication study of Cutler & Norris 1988, conducted by Koster in collaboration with H. Quené, Utrecht U.) indicated a large role for stress placement in Dutch word recognition, but less effect of vowel quality. When subjects had to spot monosyllabic target words (e.g. *berk*, birch) in bisyllabic nonsense words, no (strong) effect on reaction time was found for the type of vowel in the second syllable (*berk@f* – *berkif* – *berkief*), whereas a stress shift to the second syllable resulted in a slower recognition time (e.g. *BERkif* vs *berKIF*).

### **1.3.3 Finnish vowel harmony as segmentation information**

Vowel harmony rules in Finnish require that if the vowel in the first syllable of a word belongs to one of two vowel sets, then all subsequent vowels in that word must either belong to the same set, or to a neutral set. A harmony clash between two syllables containing vowels from the opposing sets thus signals a likely word boundary in continuous speech. A series of experiments by K. Suomi (U. Oulu) in collaboration with McQueen and Cutler

showed that Finnish listeners can exploit this information in an on-line speech segmentation task. Listeners found it easier to detect words like *hymy* (smile) at the end of the nonsense string *puhymy* (where there is a harmony clash between the first two syllables) than in the string *pyhymy* (where there is no clash). There was no such effect, however, when the target words appeared at the beginning of the nonsense string (e.g. *hymy* vs *hymy*). Harmony clash thus appears to provide a useful segmentation cue for the detection of word onsets. Stronger harmony effects were found for targets containing front harmony vowels (e.g. *hymy*) than for targets containing back harmony vowels (e.g. *palo*, fire, in *kypalo* and *kupalo*); this could reflect an underlying perceptual motivation of the Finnish vowel harmony system. Related work on segmentation in the Spoken Word Recognition project (see 2.1) has led to the suggestion that there are multiple cues to word boundaries in the speech signal (such as those provided by metrical structure, phonotactics and silence), all of which can be used by a single segmentation process during word recognition. Vowel harmony appears to provide yet another means by which clear boundaries may be signaled in the speech signal.

## 1.4 Prosodic structure and its role in processing

Divisions within this project report are somewhat artificial; for example, the research on the role of lexical stress and lexical tone in word recognition (1.2.2, 1.2.5) could equally well be described under the heading of prosodic structure; so too could the work on metrical structure in lexical segmentation (1.3.1, 1.3.2). Conversely the immediately following report deals with prosodic cues to segmentation, and could have found a home in section 1.3. Here in fact are grouped studies where the primary emphasis is on prosodic structure above the word level, or the interaction of levels of prosodic structure. With regard to the latter issue, Dahan, van Donselaar and Cutler are currently collaborating on a review of the literature on prosodic processing at different levels of the comprehension process. The visits of D.R. Ladd (U. Edinburgh) and H. Kubozono (Osaka U. of Foreign Studies) during the summer contributed significantly to the research described in this section. During his visit Ladd also organized a workshop on



prosodic structure, and completed a book on intonational phonology, to be published by Cambridge University Press in 1996.

#### **1.4.1 Prosodic cues to sentence segmentation**

Research by Dahan (Fyssen Foundation fellow) addresses the role of sentence-level prosodic structure in segmentation and lexical access. The guiding hypothesis is that prosody, through the presence of pauses, but also through more subtle variations of duration and pitch, can segment an utterance into constituents. The constituent boundaries could in turn be used as indicators of some of the word boundaries, at the edges of the constituents. In the framework of a spoken-word recognition model (such as Shortlist; see 2.1), lexical candidates which straddle a prosodically defined boundary would therefore be excluded, or at least inhibited. A series of experiments was conducted in French, using phoneme or syllable detection tasks in continuous speech: The faster the target is detected, the easier the lexical access of the target-bearing word is assumed to be. The first higher-level constituent of segmentation to be investigated was a French-specific domain: the rhythmic group, right-bounded by the final stress. No reliable evidence of an influence of the rhythmic group in the segmentation of French was found. Subsequent findings, however, suggested that the presence of a boundary marked by pitch movement facilitates the lexical access of the word following the boundary. Listeners may be able to use the prosodic information to optimize the processing of continuous speech, insofar as the speaker provides them with such a rich prosodic structure. If the speech rate is fast, however, most such pitch variations may be omitted, and hence this source of segmentation information may disappear.

#### **1.4.2 Intonational phrasing in speech comprehension**

A new dissertation project by E. Grabe investigates global intonational cues to speech comprehension. Local prosodic cues such as boundary tones and phrase-final lengthening have been shown to affect listeners' interpretation of syntactically ambiguous sentences, but the effect of global prosodic events such as structural relationships between successive intonational phases has received little attention – primarily because the analysis of in-

tonation has rarely gone beyond the structure of isolated phrases. The aim of this study is to take the phonological analysis of phrasing beyond the level of the intonational phrase and to derive predictions for the use of global prosodic cues in comprehension. Specifically, intonational phrasing is studied and compared in two languages: English and German.

The phonological analysis of phrasing is carried out within an autosegmental framework. Autosegmental models of intonation exist for English, but no satisfactory model for German is available. Therefore, a first step was to develop a German model. A controlled corpus of comparable English and German read speech was collected and analyzed. A model was developed which is compatible with existing models for English but captures intonational similarities and differences between the two languages. The new model advances existing models in two ways. Firstly, it accounts for an asymmetry in the behavior of high and low boundaries in both languages. The corpus showed that in both languages, high boundary tones are chosen independently, that is, they can follow any accent, and only they change  $F_0$ . Low boundaries, on the other hand, are invariably preceded by a falling accent ( $H^*+L$ ). Low boundaries do not follow rises ( $L^*+H$ ), and have no effect on  $F_0$ . In the model, this asymmetry is accounted for as follows: high boundaries are represented as  $H\%$  whereas low boundaries are simply “%”. % does not have a tonal specification in the phonology. In the phonetic implementation, % receives an  $F_0$  value from the trailing tone of the preceding  $H^*+L$  pitch accent (i.e., the value of the “L” is copied into the % boundary slot). The resulting phrase-final  $F_0$  trace is low-level. Secondly, the model captures phrasing above the level of the intonational phrase with a compatible copy mechanism; here, the phonological structure of a complete intonational phrase is copied onto the next phrase. The corpus showed that systematic intonational phrase copy characterizes, for example, coordination structures and accented tags. Copy at intonational phrase level is hypothesised to signal discourse coherence.

Cross-linguistic differences emerged in pitch accent realization, that is, the way phonological targets are realized in  $F_0$ . Pitch accent realization was investigated in a cross-linguistic production experiment, focusing on the phonetic realization of phrase-

final L\*H and H\*L accent as a function of decreasing segmental duration. A clear cross-linguistic difference emerged. English “compresses” both falling and rising tonal instructions if segmental material is shortened. The targets move closer towards one another in time, preserving the F0 range, while the slope of F0 accelerates to reach the second target in a shorter time span. In German, in contrast, when segmental material is shortened, the slope of F0 remains the same, but the range decreases. Additionally, the experiment showed that truncation does not apply indiscriminately: if a candidate syllable appears phrase-finally and is associated with a high boundary tone (H%), then truncation does not apply. This finding supports the asymmetry between German high and low phrase boundaries reported above, i.e. the fact that H% is chosen independently, whereas L% is not. The non-application of truncation in words associated with H% suggests that H% is not expendable, presumably because high boundaries play a significant role in discourse (commonly, H% signals a yes-no question or “continuation”). Low boundaries do not have a similarly relevant function role, and undergo truncation.

### 1.4.3 Levels of prosodic structure in Japanese

The main topic of the research of Kubozono, who visited during July, August and September, was to examine from a cross-linguistic perspective the roles of prosodic units such as the mora, the syllable, and the foot, in various linguistic processes in Japanese. The research centered around two main questions: (a) to what extent is mora structure relevant for characterizing speech production and perception processes in Japanese? and (b) what is the structure of what phonologists call “bimoraic feet”? In answer to the first question, it was confirmed that the mora plays a crucial role in various representations and processes in Japanese where in other languages different prosodic units (syllable or stress foot) are relevant. Concerning the second question, independent sources of evidence – phonological, morphological, and psycholinguistic – indicated that what really counts is “phonetic bimoraicity” as measured in terms of physical duration, and not “phonological bimoraicity” as defined in terms of the phonological structure of the syllable.



## 2. Spoken Word Recognition

Research on this project explores how listeners recognize words in spoken language. Experimental work on these issues is complemented by computational modeling, and by the analysis of speech corpora. Of particular importance to the project are the problems of continuous speech recognition: since word boundaries are not marked deterministically in continuous speech, how do listeners nevertheless segment this input, and recognize it as a series of discrete words? Work on continuous speech recognition is summarized in 2.1. Related research on segmentation, done in the Phonological Structure in Comprehension Project, is covered in 1.3. Another major goal of the Spoken Word Recognition project is to map out the information-processing architecture of recognition: what information is used at different stages in the recognition process, and how does information flow through the recognition system? In 1995, this part of the project has focused on phoneme sequencing constraints: listeners' sensitivity to the relative likelihoods of phonemes appearing after each other (their transitional probabilities; 2.2.1); and a comparison of lexical and phonotactic influences on phonetic categorization (2.2.2). This work, and also that on phonotactics in segmentation (2.1.1), is related to work done on acquisition in the Phonological Structure in Comprehension Project (see 1.1.1). A final component of the SWR project has been concerned with the processing and representation of morphology (2.3). This research has primarily tested the recognition of visually-presented words, but spoken word recognition has also been examined; indeed, the comparison across modalities has proved to be very important for theoretical development.

### 2.1 Segmentation of continuous speech

The central claim underlying this research is that spoken word recognition is based on a process of competition between candidate words. A. Cutler and J. McQueen, together with D. Norris (MRC Applied Psychology Unit, Cambridge) have pro-

posed that lexical competition provides an efficient means not just for the recognition of isolated spoken words, but also for the segmentation and recognition of continuous speech (see Annual Report 1994). Competition is the core mechanism of the Shortlist model (Norris, *Cognition* 1994). Candidate words compete with each other whether they begin at the same point in the signal (e.g. *sack* and *sacrifice* given *sacrifice*) or at different points (e.g. *mess* and *domestic* in *domestic*). Through this competition process, Shortlist settles on an optimal interpretation of a continuous stretch of speech. The input can thus be segmented into words, and these words can then be recognized, without the need for any word boundaries to be marked in the speech signal.

Although word boundaries are indeed not reliably marked in speech (if they were, there would be no segmentation problem), there are nevertheless several cues in the speech signal which listeners could use to assist in segmentation, when those cues are available. It has already been shown that listeners do indeed use one such set of cues: those from the metrical structure of language. Given that languages differ metrically, the cues offered by different languages must also vary; listeners appear to use the language-specific cues of their native language. In stress-timed languages, like English or Dutch, word boundaries appear to be postulated by listeners at the onsets of strong syllables. The question then arises as to how to relate this Metrical Segmentation Strategy (MSS) to the competition framework of Shortlist. In last year's report, it was described how the MSS could be implemented in Shortlist, as a bias in the activation and competition process; the model then accounted well for data showing involvement of both lexical competition and metrical information in segmentation. Work in 1995 has looked at other segmentation cues, and asked how their use could be modeled, alongside the use of metrical cues, in the Shortlist competition framework.

### 2.1.1 Phonotactics as a segmentation cue

McQueen and E. Cox (Northeastern U., Boston) examined whether listeners can use phonotactic constraints to assist in segmentation. Some strings of segments (such as [lb] and [mr] in Dutch) never occur within the same syllable. Word boundaries

are more likely where such a sequence of segments requires there to be a syllable boundary, and words are not likely to begin at points which are misaligned with such boundaries. In a word-spotting experiment, Dutch listeners were asked to detect monosyllabic Dutch words, embedded in bisyllabic nonsense strings. These words were either aligned with a phonotactic boundary (e.g., *vel*, *skin*, in [vel.brul]) or misaligned with a boundary (e.g., *vel* in [velm.rul]). There were powerful alignment effects: listeners were faster and more accurate in detecting aligned than misaligned targets.

Two further experiments have also been run. In one, where the target words were taken out of their contexts and presented in isolation for lexical decision, only small differences between targets from aligned and misaligned contexts were found. The alignment effect in the first experiment therefore cannot be attributed simply to acoustic differences between the targets in the different conditions. In the other experiment, targets were again presented in syllabified contexts (e.g., *vel* in [vel.frul] or [velf.rul]), but where the critical consonant cluster ([lf]) did not force a particular syllabification on phonotactic grounds. Targets were easier to detect when they were aligned with a syllable boundary than when they were misaligned, but the effect was much smaller than that obtained when the boundaries were phonotactically determined. It therefore appears that phoneme sequences provide a segmentation cue which listeners use in continuous speech recognition.

### 2.1.2 Silence as a segmentation cue

Another, extremely powerful cue to word boundaries in continuous speech is a very obvious one: that provided by silence. McQueen and Cutler, together with Norris and S. Butterfield (MRC Applied Psychology Unit, Cambridge), have tested whether listeners can use this cue. The word-spotting task was again used. English listeners were asked to detect words like *apple*, embedded in nonsense strings like *fapple* and *vufapple*. If silence provides a segmentation cue, then words which are misaligned with a boundary cued by silence should be more difficult to detect than those which are not misaligned. The target *apple* is misaligned with the clear boundary cued by silence be-

fore the [f] in *fapple* because the portion of speech between the edge of *apple* and the silence (the [f]) is non-syllabic, and hence is not a possible word of English. In contrast, the portion of speech between *apple* and the initial silence in *vufapple* is syllabic, and hence a possible word.

Subjects were faster and more accurate in detecting targets in syllabic than in non-syllabic contexts, whether the context preceded or followed the target, for both monosyllabic and bisyllabic targets (i.e., across pairs such as *fapple/vufapple*, *fegg/mafegg*, *sugarth/sugarthim* and *oilch/oilchun*). A second experiment, which controlled for acoustic differences in the target words by cross-splicing them (e.g., *fapple* made from the *apple* originally spoken in *vufapple*, and vice versa), confirmed that targets in non-syllabic contexts were more difficult to detect than those in syllabic contexts. Like the cue provided by phonotactic constraints, silence appears to be used to assist in speech segmentation.

### 2.1.3 The Possible-Word Constraint

These new data on segmentation raise the question of how they might be modeled in the Shortlist framework. The work on the silence cue suggests that words misaligned with a boundary cued by silence are more difficult to recognize than those which are not misaligned. Crucially, words were misaligned where the speech material between the edge of the word and the boundary cued by silence (e.g., the [f] in *fapple*) could not be a possible word of English. In Shortlist, candidate words which were misaligned in this way could be penalized (their activation could be lowered) making them less likely to win the competition between words. This Possible Word Constraint (PWC) has been implemented in Shortlist by Norris, McQueen and Cutler: the activation of any candidate word which is misaligned with a segmentation boundary is halved. A word counts as being misaligned if there is no vocalic segment between the edge of the word and the clear boundary.

Shortlist, enriched with the PWC, simulates the English data where silence provided a clear boundary cue. But the real power of the PWC is that it can also account for other segmentation effects. Words which are misaligned with boundaries cued by phonotactics (e.g., *vel* in [velm.rul]) will also be penalized by the



PWC. Shortlist, running on a Dutch lexicon with the PWC, simulates the phonotactics data. Further, words are penalized by the PWC when they are misaligned with boundaries cued by metrical structure (e.g., *mint* in *min.teif*, where the second strong syllable cues a boundary before the [t], leaving only this non-vocalic [t] between the boundary and the end of *mint*). Shortlist, running on either English or Dutch, simulates the metrical segmentation effects which have been found in these two languages, and also the interaction of metrical and lexical competition effects. In this way, the PWC instantiates the MSS, making any further implementation of the MSS (such as that reported in the 1994 Annual Report) redundant. The PWC therefore provides a unified account of the segmentation and recognition of continuous speech. Lexical competition is modulated by a single process, the PWC, which uses clear boundaries in the input, whether they are marked by silence, metrical structure, or phonotactic constraints.

#### 2.1.4 Statistical analyses of metrical structure

As proposed by the MSS and instantiated in the Shortlist model, Dutch listeners appear to use metrical structure to assist in segmentation. In addition to the experimental evidence, a computational question can be asked: how efficient would the MSS be for the segmentation of Dutch? D. van Kuijk (U. Nijmegen) performed a study using the CELEX database which investigated the occurrence of strong vowels in the first syllable of Dutch words. The main goal was to find out whether metrical stress or lexical stress is a better predictor for a syllable being word-initial. In order to get estimates for fluent speech, the counts were weighted for word-frequency. Because the mapping from the markings of stress given for the citation forms of words in CELEX to the stress patterns of fluent speech is not clear, several definitions for the concepts "lexical stress" and "metrical stress" were compared. According to these CELEX-counts in Dutch, metrical stress is a slightly better predictor for the word-initial position of a syllable than is lexical stress (irrespective of which definitions were used). The results showed that in an estimated minimum of 76% of the words in fluent speech, the first syllable contains an unreduced vowel, and that about 73% of the strong vowels encountered in fluent speech are likely to be in the

first syllable of a word. These findings suggest that the MSS is a feasible segmentation procedure for Dutch listeners, and perhaps also for automatic speech recognizers of Dutch.

Van Kuijk is currently investigating the distribution of duration, intensity, pitch, and spectral tilt over the stressed and unstressed variants of vowels in the Dutch Polyphone-Corpus. The goal of this study is to get a clearer picture of the phonetic differences between stressed and unstressed vowels, and to look at the feasibility of building an automatic stressed-unstressed classifier. The first analyses compared for each vowel the durations of the stressed and unstressed variants. The results indicate that for most vowels the mean duration of the stressed variant is significantly longer than that of the unstressed variant.

### 2.1.5 Lexical embedding in continuous speech

Work has continued on the MARSEC corpus of continuous speech (this is a 49269-word machine-readable version of the Spoken English Corpus; see Annual Report 1994). H. Baayen, H. Drexler, Cutler and McQueen have continued their analysis of lexical embedding: words embedded within other words (*can* in *candle*) and words embedded across word boundaries (*sizzle* in *premises along*). Earlier analyses were based on simple segmental transcription; but this has two inherent limitations. First, the transcription was deterministic with respect to pronunciation: a word with multiple pronunciations was always coded in the same way, potentially influencing the number and type of embeddings found. A solution to this problem has been to assign different pronunciations at random. The orthographic transcriptions of words from the corpus were assigned pronunciations based on the CELEX database; words with more than one pronunciation being assigned one alternative, selected at random for each occurrence of that word. Three hundred iterations of this procedure revealed relatively small variability between iterations: the iteration yielding numbers of within-word embeddings closest to the mean across iterations was therefore chosen for all subsequent analyses.

The overall statistics were similar to those of the earlier analyses. In a phoneme-based analysis (where embedded words match embedding words segmentally, but not necessarily syllab-

ically), 99% of word tokens in the corpus contained at least one embedded word, and 29% of word boundaries had a word embedded across them. Applying the constraint of a syllabic match reduced the proportion of embedding: 62% of words still contained at least one embedded word matching in syllabification (e.g., *can* in *candle*), but only 1% of word boundaries had a word embedded across them which matched the syllabification around that boundary (e.g., *litter* in *likely tomorrow*). Within-word embedding is therefore far from being a trivial problem. These results suggest that models of word recognition, such as Shortlist, which confront the problem of lexical embedding head on (by allowing all plausible candidate words to compete with each other), are to be preferred over models which have no mechanism for dealing with words within other words.

A second problem with the original transcription was that it was done on a word-by-word basis, allowing no ambiguities in syllabification, nor capturing any running-speech phenomena, such as resyllabification and place assimilation, factors which could also influence the embeddings found. This problem has been addressed by applying various procedures to the random-pronunciation transcription. A central motivation of the MSS is that syllable boundaries before weak syllables are unclear. Analyses were therefore done which ignored all syllable boundaries before weak syllables. Additional within-word embeddings (such as *jump* in *jumper*) caused the proportion of words with at least one embedding to rise from 62% to 66%. Additional cross-word embeddings (such as *shutter* in *shut again*) increased the proportion of boundaries with embeddings to rise from 1% to 4%. Resyllabification rules have also been applied to the transcription: the combination of no clear syllable boundaries before weak syllables and resyllabification (producing embeddings such as *fen* in *enough energy*) increased the proportion of boundaries with embeddings to 10%. Although the cross-boundary results with perfect syllable matches suggested that lexical embedding across word boundaries does not pose a particular problem for recognition models, these more realistic analyses show that these embeddings cannot be ignored in the modeling of the recognition process: there will be an embedding across a word boundary approximately every ten words.

## 2.2 Phoneme sequencing constraints in word recognition

### 2.2.1 Transitional probability

M. Pitt (Ohio State U.) and McQueen have carried out a series of experiments examining listeners' sensitivity to the relative likelihoods of phonemes appearing after other phonemes (i.e., their transitional probabilities). The work on segmentation described above (2.1.1) suggests that consonant clusters with transitional probabilities of zero (phonotactically-illegal clusters) provide a segmentation cue for listeners; the present experiments sought to look in detail at transitional probability effects on the recognition of speech sounds.

Two phoneme monitoring experiments have examined the influence of transitional probability both into and out of target phonemes in monosyllabic Dutch nonwords. In the first experiment, a group of Dutch listeners monitored for consonants in the coda of Consonant-Vowel-Consonant (CVC) items. High and low probability CV and VC transitions were manipulated factorially. No reliable differences emerged. A second group of listeners monitored for the first consonant of the coda cluster in CVCC items. The transitional probabilities into the target phoneme (CVC) and out of the target phoneme (CC) were examined. Targets with high probability CVC transitions were detected more accurately than those with low CVC probability transitions. Within items with low CVC transitions, there was also an effect of the CC transition: targets were detected more rapidly when the consonants following them were more likely. Since target location was fixed in Experiment 1, subjects could focus attention on that location, perhaps weakening any transitional probability effects. In the second experiment, listeners were therefore forced to process each item more fully: the CVC and CVCC items were mixed together, and target location was varied in filler items. The CVC items again showed no reliable effects. In the CVCC items, the targets with low CVC and low CC transitions were more difficult to detect than those in any of the other three conditions.

Listeners therefore showed sensitivity to transitional probability, but only in CVCC items, where targets, in clusters, were more difficult to detect than those in CVC items. This result con-

trasts with one obtained in a further experiment, employing the phonetic categorization task, where an effect for CVC items was obtained. English listeners were presented with CVC nonwords, where the final consonant was either [p], [t], or one of a continuum of ambiguous phonemes ranging between [p] and [t]. The listeners' task was to categorize these consonants as either [p] or [t]. In the continuum *yeep-yeet*, [p] is more likely after [i] than [t] is, while in *chape-chate*, [t] is more probable than [p]. Subjects showed a clear transitional probability bias, labeling the ambiguous phonemes more often as [p] in the *yeep-yeet* context than in the *chape-chate* context. A phoneme's likelihood of occurrence may exert a stronger influence on recognition when there is poorer information in the signal specifying that phoneme, as when the phoneme is either perceptually ambiguous (in the categorization task) or in a consonant cluster (in phoneme monitoring). Together, these results certainly suggest that likelihood information, in addition to providing a segmentation cue (2.1.1), can also be used in segment recognition.

### 2.2.2 Phonotactic and lexical effects

Cutler, McQueen and Norris have continued their examination of phonotactic and lexical influences in phonetic categorization of stops in English (see Annual Report 1994). Subjects show tendencies to label ambiguous segments as phonotactically legal (e.g., [ʔ], an ambiguous stop between [t] and [k], will tend to be labeled as [k] in the string *?lig*, because [tʃ] is an illegal cluster, while [kl] is legal). Subjects also show tendencies to label segments to form words rather than nonwords (e.g., [ʔ] will tend to be labeled as [t] in the string *?race*, because *trace* is a word, but *krace* is not; and [ʔ] will tend to be labeled as [k] in *?rave*, because *crave* is a word, but *trave* is not). A series of experiments has tested whether it is possible to dissociate these two effects. Such a dissociation would challenge interactive models of word recognition (e.g. TRACE): the top-down connections from the lexical to the phonemic level in TRACE account for both phonotactic and lexical effects. The model thus predicts that the two effects should co-occur, and not dissociate. In contrast, the autonomous Shortlist model accounts for the two effects with two separate mechanisms (a prelexical mechanism sensitive to transitional

likelihoods for the phonotactic effect, and a race between prelexical and lexical procedures for the lexical effect), and thus predicts that the two effects can (but need not) dissociate.

In two experiments run in 1995, as in the experiment reported in 1994, it has not been possible to find a dissociation of the two effects. In the most recent experiment, subjects were put under severe time pressure, and had to respond as fast as possible to word-initial stops in continua such as *tlig-?lig-klig*, *trace-?race-krace*, and *trave-?rave-crave*. Since lexical influences in initial-position phonetic categorization take time to build up, it was thought that these fast responses might show no lexical effects, but still show strong phonotactic effects. Both effects were found, however, and both grew larger moving from fast to slow responses. Such results are consistent with both interactive and autonomous models; these experiments unfortunately do not allow any strong conclusions to be made about the architecture of the recognition system.

## 2.3 Morphology

### 2.3.1 Representation and processing of Dutch plurals

Together with R. Schreuder and T. Dijkstra (both U. Nijmegen), Baayen continued his investigation of the processing of plural inflections in Dutch. Earlier experiments had revealed frequency effects for regular plurals with the suffix *-en*. Whereas reaction times for singular nouns were determined by the summed frequency of the singular and the plural, the reaction times to plural nouns were determined by the surface frequency of the plural itself. Plural-dominant plurals, that is, plurals with a surface frequency exceeding that of the corresponding singular, were processed as fast as their singulars. However, singular-dominant plurals, that is, plurals for which the frequency of the singular exceeds that of the plural, produced substantially longer response latencies. This pattern was observed for both the visual and the auditory modality, and suggests that there may be independent access representations for high frequency (plural-dominant) plurals. Low frequency (singular-dominant) plurals are slower to process because they tend to lack access representations, and thus tend to be recognized only through morphologi-

cal parsing. These ideas have been implemented in a stochastic dual-route model; simulations show that this model fits these data extremely well.

Two new experiments were carried out, now using the plural in *-s* instead of the *-en* plural. In the visual modality, a lexical decision task revealed essentially the same pattern for *-s* plurals as observed for the plurals in *-en*: high-frequency plural forms were responded to more quickly than low-frequency plural forms. In the auditory modality, however, no such effect could be observed. Here, plurals required significantly longer response latencies than singulars, irrespective of whether their surface frequency was higher or lower than that of their corresponding singulars.

Why might surface frequency effects disappear in the auditory modality when changing from the *-en* plural to the *-s* plural? The hypothesis under current investigation is based on the observation that the *-s* plural minimally affects the syllable structure of the noun it attaches to, while the *-en* plural adds a new syllable and often induces resyllabification of the stem-final consonant. Thus, *kast* (cupboard) becomes *kas.ten* after suffixation of *-en*, with a first syllable that constitutes only part of the stem. Often, this initial syllable is itself a word. In this example, *kas* means hothouse. Our hypothesis is that because full-form access representations for *-en* plurals allow for direct activation of plural meaning, they obviate the computationally-costly process of unraveling the phonological changes associated with *-en*, a process which would be required for recognition via morphological parsing. This benefit motivates the construction of these full-form representations. For the *-s* plural, however, the effects of suffixation on syllabification are minimal, e.g., *za.del* (saddle) becomes *za.dels* in the plural, where the only change is an increase in the complexity of the coda of the second syllable. Because of this minimal phonological change to their stems, plurals in *-s* can be recognized more easily through parsing, are thus less in need of full-form access representations, and hence fail to show surface frequency effects.

### 2.3.2 Representation and processing of Italian plurals

Baayen, C. Burani (Istituto di Psicologia del CNR, Rome), and Schreuder investigated the processing of Italian singular and plural nouns in the visual modality, again using the frequency dominance paradigm. Unlike in Dutch, both the singular form (*nas-o*, nose) and the plural form (*nas-i*) receive overt morphological marking in Italian. Nevertheless, as in Dutch, singular-dominant and plural-dominant singulars were responded to equally fast. This finding supports the hypothesis that the response times for singular nouns are determined not by their surface frequency but by the summed frequency of all their inflectional variants. Not surprisingly, singular-dominant plurals required significantly longer response latencies than their corresponding singular forms. Interestingly, however, the plural-dominant plurals were responded to significantly faster than their singulars. An excellent fit to these data was obtained for the stochastic dual-route model developed by Baayen, Dijkstra, and Schreuder. In the model, the short response latencies of the plural-dominant plurals follow as a result of statistical facilitation. Due to the combined availability of both a direct access route and a parsing route, mean reaction times become significantly faster.

### 2.3.3 Cumulative frequency effects in different lexical strata

Baayen, Schreuder, and Burani also investigated the role of cumulative frequency effects with respect to lexical stratum and semantic transparency. Various researchers have reported that the frequency with which the stem of a morphologically complex word is used co-determines the speed with which lexical access to the derived word is completed. Three experiments were carried out to gain further insight into the nature of this so-called cumulative frequency effect. In the first experiment, words with high and low cumulative frequency were compared for the Latinate and Germanic strata in the Dutch lexicon. An effect of cumulative frequency could be observed only for the Germanic stratum.

The absence of an effect for the Latinate stratum might be due to a lack of semantic transparency between stem and derived form, a lack of phonological transparency between forms, or to a



combination of both. The second experiment therefore contrasted words with high and low cumulative frequency for semantically transparent and semantically opaque words. A main effect of cumulative frequency was observed, but no effect of semantic transparency. This finding suggests that the absence of a cumulative frequency effect for Latinate words is due to the lack of phonological transparency that is characteristic of this lexical stratum. In addition, this result seems to indicate that the high-frequency stems of the (low-frequency) semantically opaque words with a high cumulative frequency (e.g., *branding*, surf, from *brand*, fire) influence visual lexical decision. To test this hypothesis, the third experiment exploited a priming task to investigate whether seeing *branding* influences subsequent recognition of *vuur*, fire, as compared to an unrelated control condition (e.g., *schuchter*, shy, followed by *vuur*). With an SOA of 350 milliseconds, a significant priming effect was obtained. This result suggests that in the early stages of visual word recognition the transparent reading of an opaque derived word with a high-frequency stem is activated.

### 2.3.4 Morphological ambiguity in large corpora

Together with R. Sproat (Bell Laboratories, Murray Hill), Baayen considered the following morphological problem in lexical statistics. Given a form that is previously unseen in a sufficiently large training corpus, and which is morphologically *n*-ways ambiguous – i.e., serves *n* different lexical functions – what is the best estimator, based on the available corpus, of the probability of each reading of that form? For example, suppose that the word *aanlokken* (entice, appeal) has not been encountered before. Is *aanlokken* more likely to be the infinitive (to entice), or is it more likely to be the plural present tense form (we, you, or they entice)? Baayen and Sproat argued that the best estimator is provided by computing the relative frequencies of the various functions among the *hapax legomena* – the forms that occur exactly once in a corpus; in particular, a hapax-based estimator is better than one based on the proportion of the various functions among words of all frequency ranges. This is because when one computes an overall measure, one is including high-frequency words, and high-frequency words tend to have idiosyncratic properties

which are not at all representative of the much larger mass of (productively-formed) low-frequency words. This result has potential importance for various kinds of applications where lexical disambiguation is important, including, in particular, the stochastic tagging of text corpora. This is especially true when some initial hand-tagging of a corpus is required: in order to estimate accurately the probabilities of different lexical meanings of very low-frequency morphologically-ambiguous types (most of which would not occur in any given corpus) one should concentrate on tagging a good representative sample of the hapax legomena, rather than extensively tagging words of all frequency ranges.

### **3. Lexical Access in Speech Production**

How do speakers produce words in isolation and in larger utterance contexts? The project continued to study the processes that mediate between the initial generation of a lexical concept and the final utterance of the corresponding word. The work involved a further refining of the theory and its computational implementation, intensive experimentation on almost all levels of processing (roughly a hundred different experiments were run, many of them reliability checks on earlier findings) and statistical analyses of Dutch lemma and syllable properties. The theory also guided two neurolinguistic studies. One is the continued project by M. van Turenout et al. on lemma versus word form access in picture naming; it is reported in Chapter 9 of this report. The other one is a new project in which word form access is studied by magnetic encephalography; we will report on this research in section 3.3.

#### **3.1 The formation of lexical concepts**

A first step in naming a picture is to activate the relevant concept. This step is highly context-dependent, involving a process of perspective-taking. An aspect of perspective-taking are the "semantic shackles" that are momentarily in force. A. Meyer and W. Levelt compared picture naming latencies under two conditions. In a "homogeneous" condition a subject named pictures from a single semantic category (e.g. all animals or all body parts). In a "heterogeneous condition" a subject named pictures from different categories, all mixed together. On average, the naming latency for a picture in the homogeneous category was 24 ms longer than for the same picture in a heterogeneous category, a significant effect of semantic interference.

## 3.2 The two-stage model – a never-ending discussion

There is quite general agreement now that accessing a word involves a stage of lemma access and a stage of word form (or lexeme) access. The theoretical issues, however, continue to be whether these stages overlap in time and whether there is mutual interaction between stages. Our position has been and continues to be that lemma and lexeme access are discrete. But we did make two further contributions to this ongoing discussion.

### 3.2.1 Interaction between semantic and orthographic factors

Starreveld and La Heij (*J Exp Psych:LMC*, 1995) reported an interaction between semantic and orthographic relatedness of written distractor words in tasks that required conceptually-driven naming. Less semantic inhibition is obtained when target and distractor are orthographically related (target *cat*; distractors *calf* versus *cap*) than when they are unrelated in form (target *cat*; distractors *horse* versus *house*). Starreveld and La Heij argued that this interaction refutes the discrete view of lexical access. A. Roelofs, Meyer, and Levelt (*J Exp Psych:LMC*, 1995) showed that this rejection is based on an oversimplified conception of discrete access. They conducted computer simulations showing that an interaction rather than additivity is predicted by existing conceptions of discrete access.

### 3.2.2 Do SOA curves for lemma and form access overlap?

Stimulus Onset Asynchrony (SOA) curves have been important in the discussion about whether lemma and form access occur in a discrete or continuous fashion. Schriefers, Meyer, and Levelt (Annual Report 1990) took the absence of a temporal overlap between semantic and phonological effects in the spoken modality as support for discrete access. However, the literature reports overlap of semantic and form effects in the written modality. The curves for spoken and written distractors have been obtained in different experiments and a number of factors have never been controlled for. In a new study by Roelofs, within-experiment comparisons with appropriate controls showed that se-

mantic and form effects overlap irrespective of modality. The SOA curves do not exclude discrete access but no longer specifically support it.

### 3.3 An MEG study of picture naming and word form access.

In their 1994 paper (*J Exp Psych: LMC*), Jescheniak and Levelt demonstrated that the word frequency effect (naming pictures with high-frequent names is faster than naming pictures with low-frequent names) arises at the level of word form access. This finding became the starting point for an MEG study of picture naming, using the 122 channel whole head neuromagnetometer in the Helsinki Low Temperature Laboratory. The idea was this. If word frequency affects the single stage of word form access in naming, then it can be used as a litmus test for localizing this stage of processing in the brain. A further aim was to obtain reliable descriptive data of whole-cortex involvement in the process of picture naming. The approach can be seen as a more general methodological exercise in relating psychological stage models to high temporal resolution brain-imaging procedures such as MEG and EEG. In the "single factor" or "stage focusing" (SF-) method, an independent variable is chosen that is known to affect a single stage in the processing model. Any spatio-temporal effect of this independent variable on the imaging data can then be interpreted as a clue to the cerebral localization of that processing stage. The SF-method was applied here by singling out the stage of word form access in picture naming, using the independent variable of word frequency. Any difference in brain responses evoked by naming pictures with high-frequent names and pictures with low-frequent names should be due to differences in word form access.

In preparation of this MEG experiment, Meyer and Levelt ran several pre-experiments to pilot the materials and the experimental procedures. In the final pre-experiment, the carefully preselected pictures (all with monosyllabic names, many of them adapted from the original Jescheniak and Levelt study) were presented in just the same way as they would be during the MEG experiment. In particular, each of the 24 High Frequency (HF) and

24 Low Frequency (LF) pictures were named no less than 12 times by the same subject. This was done in order to test whether the word frequency effect would be robust over time, as had been the case over three repetitions in the original experiments. Figure 3.1 presents the naming latencies obtained in that pre-experiment. It shows, first, that the word frequency effect is indeed stable over multiple repetitions but, second, that the word frequency effect is by far not as large as the one obtained in the original Jescheniak and Levelt experiments (62 ms there versus 37 ms here). The latter may be due to the faster reaction times in the present study (592 ms on average, which is faster by 59 ms).

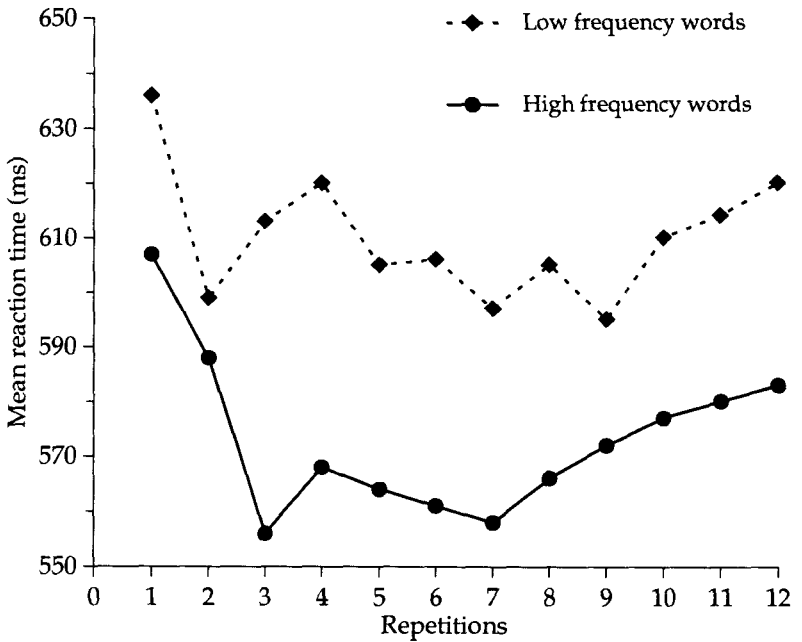


Figure 3.1 Naming latencies for HF and LF words

The MEG experiment was then performed jointly with R. Salmelin and P. Kiesila (both Technical U. Helsinki) and P. Praamstra (U. Nijmegen). Ten native Dutch speakers performed the same picture naming task as in the final pre-experiment, but now in the 122 channel neuromagnetometer in Helsinki. The

data are presently being analyzed, but three preliminary findings can be mentioned. First, although the experiment was an exact repetition of the pre-experiment, the word frequency effect was regrettably further reduced to a non-significant 3 ms. The highly motivated subjects had an average response latency of no more than 537 ms, 55 ms faster than in the pre-experiment. This doesn't mean that word frequency had no effect on the activation patterns; the activation data are presently being analyzed for any such effects. Second, source analyses confirm and refine the overall finding by Salmelin (*Nature*, 1994), showing progressive activation of occipital to temporal to frontal cortical structures. Third, all subjects showed a response in the 400-500 ms range over the right fronto-temporal sensors.

### **3.4 The WEAVER model**

Roelofs continued his work on a computational model called the WEAVER model of word-form encoding in speech production (Annual Report 1994). The model is built around chronometric data rather than speech errors, which makes it unique in the production literature. WEAVER (Word-form Encoding by Activation and VERification) generates word forms in a rightward incremental fashion by spreading activation in a lexical network and verifying whether integration of activated elements into the developing phonetic plan is licensed. The model adopts Levelt and Wheeldon's (*Cognition* 1992) proposal of on-line syllabification and a syllabary of articulatory programs. WEAVER solves computational problems that face existing error-based models. It simulates key findings about encoding times in a picture-word interference paradigm, about the order of encoding inside and between morphemes and syllables, about word and syllable frequency, and about speech errors. New experimental tests of WEAVER conducted in 1995 concerned semantic transparency, metrical structure, and morpheme frequency.

### **3.5 Semantic transparency in accessing multimorphemic words**

Roelofs and H. Baayen employed the implicit priming paradigm (Meyer, Annual Report 1988) to examine the influence of

semantic transparency in planning morphologically-complex forms. On each trial, participants had to produce one prefixed word out of a set of three as quickly as possible. In homogeneous sets, the responses shared the prefix whereas in heterogeneous sets they did not. Opaque prefixed verbs, such as *onthutsen* (to bewilder), whose bases are bound morphemes (i.e., like *cran* in English *cranberry*) were compared with fully transparent prefixed verbs, such as *ontkorsten* (to remove crust). Words in homogeneous sets were named faster than those in heterogeneous sets, and transparent verbs were named more quickly than opaque verbs, but there was no interaction of homogeneity and transparency. Since transparent verbs have free bases, the main effect of transparency may be a result of comparing bound and free bases. Therefore, opaque prefixed verbs whose bases are bound morphemes were compared with opaque verbs whose bases are free morphemes (e.g., *onthutsen* versus *ontbijten*, to have breakfast). Again, main effects of homogeneity and type of verb were obtained but no interaction, which suggests that the earlier effect of transparency is indeed a result of comparing bound and free morphemes rather than semantics. Free morphemes are of higher frequency of use than bound morphemes, which may explain why the verbs with free morphemes were produced faster than the verbs with bound morphemes. The findings support WEAVER's modular view in which morphological complexity can play a role in form-planning without having a (synchronic) semantic motivation. Note that the inflectional paradigm reveals that opaque prefixed words such as *onthutsen* are formally complex (e.g., like transparent prefixed verbs and in contrast to simple verbs, opaque prefixed verbs do not take *ge* in forming the past participle).

### 3.6 Metrical structure

Roelofs and Meyer conducted a series of implicit priming experiments examining the role of metrical structure in planning speech. On each trial, participants had to produce one word out of a set of three, or four, as quickly as possible. In homogeneous sets, the responses shared a number of word-initial segments, whereas in heterogeneous sets they did not. Earlier research has shown that sharing initial segments reduces production latencies



(Meyer, Annual Report 1988). The responses shared their metrical structure (the constant sets) or they did not (the variable sets). Following Levelt and Wheeldon's proposal (*Cognition*, 1992), WEAVER computes phonological words by integrating independently retrieved metrical structures and segments. Metrical structures in the model specify the number of syllables and the stress pattern but not the CV sequence.

This view of syllabification implies that preparation for word-initial segments should only be possible for response words with identical metrical structure. This prediction was tested by comparing the effect of segmental overlap for response sets with a constant number of syllables such as {*manier, matras, makreel*} to that for sets having a variable number of syllables such as {*majoor, materie, malaria*} (respectively, two, three, and four syllables). Word stress was always on the second syllable. As predicted, facilitation was obtained for the constant sets but not for the variable sets. In addition, the effect of segmental overlap for sets having a constant CV structure such as {*bres, bril, brok, brug*} (all CCVC) was compared to that for sets having a variable CV structure such as {*brij, brief, bron, brand*} (respectively, CCVV, CCVVC, CCVC, CCVCC). As predicted, now facilitation from segmental overlap was obtained for both the constant and the variable sets, and the size of the effect was the same for both types of set.

This total absence of CV-priming was further confirmed in two further experiments by Meyer, in which acoustic distractors were presented in a picture naming task. In the first experiment targets were monosyllabic CVVC words. The distractors were syllables with the same or a different CV-structure (CCVV or VVCC). Naming latencies were shorter after VVCC than after CCVV and CVVC distractors, which did not differ from each other. Hence there was no specific effect for the CVVC distractor that matched the target. In the second experiment, mono- and disyllabic targets were tested. The distractors were syllables that either had exactly the same CV-structure as the target's first syllable or mismatched on the syllable onset (i.e., targets with an onset consonant were combined with distractors without and vice versa). There was no effect of onset match vs. mismatch, but as in the first experiment, reactions were faster after distractors

beginning with a vowel than after distractors beginning with a consonant. Most likely, this difference is simply due to the fact that the vocalic distractors were shorter than the consonantal ones.

Just in the same way that implicit priming of word-initial segments is only possible if the metrical structure is shared between words in the homogeneous set, WEAVER predicts that implicit metrical priming is only possible if word initial segments are shared. That is the above result, formulated in a different way. But then it should still be verified that metrical priming disappears if no segments are shared between the words in the homogeneous set. This prediction was tested by directly comparing sets having a constant number of syllables such as {*majoor, sigaar, detail*} (all two syllables) to sets having a variable number of syllables such as {*sigaar, materie, delirium*} (respectively, two, three, and four syllables). In addition, sets with a constant stress pattern such as {*podium, makelaar, regio*} (stress on the first syllable) were compared to sets with a variable stress pattern such as {*podium, madonna, resultaat*} (stress on the first, second, and third syllable, respectively). As predicted, sharing metrical structure (i.e., number of syllables or stress pattern) without segmental overlap did not yield facilitation. Levelt, Meyer and Roelofs also performed three distractor-type experiments on metrical priming. In a first experiment, subjects named pictures that either had iambic or trochaic names. At zero SOA they heard a bisyllabic non-word that could also either be iambic or trochaic, whereas target and distractor always differed in all phonological segments. Naming latencies were not affected by metrical correspondence between target and distractor. In a second experiment the first phonemes of target and distractor were made identical, in order to give segmental spell-out some "head start". Again, no effect of metrical correspondence was found. In a third experiment the distractors were real words, but even then no metrical priming was found.

### 3.7 Lexicality and mismatch

Roelofs and Meyer examined the effect of lexical status and mismatch of spoken distractors on form encoding. Participants had to learn word pairs and had to produce the second member of a pair upon presentation of the first member. The responses

were disyllabic words. Spoken distractors were presented just before, simultaneously with, or right after prompt onset (i.e., SOAs of -150, 0, +150 ms). The distractors consisted of the first syllable of the target or of the first syllable of another target, or the distractors contained such syllables plus a second nonmatching syllable.

In a first experiment, participants produced words while hearing nonword distractors. For example, they had to say *zwaluw* (swallow) while hearing *zwa* (+related, -mismatch) or *scho* (-related, -mismatch) or *zwadon* (+related, +mismatch) or *schovar* (-related, +mismatch). As predicted by WEAVER, main effects of relatedness and mismatch were obtained (i.e., related distractors speeded up production and mismatch slowed production down) but no interaction. The effect of mismatch was only observed at the early SOAs, which had also been predicted. In a second experiment, participants produced words while hearing word or nonword distractors. For example, they had to produce *zwaluw* while hearing *zwager* (brother-in-law, +related, +word) or *schorem* (scum, -related, +word) or *zwadon* (+related, -word) or *schovar* (-related, -word). As predicted by WEAVER, only a main effect of relatedness was obtained (i.e., related distractors speeded up production); there was no effect of lexicality and no interaction.

### 3.8 Morpheme frequency

On-line syllabification requires morphologically decomposed form entries, because morphemes are domains of syllabification. Roelofs tested predictions of WEAVER concerning the effect of morpheme frequency using the implicit priming paradigm. As predicted, in producing nominal compounds, more facilitation was obtained from sharing low-frequency morphemes than from sharing high-frequency morphemes. The frequency effect did not disappear with repeated production. This confirms that the locus of the effect is the lexeme level as proposed by Jescheniak and Levelt (see 3.3 above) rather than the lemma level as proposed by Dell (*Language and Cognitive Processes*, 1990). Dell supported his argument for a lemma locus by simulations of facts about speech errors, but new computer simulations by Roe-

lofs showed that a lexeme locus can also account for the error evidence.

### 3.9 Syllabification and syllable structure

The syllabification theory proposed in Levelt and Wheeldon (1994) and in earlier work and implemented in Roelofs' WEAV-ER model, makes two rather strong claims. The first one is that there is only one level of syllabification. It occurs at the level of segment-to-frame association, i.e. when a phonological word is incrementally built up. The second claim is that the phonological syllables that come about in this process each activate a phonetic "gestural score" stored in a mental syllabary. The first claim was put to test by M. Baumann (see Annual Report 1994). She showed that syllable-final devoicing of stops like /d/ arises in phrases like *twee pond en een kilo* (two pounds and one kilogram), although the word *en* normally encliticizes to *pond*. As a consequence of this encliticization, the stop is in syllable-initial position. Nevertheless, it is subject to final devoicing (see Annual Report 1994). Baumann replicated this finding using a different task for eliciting the critical utterances. This repeated articulation task makes the occurrence of encliticization, which is an optional process, most likely. In a subsequent perception task on the elicited productions, (different) participants could not determine whether a phrase had contained the word *pond* or its minimal pair *pont* (ferry). They could only do this for the plural forms *ponden* and *ponten*, where the stops are syllable-initial and final devoicing does not apply. Clearly, then, lexical boundaries are still "visible" in the syllabification process, different from the original claim. More theoretical modeling is required here.

A further experiment by Levelt, Meyer and Baumann checked the existence of syllable structure at the earlier stage of segmental spell-out. According to the theory there should be no syllable structure at this level, that is, before the process of segment-to-frame association. There is, by now, reasonable evidence that acoustic phonological distractors affect the process of segmental spell-out. In an experiment subjects produced pairs of phonological words of the following kind. In one condition they would produce the command *kook het* (literally, cook it), which is syllabified as /ko-kət/. In another condition they produced the

question *kookt het?* (literally, cooks it?), which is syllabified as /kok-tət/. As auditory distractor they heard either /ko/ or /kook/. If the spell-out process is sensitive to surface syllable structure, a cross-over effect should be obtained in this experiment, i.e. shorter latencies if the surface syllable matched the distractor. Nothing of the kind was found in the experiment. Only length of the distractor worked: /kook/ was a better distractor for both targets than /ko/. This length effect is predicted by the WEAVER model.

The second claim, access to a mental syllabary, is not new. It was originally made by Crompton (1981) to account for allophonic accommodation of segments in speech errors, and adopted in Levelt's *Speaking*. The hard part is to establish a reaction time effect in support of the syllabary notion. This was done in the Levelt and Wheeldon (1994) paper. Three experiments demonstrated that words containing high-frequent syllables were produced faster (by about 15 ms) than words containing low-frequent syllables – independent of word frequency. In the paper's discussion room was left for alternative explanations. For instance, the same results would appear if speakers were accessing frequency-dependent demi-syllables. Meyer carefully reanalyzed the experimental materials of those experiments and found other potential confounds as well. Hence, Levelt and Meyer tried to replicate the syllable frequency effect in two further experiments in which every potential linguistic nuisance-variable, such as segment frequency, demi-syllable frequency, and word frequency, was carefully controlled for. In both experiments the syllable frequency effect disappeared. It should be said that these controls put heavy restrictions on the linguistic materials. But whether that is the cause of the null-effect or not, it definitely makes syllable frequency a less attractive variable for studying access to the mental syllabary.

One aspect of the syllabary theory has always been that only relatively frequent syllables are represented in the syllabary. Low-frequent syllables, like entirely new syllables, are probably constructed on line. From work by Sevald and Dell (*J Mem Lang*, 1995) it is clear, moreover, that the CV structure of syllables is highly relevant for their execution. Hence, to understand the process of articulating syllables it is important to explore type

and token frequency of a language's syllables. N. Schiller, whose dissertation project is concerned with the articulatory basis of the syllabary, set out to statistically analyze the distribution of Dutch syllables. A first step in these explorations was to analyze syllable type and token distribution in the Dutch CELEX lexical data base. But, of course, this data base only presents the syllabification of isolated words. Syllabification may be quite different in connected speech, where syllable boundaries often straddle lexical boundaries and sandhi phenomena abound. Therefore, Schiller, in co-operation with Meyer, Baayen, and Levelt, carried out an empirical investigation on a large contemporary Dutch newspaper corpus which was transcribed, phonologically processed, and finally syllabified.

The phonological processing yielded two different sets of syllables, one based on an isolated word syllabification, as in CELEX ("lexeme syllables"), the other on a hypothetical syllabification of "connected speech" after the application of higher level phonological rules, such as cliticization ("speech syllables"). Statistical analyses revealed that the correlation between both types of syllables in terms of their token frequencies was highly significant ( $r = .88$ ). There were, however, many more speech syllables types than lexeme syllable types. This can be explained by the fact that phonotactic constraints are weakened at the level of connected speech, so that more complex C-clusters are allowed. As a consequence, the syllable structure of the speech syllables became more complicated. But although this caused the frequency ranking of syllable types to be rather different between lexeme and speech syllables, the token frequency distribution of syllables was almost identical between the two sets.

In an experimental study, Schiller (together with Meyer and Levelt) tested the claim by Dutch phonologists that Dutch does not allow for short vowels in open syllables and that schwa is to be represented as VV (= long vowel) on a skeletal tier because it patterns with the long vowels in Dutch (cf. Booij, *The Phonology of Dutch*, 1995). This claim has important implications for the theory of Dutch syllable structure and a theory of core syllables. The experiment used Treiman's (1983) syllable reversal game, where subjects are requested to reverse the order of a word's syllable, like in *cartoon* -> *tooncar*. What would they do with a Dutch

words like *ladder* (/lader/, ladder) or *kachel* (/kaxəl/, stove)? Phonologists claim that intervocalic consonants are ambisyllabic, and should therefore predict reversals such as *chelkach* and *derlad*. The results showed that Dutch native speakers generally had the tendency to produce closed syllables, and that this tendency was especially pronounced for short vowel syllables. However, it could also be shown that the restriction to close short vowel syllables is not categorical, i.e., in a significant number of cases participants left the first syllable open (as in *derla*) although it contained a short vowel. Schwa, although phonetically short, behaved very much like long vowels, supporting the claim that schwa occupies two V-slots in the syllable skeleton.

### 3.10 Gender statistics for Dutch

J. van Berkum completed his dissertation research on recency effects in the retrieval of grammatical gender during speech production (Annual Report 1994: 36). As a complement to his empirical research he explored several linguistic and statistical properties of the Dutch grammatical gender system. A review of the linguistic literature on this system confirmed that, contrary to the belief of many native speakers (as well as of the psycholinguists who study them) there are only *two* grammatical genders in northern Standard Dutch: 'neuter' (*het*-words) and 'non-neuter' or 'common' (*de*-words). Although usually maintained in dictionaries and attempts at correct writing, the old distinction between *de*-words of 'masculine' and 'feminine' grammatical gender is no longer part of the colloquial language. A statistical analysis on the CELEX lexical database of Dutch showed, amongst other things, that there are now almost three times as many *de*-words as *het*-words in the language (73% and 27% of some 90,000 nouns respectively). But because the average *het*-word has a somewhat higher frequency of occurrence than the average *de*-word, one will encounter only about twice as many *de*-words as *het*-words in a sample of actual Dutch (67% and 33% of some 6 million singular noun tokens in the 42 million word Instituut voor Nederlandse Lexicologie text corpus). The actual size of the often quoted "large" *de-het* asymmetry therefore depends on whether one does a type count or a token count.

## 3.11 Lexical access in larger utterance contexts

### 3.11.1 Units of production

Meyer continued her research on advance planning of phrases. Earlier research (see Annual Report 1994) using the picture-word interference paradigm, had shown that before speakers initiate utterances such as *the dog and the table*, they retrieve the lemmas of both nouns. Thus the time span of advance planning at the lemma level comprises the entire utterance. In a new series of experiments, participants were presented with pairs of objects that varied in size, and they described them in phrases such as *the small cat and the large jar* or *the big monkey and the small child*. Each picture was accompanied by an auditory distractor word that was semantically related to the first or second noun of the utterance or unrelated to both. A semantic interference effect was found only for the first, but not for the second noun. Thus, the mean utterance initiation latency for *the small cat and the large jar* was longer after the distractor *bird* (semantically related to the first noun) than after *brush* (unrelated), but the distractors *cup* (related to the second noun) and *brush* did not differ in their effects. The mean latency was shorter when the left object was large than when it was small. In the next experiment, the same pictures were presented, but the participants only named the object categories, not their sizes. Interestingly, the semantic interference effect remained confined to the first noun, and the effect of the size of the left object was also replicated. The results suggest that the reduction of the planning span in these experiments compared to the earlier ones was not due to increased syntactic complexity or utterance length, but to differences in the visual or conceptual processing.

M. van der Borg (U. Nijmegen), Meyer, and Roelofs explored whether the implicit priming paradigm can also be used to study phonological units of production in utterances larger than single words. In their experiment, the prompt was the sentence subject (e.g., *de boer*, the farmer), and the response phrase was the verb phrase (*eet appels*, eats apples). A promising first result is that an implicit priming effect was indeed obtained for the first syllable of the response phrase, provided that the materials were very carefully selected and the participants were well trained.



### 3.11.2 Pronoun generation

Does the speaker activate the meaning or the word form of a noun when it is pronominally referred to? B. Schmitt investigated the production of pronouns, such as in an utterance like *The queen is small ... She is close to the table*. Here, the pronoun *she* anaphorically refers to the noun *queen*. One may therefore expect semantic (re-)activation of the noun. But because the noun is not articulated, no phonological re-activation should be expected. These hypotheses were tested in experiments where participants made lexical decisions during picture description. They described a sequence of two pictures. The first picture description, such as *The queen is small*, included reference to a person. In the second picture this person re-appeared on some trials. In that case the subject had to use a pronoun, such as in *She is close to the table*. In 50% of the trials an acoustic lexical decision probe was presented, locked to second picture onset. In these cases the task was to make a lexical decision on the probe and then complete the utterance. The probe could be semantically or phonologically related to the relevant noun, or unrelated. Preliminary results indicate that producing the pronoun involves activation of both the meaning and the word form of the noun.

### 3.11.3 Pronoun gender agreement

In ongoing research on the production of pronouns, K. Bock (U. Illinois) and Meyer are examining how grammatical gender agreement is implemented in Dutch, and how it interacts with natural gender. Dutch nouns come in two gender classes, the "common" de-class and the "neuter" het-class. Each class is associated with a set of agreeing elements that includes the definite determiners themselves, singular pronouns (personal, demonstrative, and relative), and certain adjective inflections. Several preliminary rating and elicitation studies have been carried out during the past year, with the goal of gathering normative data regarding speakers' preferences for gender-agreeing vs. gender-clashing demonstrative pronouns. These experiments have disclosed two clear effects that are qualitatively similar across naturalness ratings, production latencies, and pronoun-gender errors. The first is a strong and unsurprising preference for demonstrative pronouns to agree in grammatical gender with their

antecedents. What is notable about the result is that the effects are equivalent regardless of whether the antecedent is overtly marked for gender (with a definite determiner) or unmarked for gender (with an indefinite determiner). The magnitude of the preference is similar for both gender classes. The second effect is overlaid on the first: Agreement with the grammatical gender of the antecedent is reliably reduced when an interloper (a noun phrase with a different gender) separates the agreeing pronoun from its antecedent. This result sets the stage for experiments to examine whether natural gender has a similar ability to disrupt agreement with the grammatical gender of a head noun.

## 4. Argument Structure

The Argument Structure Project was established in 1994 to explore the relationship between predicates and their arguments in both cross-linguistic perspective and in language acquisition. Fundamental to the project, which encompasses researchers of different theoretical perspectives, are both general questions about the possible universality and innateness of argument structure and more specific questions about the patterning and acquisition of aspects of argument structure in particular languages. The research carried out in 1995 is summarized below under five topic headings: Realization of arguments, Identifying predicates and predicate classes, Cross-linguistic perspectives on syntactic bootstrapping, Argument linking, and Argument structure and the semantic extension of predicates.

### 4.1 Realization of arguments

S. Allen began a new project investigating the representation of arguments in early Inuktitut spontaneous speech. Inuktitut exhibits rich verbal agreement for both subject and object, thus licensing argument ellipsis. Analysis of some 2300 child utterances containing verbs indicates that 7% of arguments are represented as full NPs, 12% as pronominals (demonstratives), and 81% are omitted. This rate of ellipsis is much higher than that reported for early child speech in languages which do not permit argument ellipsis in the adult language (e.g., English), and in languages which license argument ellipsis through discourse (e.g., Chinese; Wang et al., 1992, *Language Acquisition* 2). Children thus show early sensitivity to the general ellipsis patterns in their own language. These findings also support the Preferred Argument Structure hypothesis, PAS (DuBois, 1985, in J. Haiman, ed., *Iconicity in syntax*, 1987, *Language* 63). The PAS predicts that only one lexical argument will be present per clause, and that overt arguments will appear predominantly in S (subject of intransitive verb) and O (object) positions but not in A (subject of transitive verb) position. In Inuktitut child language, more than one lexical

argument is found in fewer than 0.01% of the utterances with verbs, and lexical arguments appear in 22% of S and O positions, but only in 1% of A positions. Research is currently underway to analyze discourse factors that influence children's patterns of argument representation.

In a second project on ellipsis in language acquisition, M. Bowerman examined the handling of the arguments of prepositions by children learning English and Dutch. Several researchers have suggested that English prepositions can be subdivided into those that are obligatorily transitive (i.e., must take a nominal complement, e.g., *with, to, at, from, toward*), those that are obligatorily intransitive (i.e., cannot take a complement, e.g., *away, back, together*), and those that are optionally intransitive (i.e., can appear both with and without a complement, e.g., *in, out, down, around*). When used intransitively, optionally intransitive prepositions merge syntactically to some extent with true particles (as in *look the telephone number UP*), but they differ in that they clearly imply an argument; the referent of this argument is definite (in contrast to the argument of optionally intransitive verbs like *eat*) and must be identifiable on the basis of either linguistic or non-linguistic context; cf. (1).

- (1) a. I threw the ball into the room; I threw the ball in.  
 b. I walked down the stairs; I walked down.  
 c. I tacked the notices on the board; I tacked the notices on.

There are a number of constraints on the omission of the complement of optionally intransitive prepositions. Most fundamentally, the missing argument comes from a directional prepositional phrase and usually identifies the source or goal; locative arguments in static PPs cannot (with certain well-defined exceptions) be omitted:

- (2) a. We sat in the courtyard; \*we sat in. (On the intended reading.)  
 b. I show you what's in it/this/here; \*I'll show you what's in.  
 c. These cups have dirt on them; \*these cups have dirt on. (OK in British but not American English.)

Discovering when the complements of optionally intransitive prepositions must be realized or may be omitted constitutes a complex learning problem: i) for a complement that may be omitted, children must master pragmatic principles governing whether it should be omitted on a particular occasion (i.e., whether the listener can identify its referent), and ii) children must discover under what circumstances complements cannot be omitted no matter how easily their referent can be identified. To explore how children approach this domain, Bowerman analyzed detailed longitudinal data from two English-speaking children aged 1;8-2;3 years. With respect to i), she found that the children were sensitive to pragmatic factors essentially from the beginning: they omitted complements almost exclusively in contexts where the intended referent was obvious and there was no reason to mention it, and they produced full NPs when this was not the case; provision of proforms fell in between. With respect to ii), she found that the children distinguished strictly between complements of directional vs. static PPs from the moment both were present (1;11 for one child and 2;0 for the other): omitted complements were exclusively directional. In comparison, Bowerman found that a Dutch child of the same age treated the complements of directional and static PPs identically, providing a full NP or proform complement for both, as is required in adult Dutch (cf. *doe het ERin* / \**doe het in*, put it THERE in, 'put it in it/there' / \*'put it in'). These findings mean that the omission of arguments in young children's speech cannot be explained purely by reference to functional considerations (how easily the referent can be identified). Instead, it is clear that – congruent with Allen's findings for Inuktitut – learners of English and Dutch are sensitive to language-specific ellipsis patterns from a very early age.

In the context of J. Weissenborn's project on early argument structure development in Dutch, German, and French children (see Annual Report 1994), I. Krämer completed her MA thesis on the occurrence of subject and object NPs in relation to finiteness in Dutch child language. Transcripts of the spontaneous speech of seven children aged between 1;8 and 3;1 were analysed. Earlier studies have argued that the occurrence of overt subjects in early child language is related to finiteness. This was confirmed

in Krämer's research: subjects were provided with 76%–87% of the children's finite verbs, but only with 15%–66% of their infinitives. This result is expected if the subject of the sentence can be case-marked only if the sentence includes a finite verb. For some of the younger children, however, the proportion of infinitives occurring with an overt subject was much higher than in previous research. Krämer proposed that in the language of these children, the verb may move only partially in the syntax tree, case-marking the subject in a lower position corresponding to the object position AgrOP (agreement object phrase). An analysis of first person pronouns supports this hypothesis: there was a strong association between non-finiteness and accusative case marking on the subject (infinitival *mij maken*, me make, finite *ik heeft*, I has). As to object occurrence, Krämer found that children distinguish between verbs that are optionally vs. obligatorily transitive, but that they still incorrectly omit objects with 18%–30% of obligatory transitives (e.g., *mag nie vuil maak*, mustn't make dirty, *mama doen*, mommy do). She proposed a dynamic system in which object occurrence is linked to sentential aspect: If a transitive predicate denotes an event (i.e., a particular instantiation of the verb), the object is obligatory; if it does not denote an event, the object may occur optionally as a modifier of the predicate (e.g., *De man slaat een hond*, the man is beating a dog vs. *Deze man is een dronkelap*. *Hij slaat/slaat zijn kinderen*, This man is a drunk. He beats/beats his children). Pragmatic considerations determine whether the lexical content of a particular optional transitive is sufficiently informative in a given situation to appear without an object modifier. This system can account for the child data: among obligatory transitives, the children omitted objects with infinitives and embedded non-finite verbs – which invite a non-event interpretation – more often than with finite verbs. The children showed knowledge of the syntax/semantics involved in transitivity by age two. Still to be acquired, however, was a better understanding of the interaction between lexical content and pragmatics.

## 4.2 Identifying predicates and predicate classes

P. Brown continued her longitudinal study of Tzeltal (Mayan) child language acquisition, emphasizing the acquisition of

semantics and argument structure. Tzeltal is a language with rampant dropping of overt NP arguments (these are cross-referenced on the verb) and no case marking on nouns. This means that a necessary first task for the child is to distinguish the verb root from the affixes in order to match the latter to the appropriate argument referents. Brown has been following four children from age 1;6. Their first words were deictic particles and verb roots, both of which outnumber nouns in their early speech (as observed also by de León for the closely related Mayan language Tzotzil, but counter to what is typical for English). The children show a remarkable ability to isolate the CVC verb root, stripping off argument cross-referencing affixes even when they form a phonological unit with the root (e.g., *k-ak'* ERG(1st pers.)-give 'I give'). This early root extraction suggests a sensitivity to the canonical CVC form of Mayan roots (as opposed to the non-CVC nature of most affixes). It is also doubtlessly promoted by the high frequency of imperatives in the input to small children (the imperative form has no prefix), as well as by the conversational style of repeating the semantically newsworthy part of a previous interlocutor's utterance (thus, children are constantly producing and hearing sequences like: "I get this one" "Ah, you get this one," where in the immediate discourse context the contrast between "I"-CVC and "you"-CVC is highlighted). This conversational style also in principle provides the learner with an early contrast between the person prefixes, but some children continue to omit these occasionally (especially third person markers) even up to four years of age; in contrast, from an early age they accurately provide the suffixes *-a/-an* (imperatives), *-ix* (completion of change of state), *-em* (stative intransitive), and *-(t)es* (causative).

Also omitted in the speech of all the children studied, even well past their fourth year, is the intransitive "neutral aspect" prefix *x-*. This is surprising, given that adults never omit it, that it is an unambiguous signal of the intransitive nature of the root that follows it, and that children do not make transitivity errors. Although children routinely hear, for example, *ya x-bajt* (He is going), they systematically edit out the *x-* in their repeat-response, *ya bajt*. This contrasts with their clear ability to produce *x-* when it is the first or last consonant of a CVC root, or the final consonant of the suffix *-ix*, and is evidence again of their sensitiv-

ity to semantically weighty parts of the linguistic signal (CVC roots and semantically salient affixes like completive or causative), as opposed to lightweight “meaningless” affixes.

Children also show early sensitivity to verb classes in Tzeltal: e.g., (1) they do not make transitivity errors of the type found by Bowerman and others for English (e.g., they never omit the causative suffix or illegitimately use an intransitive causatively), and (2) they appear to be sensitive from an early age to a typological characteristic of their language: the joint presence of transitive and positional roots with very specific meanings that incorporate features of the arguments, and semantically less specific intransitive roots. While a few transitive verbs with general meanings appear among children’s first verbs (*give, want, take*), these are outnumbered by very specific verbs (eg. *insert into narrow opening, break long thin thing, carry by handle from above, lie face down, tip over sideways, fall from standing position*), which do not seem to be overgeneralized to wider contexts than in adult speech. A puzzle that remains to be explored is how children determine the argument structure of verbs – e.g., whether they are transitive or intransitive – in the face of the massive deletion of noun phrase arguments in the input.

Allen continued her work on the acquisition of causatives in early Inuktitut (children aged 2;0-3;6). Lexical causatives (e.g., *Jaaniup puvirtajuuq qaartanga*, Johnny burst the balloon) are produced from the earliest ages studied, while morphological causatives (e.g., *Jaaniup piaraq qiatitanga*, Johnny made the child cry) are used productively only around 3;0. An early overemphasis on the agency component of causation seems to lead children to link the use of the causative morpheme initially with imperative contexts. At first children produce fixed forms involving the causative morpheme and an imperative inflection. Later they produce what appears to be lexical causative overgeneralizations by failing to use the causative morpheme in non-imperative contexts, while at the same time using the causative morpheme correctly in imperative constructions.

A. Sorace (U. Edinburgh), in collaboration with W. Vonk continued her research on unaccusativity and auxiliary selection in Dutch. Across languages, intransitive verbs fall into two types, unaccusative (such as *leave, stay*) and unergative (such as *tick*,



*dance*), which have distinct syntactic and semantic properties. It has been found for a number of languages with a choice of perfective auxiliaries, that *to be* tends to be the auxiliary of unaccusative verbs and *to have* that of unergative verbs. However, Sorace has shown in an earlier study on Italian, that the selection of auxiliary is not only sensitive to this syntactic factor, but also to a lexical-semantic hierarchy of gradient dimensions such as concrete/abstract and dynamic/static. Thus, dynamic change unaccusative verbs such as *leave* are more likely to get the auxiliary *to have* than the auxiliary *to be*. A similar kind of hierarchy has been posited in Italian for unergative verbs, in which the relevant semantic gradient is the telic/atelic dimension. Accordingly, telic unergative verbs are more likely to get the auxiliary *to be* than *to have*. Ongoing work making use of different timed elicitation techniques is attempting to test the hypothesis that native Dutch speakers are sensitive to the same hierarchy of lexical-semantic verb types as the Italian, French, and English.

Of particular interest in the Dutch experiments are intuitions about positional verbs such as *liggen* (lie), *staan* (stand), and *leunen* (lean) (which are largely absent in Italian): on the basis of Levin and Rappaport Hovav's (1995, *Unaccusativity*) distinction between simple position verbs and maintain/assume position verbs, the preference for the auxiliary *to have* is predicted to be stronger for the latter than the former.

The Dutch experiments also aim to test experimentally the common impression that impersonal passives are not equally possible with all unergative verbs, or equally impossible with all unaccusative verbs. The hypothesis here is that the semantic variable "internal control" – which cuts across the unaccusative-unergative distinction – is a significant predictor of the acceptability of impersonal passives. This means that (4a) would be more unacceptable than (4b):

- (4) a. Er werd een goede vervanging gebleken.  
 There was a good substitute seemed  
 There seemed to be a good substitute (existence of state)
- b. Er werd precies op tijd aangekomen.  
 There was precisely on time arrived  
 People came on time (change of location)

The Dutch data may further justify the distinction between continuation-of-state and existence-of-state unaccusative verbs – contra Levin and Rappaport Hovav, who conflate them into a single class.

### 4.3 Cross-linguistic perspectives on syntactic bootstrapping

Inspired by the Nijmegen Lectures delivered by L. Gleitman, the Argument Structure Project decided to examine the feasibility of some of Gleitman's claims about "syntactic bootstrapping" – the hypothesis that children use the syntactic frames a verb appears in to make predictions about its meaning. Gleitman (1990, *Language Acquisition 1*) has acknowledged that "the first proviso to the semantic usefulness of syntactic analysis for learning purposes is that the semantic/syntactic relations have to be materially the same across languages". Thus, one means of assessing her proposals is to examine them cross-linguistically. One of her proposals is that, given their semantics, verbs meaning *put* and *look* would necessarily have different argument structures:

Verbs that describe externally caused transfer or change of possessor of an object...fit naturally into sentences with three noun phrases, for example, *John put the ball on the table*. This is just the kind of transparent syntax/semantics relation that every known language seems to embody...That is, 'putting' logically implies one who puts, a thing put, and a place into which it is put; a noun phrase is assigned to each of the participants in such an event. In contrast, because one can't move objects from place to place by the perceptual act of looking at them, the occasion for using *look* in such a structure hardly, if ever, arises...the component 'transfer' is inserted [by the learner] into a verb's semantic entry in case it is observed to occur in three noun-phrase structures. This happens for /put/ but not for /look/. (Gleitman 1990: 30)

D. Wilkins examined this claim with respect to Mparntwe Arrernte, an Australian language with pragmatically (not grammatically) determined word order, case-marking on NPs,

massive ellipsis of arguments (there is no argument that must occur obligatorily at the surface), and no form of obligatory verb agreement for arguments. The only clear diagnostic of “argument structure” in Mparntwe Arrernte involves relative clauses: NPs functioning as arguments relativize leaving a gap, while those functioning as adjuncts relativize leaving a case-marked pronominal copy. Using this diagnostic we are able to determine the range of predicate-argument structures in Mparntwe Arrernte precisely, and so know what it is a child must learn.

As Gleitman would predict, the Arrernte equivalent of *put*, /*arrerne-*/, has the following argument structure: {ERG, ACC, DAT}. That is, it has three arguments, an NP in the ERGATIVE case role (*putter*), an NP in the ACCUSATIVE case role (*thing put*), and an NP in the DATIVE case role (*place put*). However, verbs of perception and construction have the same argument structure (cf. Wilkins 1989, *Mparntwe Arrernte: Studies in the structure and semantics of grammar*, doctoral diss., Australian National University, Canberra). For /*are-*/ (see, look), ERG = perceiver, ACC = thing perceived, DAT = place of thing perceived, and for /*mpware-*/ (make), ERG = maker, ACC = thing made, and DAT = place where thing made. Thus, contrary to Gleitman’s claim, *put* and *look* do share the same 3-NP argument structure frame in Mparntwe Arrernte.

The facts of the surface structure are not, however, identical for Arrernte *put* and *look*. Indeed, there may be a sufficient difference in the frequency of cooccurrence of the DAT and ACC arguments with the verb to guide learners to semantic differences. Related to this, pragmatic constraints on ordering may result in different preferred orderings of the three arguments for each predicate. To test these hypotheses, Wilkins examined a text corpus of approximately 10,000 clauses for occurrences of /*are-*/ (see, look) and /*arrerne-*/ (to put) in past tense main clauses with the ERG argument and either the ACC or the DAT arguments, or both (see table on the next page).

Although the two verbs have the same argument structure, the pattern of occurrence with arguments is different: /*are-*/ (see, look) occurs rarely with only a DAT argument, but commonly with only an ACC argument; for /*arrerne-*/ (to put) the pattern is reversed. The hypothesis that the pragmatic con-

straints on ordering of arguments may be different for the two verbs was also supported: in clauses containing both ACC and DAT arguments, ACC and DAT occur immediately adjacent to the verb (before or after it) 87% vs. 43% of the time for /are-/ (see, look) (n=23); the equivalent figures for /arrerne-/ (put) are 50% vs. 73% (n=22). These results suggest that syntactic bootstrapping on the basis of number of arguments would not be sufficient to distinguish the Mparntwe Arrernte *look* and *put* verbs. Thus, one of Gleitman's proposed suggestions for a universal syntax-semantics alignment fails on cross-linguistic grounds. However, to the extent that the learner is sensitive to differences in frequency (c.f. Bowerman 1990, *Linguistics* 28; Rispoli 1987, *First Language* 7), the semantic differences between the two verbs could perhaps be extrapolated from statistical differences in argument cooccurrence and ordering.

	/are/ 'to see, look'	/arrerne-/ 'to put'
	[n=57]	[n=39]
Both ACC & DAT	40%	56%
Only ACC, no DAT	54%	13%
Only DAT, no ACC	5%	31%

As noted, the syntactic bootstrapping proposal requires that semantically similar predicates share regularities of argument structure. One strategy for further exploring this assumption is to analyze a postulated semantic domain of verbs across languages. From the Mayan languages (cf. Lucy 1994, *Linguistics* 32) comes ample evidence that the class of verbs encoding postures and positions is a candidate semantic/syntactic grouping of the type that the syntactic bootstrapping hypothesis requires. In an analysis of "aspect-causative types" of posture verbs (Stative, Inchoative, Agentive), Talmy (1985, in Shopen, ed., *Language Typology and Syntactic Description*, Vol. 3) has proposed that there are languages which i) encode all three types with a single general morpho-syntactic and/or lexical form; ii) encode the three types with three different forms; iii) encode the Inchoative and the Sta-

tive with a single form, but the Agentive with a different form; iv) encode the Inchoative and the Agentive with a single form, but the Stative with a different form; but that v) there are NO languages which encode the Stative and the Agentive with a single form, but the Inchoative with a different form. Given this pattern, Talmy argues that the Inchoative lies in the middle of a continuum of “aspect-causative types”, with Statives on one side of it and Agentives on the other.

E. Danziger, in consultation with Wilkins, has initiated a typological survey to test these predictions, exploiting the fact that a wide range of language data on this topic is available to the Argument Structure project, through members of the Institute’s Cognitive Anthropology Research Group. The data from this survey will answer the following cross-linguistic questions:

1. Does Talmy’s generalization hold true across languages for posture verbs?
2. Is the generalization that the Inchoative occupies a mid-point on the continuum between Stative and Agentive applicable to predicates other than posture verbs?
3. Do identifiable subgroups of predicates have distinctive patterns with respect to the encoding of “aspect-causative types” within one language? Are “posture verbs” one such group? Conversely, do all or most predicates within a language show similar patterns with respect to this variable?
4. Can we characterize groups of languages according to their coding of the Inchoative? For Posture verbs? For other verbs?

#### 4.4 Argument linking

In the literature on the assignment of arguments to syntactic positions, it has been assumed that, for a given syntactic frame in which a verb can appear, all the participants in the event denoted in the semantic structure of the verb are linked to fixed and morphosyntactically distinct NPs. However, S. Kita has started an investigation of some verbs of change of location in which participants in the semantic structure are not fully linked to the surface NPs. Consider (1a,b). The semantic structure of the Japanese verb *sasu* (pierce) specifies that two participants end up in a “piercing configuration”, and that one participant has moved through a continuous trajectory en route to this configuration.

The verb allows only one syntactic frame, [NP-Acc, NP-Loc]. The referent of NP-Acc is the “mover”, but the syntactic marking of NPs does not distinguish the role of the NP referents in the end configuration; that is, the referent of NP-Acc can be either “the pierced” as with the chicken in (1a) or “the piercer” as with the skewer in (1b).

- (1) a. Taroo-ga toriniku-o kushi-ni sashi-ta  
 Nom chicken-Acc skewer Loc pierce-Past  
 Taroo put chicken on a skewer.  
 b. Taroo-ga kushi-o toriniku-ni sashi-ta  
 Nom skewer-Acc chicken-Loc pierce-Past  
 Taroo pierced chicken with a skewer.

Thus, the verb has only a partial linking specification: only the dynamic aspect of its semantics is linked to the surface syntactic structure (i.e., the “mover” links to NP-Acc), while the configurational aspect remains unlinked. This contrasts with fully-linked verbs such as *ireru* (put in), for which exchanging the two arguments results in a change in how we interpret not only what moved but also how the participants end up spatially related to each other (see 2a,b).

- (2) a. Taroo-ga kaban-o hako-ni ire-ta  
 Nom bag-Acc box-Loc put.in-Past  
 Taroo put a bag in a box.  
 b. Taroo-ga hako-o kaban-ni ire-ta  
 Nom box-Acc bag-Loc put.in-Past  
 Taroo put a box in a bag.

There are also examples of the converse linking situation, in which linking is specified for the configurational aspect of the verb’s semantics but not the dynamic aspect. Consider the Korean example (3). The semantic structure of *tul-*, roughly (enter) specifies that the two participants wind up in a certain end-configuration and that one of them has changed its location, but the mover could be the referent of either the nominative NP or the locative NP; in this the sentence differs from its closest English

counterpart, (4), in which only the subject NP can be understood as the mover.

(3) square-ka circle-ey tul-e ka-ss-ta  
 Nom Loc enter-Conn Go-Past-Decl

The square ended up in a circle, and either the square or the circle moved.

(4) The square entered the circle.

The non-specification of linking for the dynamic component of semantic structure must be distinguished from the absence of a dynamic component altogether. The Japanese sentence (5), which is often offered as a translation equivalent of (3) and (4), does not – unlike its Korean and English counterparts – semantically require any change of location at all (although change may be pragmatically implied), (cf. Chapter 5.3.2).

(5) shikaku-ga en-ni hait-ta.  
 square-Nom circle-Loc enter-Past.

The square ended up in the circle; there may be no movement involved, e.g., a circle is drawn around the square.

These examples of patterns of non-linking of participants indicate that two separate substructures must be distinguished in the semantics of motion expressions: a configurational component and a dynamic component.

## 4.5 Argument structure and the semantic extension of predicates

As part of their broader project on lexical polysemy in Australian languages, Wilkins and N. Evans (U. Melbourne) have been examining the semantics and syntax of perception verbs, and their metaphorical mappings onto verbs of cognition. This work has thrown up interesting results for theories of argument structure. Wilkins and Evans have confirmed that perception verbs in Australian languages basically conform to Viberg's (1984, in Butterworth et al., eds., *Explanations for language universals*) proposed set of pathways for semantic extension within this

verb set class. Their current version of the pathways for Australian languages is presented in Figure 4.1.

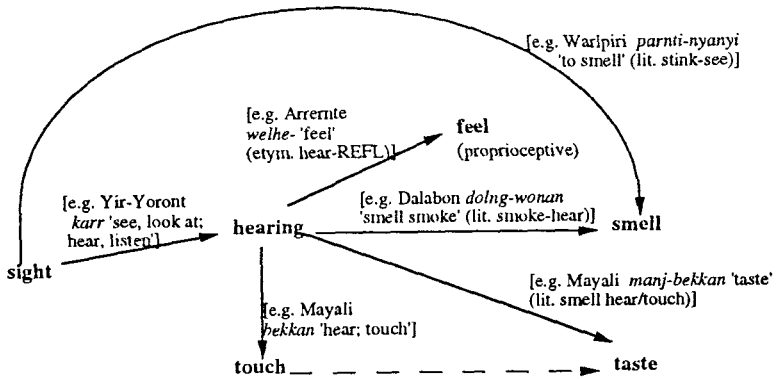


Figure 4.1: Australian patterns of semantic extension within the set of perception verbs

The original version of Viberg's hierarchy, which was established without reference to Australian languages, has visual perception ("sight") at the source of a set of extensions, with smell, taste, and feel proprioceptively at the end of the hierarchy (i.e., extension is from verbs for higher to verbs for lower perceptual modalities). In many of the Australian cases the extension is realised through argument structure changing operations of various sorts. In Warlpiri, for instance, the verb /nyanyi/ on its own means to see, but the addition of the preverb /purda/ (acts relating to the ear) generates the form /purda-nyanyi/ (hear, feel, think), which takes a different set of complements than does the base verb on its own. Reflexivisation of the clause containing /purda-nyanyi/ conveys the sense of feel proprioceptively (e.g., feel cold). So in Warlpiri we find the chain of unidirectional extensions SIGHT ---> HEARING ---> FEELING (proprioception). These findings are suggestive of (i) general (non-linguistic) constraints on lexical patterning, (ii) the systematicity of this particular semantic domain, and (iii) the type of argument structure variations which differentiate members of the class in a non-random pattern (e.g. the *see* verb will tend to be transitive and mon-



omorphemic while the *feel* [proprioceptive] verb will tend to be intransitive and derived).

Although the pattern of extension within the set of perception verbs is as predicted, the pattern of metaphoric mapping from perception verbs into cognition verbs is quite unlike that reported in the literature. Sweetser (1990, *From etymology to pragmatics*) for instance, relying largely on Indo-European data, finds 'see' as the main perception verb mapping onto 'thinking' and 'knowing', while 'hear' is restricted to mapping into 'understanding', 'heeding' and 'obeying'. In Australian languages, however, 'hear' regularly maps onto a large set of cognitive verbs, including 'knowing', 'remembering' and 'thinking' as well as 'understanding' and 'heeding', while 'see' does this extremely rarely. There is, then, more cross-linguistic and cross-cultural variation in this domain than has previously been recognized. Moreover, it has been claimed that some languages do not distinguish perception and cognition senses, so that e.g. Pitjantjatjara /kulini/ means 'hear, listen, think', without any means of disambiguation. However, as Goddard (1994, in Goddard and Wierzbicka, eds., *Semantic and lexical universals*) points out, there are clear differences in argument structure: the perception senses take an object NP for the stimulus, while the cognitive senses take a clausal complement. For other languages, such as Warlpiri, cognitive senses appear as an optional reading once perception verbs take a "state of affairs" (which could grammatically be a complement clause or a secondary predicate) as their argument instead of an object. Thus, to fully understand the nature of extension and metaphoric mapping that leads to apparently polysemous verbs, one must examine how alternative argument structure frames correspond to differences in interpretation. In turn, this may lead to a clearer view on whether there is any cross-linguistic uniformity as to which features of interpretation are derived from syntax and which features come from lexical forms.

In other work related to the activities of the Argument Structure Project, B. Comrie (U. Southern California) investigated the relationships between the structure of relative clauses, the structure of complement clauses, and argument structure, during his visit to the Institute. An English relative clause like *the book which the student bought* is plausibly analyzed in terms of movement of

the direct object *which* from its normal position after the verb to the beginning of the relative clause, in part because of the requirement of English argument structure that, except under very strictly defined syntactic conditions, arguments of predicates must be overt. Hitherto, relative clauses in languages that have no obvious movement, like Japanese, have typically been analyzed in the same way as English. Recently, however, it has been suggested that the Japanese "relative clause" structure is simply a modifying clause attached to the head noun, to give a structure like [*student-SUBJECT bought*] *book*. There is no overt reference to the book in the relative clause, but this is consistent with the general principle of Japanese that unstressed pronouns are omitted when they are retrievable from context, as when [*student-SUBJECT bought*] is the structure of the Japanese translation of *the student bought it*. Numerous other differences between English and Japanese fall into place under this analysis. Comrie also investigated the behavior of similar constructions in Turkish and a number of other Turkic languages, and in some languages of Southeast Asia, with interesting results both for the details of the analysis and the areal distribution of the different types. Surprisingly, for instance, Turkish turns out to behave essentially like English in these respects, while more easterly Turkic languages behave more like Japanese.

In her four-month visit to the Institute, M. Crago's (McGill U.) research centered on three areas: (i) ongoing work on normal acquisition and developmental impairment in Inuktitut together with Allen, (ii) bilingual acquisition and second language learning in Inuktitut and English/French together with Allen and a team of funded researchers from McGill, (iii) writing a book on research on language socialization in Inuit communities of Quebec. The monolingual and bilingual first language acquisition work is based on longitudinal speech samples and concerns morphosyntactical development, while the second language work is based on "Frog Story" narratives and addresses grammatical interlanguage effects.

## 5. Change of State

This project focuses on the interaction among categories of time, space, causality, modality, or possession, the clearest case of such an interaction being that of expressions involving a change of state (see Annual Report 1994). Work in the change of state project continued despite the loss of several key personnel; we report on the year's activities below. However, at the end of the year it was decided to reorganize this part of the Institute Project structure as currently constituted, ending the Change of State project and incorporating its subprojects in other closely related Projects: Argument Structure, Space, and a new project on Scope. This will therefore be the last time this work is reported under this Project heading.

### 5.1 Varying argument structure

Exploring the restrictions on argument structure in Change-of-State verbs, M. Bierwisch considered the particular conditions of verbs like *give*, *buy*, *sell*, *lend*, *borrow*, etc. which express a transfer of possession, where source state and target state differ by exchanging participants. While *give* and *take* are basically causative verbs the target state of which is characterized by the predicate HAVE as illustrated in (1) and (2), this does not hold for the more complex exchange verbs.

- (1) /give/ Verb  $\lambda x \lambda y \lambda z$  [ $z$  CAUSE [BECOME  
[ $y$  HAVE  $x$ ]]]  
(2) /take/ Verb  $\lambda x \lambda y$  [ $y$  CAUSE [CAUSE [BECOME  
[ $y$  HAVE  $x$ ]]]

The condition [BECOME [ $y$  HAVE  $x$ ]] in (1) and (2) introduces the presupposition NOT [ $y$  HAVE  $x$ ], which characterizes the source state in a general fashion. This condition is not sufficient for verbs like *buy* or *sell*, which require a more specific source state, in addition to the exchange of a sum of money  $m$ , as indicated by (3):

- (3) /buy/ Verb  $\lambda x \lambda y$  [y CAUSE [BECOME [[y POSS x] & [z POSS m]]] : [[z POSS x] & [y POSS m]]

Both the exchange value  $m$  and the Theme  $x$  obey specific possessive relations to  $y$  and  $z$ , the buyer and the seller, respectively, in the source state as well as in the target state. The colon “:” indicates the connection between the condition and the presupposition of the entry. Hence the generalization that change of state verbs are fully specified by the condition holding for the target state does not hold for proper exchange verbs, for natural reasons. A particularly intriguing condition holds for verbs like *rent* or *borrow*, which are underspecified for the direction of transfer, as illustrated by the following example:

- (4) (a) Although I bought the house, I ended up renting it.  
 (b) Although I didn't buy the house, I ended up renting it.

In (4a) the speaker is the possessor, but not the user of the house, while in (4b) the speaker is not the possessor, but the user; hence the renting goes in opposite directions in the two cases. The following entry for *rent* would account for both readings:

- (5) /rent/ Verb  $\lambda x \lambda y$  [y CAUSE [BECOME [z HAVE x] & [u POSS]] & NOT [z POSSx]] :  
 [[z POSS m] & [u POSS x]]  
 Condition: either (a)  $z = y$  or (b)  $u = y$   
 and (c)  $z \neq u$

Condition (5a) accounts for the reading of (4b), (5b) accounts for (4a). More generally, then, this research indicates the boundaries imposed on the relation between source- and target-state, even in fairly complex configurations.

## 5.2 Lexicalization and aspect

### 5.2.1 Russian tense and aspect

Following up earlier work on the expression of temporality (see Annual Report 1994), W. Klein worked out a strictly time-relational analysis of Russian aspect. A few exceptions aside, every

Russian verb form can be assigned to one of two aspects, usually called perfective and imperfective. Their morphological marking is very complex, but the central facts can be summed up as follows. Simplex verbs are (with some well-defined exceptions) imperfective. Adding a prefix from a limited set turns an imperfective simplex into a perfective verb (this prefixation may at the same time change the lexical meaning to some extent: it adds a particular '*Aktionsart*', that is, it adds particular inherent temporal properties to the verb). Some, though not all, of these perfective verbs can then be turned into an imperfective form by a special suffix ('secondary imperfectivisation'). The meaning of the two aspects is usually characterised by terms such as 'the situation is seen in its totality versus not in its totality, with a boundary versus without a boundary', and similar ones. Crucial to the present analysis is the assumption that aspect (as well as tense) can be given strictly time-relational definitions which reconstruct these intuitively correct but vague and metaphorical characterizations. Temporal relations, like BEFORE, INCLUDED IN, etc. obtain between three types of time spans: the time of the situation (T-SIT), the time of assertion (T-AST), and the (usually deictically given) time of utterance (TU). The basic idea is best explained by a simple example such as (1):

(1) Chris was ill.

Here, T-SIT is the time of Chris' illness. According to the standard analysis of tense, (1) states that T-SIT precedes TU. But clearly, this need not be the case; it may well be that this situation still obtains at TU, that is, T-SIT may well contain TU. What (1) asserts is rather that there is some time span T which precedes TU, and this time falls entirely into T-SIT. Whether T-SIT itself precedes TU or includes it, is left open: the speaker makes a commitment only for a subinterval T of T-SIT. The time span to which the assertion made by an utterance is confined is called here the time of assertion, T-AST. Tense then does not express a relation between TU and T-SIT; it expresses a relation between TU and T-AST, and if the listener knows anything about how T-SIT is related to the utterance in time, then this is by virtue of the fact that T-AST in turn is temporally related to T-SIT. Thus, both tense

and aspect are temporal relations between temporal intervals: TU, T-AST, and T-SIT:

Tense is a temporal relation between TU and T-AST.

Aspect is a temporal relation between T-AST and T-SIT.

Languages differ in the way in which they bundle and express these relations, a point to which we shall return below. In example (1), the lexical content of the entire utterance describes the situation as a state (with boundaries, about which, however, nothing is said in this utterance). It is assumed that there are three types of lexical contents: 0-, 1-, and 2-states. In the case of 0-state contents, T-SIT 'has no limits' (i.e., if the situation described by the lexical content of the utterance obtains at some time span T, it also obtains at any other time span T'). A situation described by a 1-state content has a beginning point and an endpoint, no matter whether the lexical content says anything about these boundaries. The situation described by a 2-state content has two distinct sub-states, source state and target state. Each of these states in itself has a beginning and an endpoint. Thus, the T-SIT includes two intervals, T-SS (time of the source state) and T-TS (time of the target state), respectively, or, the lexical content of a 2-state verb involves a change of state. The question with these 2-state situations is to which of the substates the T-AST is related. Languages vary in this regard; more precisely, they are claimed to vary with respect to what they consider to be the 'distinguished state' (DS) of 2-state verbs, the one which behaves like the single state of a 1-state expression. In all languages, the DS of a 1 state verb is necessarily that single state. In English, the DS of a 2-state expression is the source state. Thus, although the 2-state verb *bake a cake* when in the sentence *John was baking a cake* may make the listener assume that John eventually finished his cake – and this assumption may even be the default case – it is not asserted that the target state was reached, or will be reached. In Russian, the morphological variation sketched above can be naturally related to the difference between 1-state contents and 2-state contents. The basic rules of lexical content are as follows (some exceptions are ignored here):

- SI. Simple verbs express 1-state contents.
- SII. Prefixation results in a 2-state content.
- SIII. Adding a so-called 'imperfective suffix' to a 2-state verb marks its source state as 'distinguished state' for aspect marking.

Like in the case of English aspect, the two Russian aspects, imperfective and perfective, express temporal relations between the time for which an assertion is made, on the one hand, and the time of the situation, on the other. But there are two differences. The first one concerns the definition of the distinguished state. In Russian, DS is (a) the only state for 1-state expressions, and (b) the source state of 2-state expressions, if this is explicitly marked (cf. rule SIII above). Second, perfective and imperfective aspect bundle the possible temporal relations in a somewhat different way than in English. The background is the distribution of 1-state verbs and 2-state verbs, as described by rules SI - SIII above. We then have (OVL 'overlaps' means that the relevant time spans have a common subinterval):

- (2) PERFECTIVE      T-AST OVL T-SS AND T-AST OVL T-TS
- IMPERFECTIVE    T-AST OVL T-DS AND T-AST NOT OVL T-TS

Informally speaking, the perfective is characterized by the fact that the time for which an assertion is made has a common subinterval with the source state as well as with the target state. Since this is only possible for 2-state verbs, 1-state verbs are automatically imperfective. In the imperfective, the assertion time must have a common subinterval with the distinguished state, and it must not have a common subinterval with the target state. This is either the single state, or the source state when marked as such (rule SIII). Nothing is said on how precisely T-AST should overlap with T-DS: T-AST can be included in T-DS, can be simultaneous to it, and can even contain it – provided, of course, that there is no overlap with a target state. Hence, the imperfective is much wider in its range of applications than, for example, the English progressive form which requires T-AST to be properly contained in the source state or the single state, respectively. This

is in accordance with the traditional view that the Russian imperfective is somehow a ‘neutral’, ‘unmarked’ form. This analysis, while strictly time-relational, naturally explains the intuitions behind the common metaphorical characterizations such as “seen in its totality, as completed, with boundaries”. It simply reflects the fact that the time of the situation (as selectively described by the utterance) is fully included in the time for which the assertion is made. It also explains, among other things, the so-called conative use of the perfective. It is not contradictory – although pragmatically perhaps not very felicitous – to say:

(3) Ivan mne daval knigu a potom ne dal.

Ivan gave-IMPERF me a book but then not gave-PERF (it to me).

Ivan was giving me a book but then did not give it to me

The reason is simply that a claim is only made about the source state, and nothing is said about whether the target state – the state at which the speaker has the book – is ever reached: the time for which an assertion is made ends before the target state. This does not preclude, of course, that the target state is reached, and in fact, this is a common implicature. But it is not asserted.

### 5.2.2 Tamil tense and aspect

In contrast to the last Russian example, a purely aspectual account cannot fully explain sentences in Tamil which also appear to deny that the target state of the main verb was ever realized. E. Pederson is exploring the general question of how the grammatical system of Tamil semantically encodes the realization of an event. “Realization of an event” is understood as the normal final state of the affected entity/ies of an event described by a minimal verb, that is, a simple lexical root plus all obligatory co-verbs, inflections, etc. For example, in English, but not in Tamil, *John broke a coconut* necessarily entails that the coconut is afterwards broken:

(1) aiyar teengkaayai uTaittaar.

anaal teengkaay uTaiyavillai.

brahmin coconut-acc break(tr)-Past-3sResp



but coconut break(int)-Past-Neg  
 The brahmin broke the coconut.  
 But the coconut didn't break.

If full realization can be defeated (i.e., sensibly denied in subsequent clauses/utterances), what features of the event or degrees of realization are entailed as having occurred? Assume that the typical agent-patient verb has something like  $_1$ DO  $_2$ CAUSE  $_3$ STATE as part of its semantic characteristics. Many examples in Tamil seem to imply as far as  $_1$ DO but not necessarily as far as  $_2$ CAUSE. That is, Brahmin *breaks* patient (in Tamil), may only entail that agent  $_1$ DO something (perhaps *hitting-like*), but does not entail that there be any  $_2$ causal effect on the patient. In partial contrast, English *strangle* (unlike *break*) entails that the agent  $_1$ DO something such that it  $_2$ CAUSE some effect on the patient, but the patient need not reach the typical resultant  $_3$ STATE of *dead* (by asphyxiation). Many Mandarin verbs also appear to be of this pattern (cf. Annual Report 1994).

There are occasional examples in European languages which do not entail full realization. For example, Dutch *schoonmaken* (to clean) does not entail a  $_3$ STATE of *clean* despite the apparent use of a causative construction. However, European languages typically rely on special constructions to modify a verb so as to deny final realization – without such constructions, realization is entailed.

In contrast to this, a single Tamil verb often only implicates realization. However, Tamil predicates typically make use of a converb construction which either links sequences of main verbs or adds auxiliaries after main verbs. Only the final verb is inflected and these inflections have scope over all preceding non-finite verbs. However, to add a converb to another verb strongly entails that the result (or  $_3$ STATE) of the first verb is effectively the input to the semantic value of the second. For example, when the perfective auxiliary *viTu* is added after a verb, the  $_3$ STATE of this preceding verb is strictly entailed.

- (2) naan kattiyaal kaiyai tappippooy veTTineen  
 / \*veTTiviTTeen.  
 I knife-Inst hand-Acc accidentally cut-Past-1s

/ cut-Converb-\*viTu\*-Past-1s  
 aanaal nallaveelai aTipaTavillai.  
 but fortunately blow-suffer-Neg  
 I accidentally cut (someone's) hand with a knife.  
 But fortunately, it wasn't cut.

Importantly, this is a feature of the construction, not the aspectual nature of the auxiliary. For example, the reflexive auxiliary verb also entails the preceding verb's <sub>3</sub>STATE.

- (3) \*naan kattiyaa kaiyai tappippooy veTTikkoNTeen.  
 aanaal nallaveelai aTipaTavillai.  
 I knife-Ins hand-Acc accidentally cut-Converb-Reflex-Past-1s  
 but fortunately blow-suffer-Neg  
 I accidentally cut my hand with a knife.  
 But fortunately, I wasn't cut.

The extensive use of the Tamil converbial construction (which in and of itself specifies that the preceding verb's <sub>3</sub>STATE be entailed) may help license Tamil verbs to be often used as a synecdoche for an event which does not actually have the <sub>3</sub>STATE result. That is, it may well be a general (but not unrestricted) feature of Tamil that a verb with the basic semantics of <sub>1</sub>DO <sub>2</sub>CAUSE <sub>3</sub>STATE can be used to represent events which only contain <sub>1</sub>DO <sub>2</sub>CAUSE or even just <sub>1</sub>DO alone. Such an account allows an analysis of Tamil and, for example, English translation-equivalent verbs such that they have similar core lexical semantics. This seems preferable to requiring most Tamil verbs to have a basic meaning of something like 'attempt to <sub>2</sub>CAUSE'.

This synecdoche could be generally available in all languages. However, languages like English do not consistently use morphology other than the verb itself to indicate realization. So the synecdoche is less well motivated in terms of the grammar of these languages and is accordingly likely to sound distinctly odd with many verbs. Since Tamil has a number of constructions (such as the converb construction) which emphasize resultant states, such synecdoche seems well motivated.

### 5.2.3 Acquisition of aspect

S. Stoll continued her dissertation research on the acquisition of aspect in child Russian. The project consists of two parts, an experimental study with several comprehension and production experiments and a series of longitudinal studies. Stoll completed a comprehension experiment in kindergartens in St. Petersburg (age range of the children: two to six years) investigating the role of *Aktionsarten* and the morphological complexity of the verb for the acquisition of aspect. Aspect in Russian pervades the whole verb system and children have to deal with this category from early on. There are two main difficulties with the static picture techniques mainly used to date to test for aspect knowledge: such tests are difficult for children under age three, and they fail to capture the temporal structure of a situation, which is crucial for aspect. Stoll developed a video-based experiment to avoid these difficulties and to test the interrelation of aspect, *Aktionsart* and morphological markers. The experiment tests two hypotheses at the same time: (i) whether children start out to learn aspectual differentiations by lexical means, or (ii) whether children link innate concepts with special morphological characteristics. Since specific aspect functions (backgrounding, consecutive, narrative, etc.) reveal themselves only on the text level, Stoll also conducted a narrative test to investigate the aspect use in longer texts (age of the children: three to six years). This makes it possible to test the order of appearance of such functions. Analysis of these two experiments is currently under way.

The second part of this project consists of a series of longitudinal studies. Stoll started collecting one-weekly longitudinal video data of five Russian children in St. Petersburg. Since aspect is hypothesized to be acquired in the very early stages of language acquisition, she is investigating three children, who were at the one-word stage at the beginning of the study.

## 5.3 Motion

D. Slobin (U.C. Berkeley) continued to carry out his crosslinguistic and developmental study of encoding of motion events in narrative. This work is reported in the Space project (6.1).

### 5.3.1 COME and GO in Kilivila

G. Senft checked his analyses of Kilivila motion verbs in the field (in Papua New Guinea) and elicited some additional data in this Austronesian language using the "route description task" developed within the Space project (see Annual Report 1994). The results for all Kilivila verbs that express 'COME' and 'GO' concepts are presented here.

Only the most general verb expressing motion towards the speaker, *-ma-* (to come) does not differentiate at all whether the speaker knows something about the source, the path, and the direction of the motion event and the speaker's position or place with respect to this event. In general, any kind of knowledge about the source of the motion event is not explicitly expressed in all the verbs expressing motion towards the speaker.

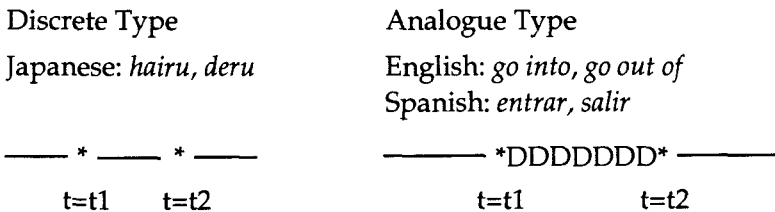
The verbal expressions *-mweki-* (to come straight to), *-suma-* (to come and pass s.o./s.th. close to the speaker) and *-sumwa-* (to come and pass s.o./s.th. further away from the speaker) imply that the speaker knows something about the path of the motion or certain parts of this path. The verbs *-mema-* (to come to), *-mwa-* (to come), *-mweki-* (to come straight to), *-meki-* (to come to s.o. (other than speaker)/s.th), and *-mwemwa-* (to come to a place different from speaker's place) clearly indicate that the motion event they refer to is telic; their use implies that speakers have information about the destination of the motion events to which they refer. In addition, *-mekeya-* (to come with s.o.) and *-mikeya-PP IV-* (to come towards s.o.) imply that the speaker's place is at the destination of the motion event. With the expressions *-ma-* (to come) and *-mema-* (to come to) the speaker's place may or may not be at the destination of the motion event, however, the verbs *-mwa-*, *-mweki-*, *-meki-*, *-mwemwa-*, *-suma-*, and *-sumwa-* imply that the speaker's place is not at the destination of the motion event.

The verbs expressing motion away from the speaker, *-la-* (to go), *-lola-* (to go/walk), and *-lilola-* (to (habitually) go/walk) may or may not imply knowledge about the source, the path, and the destination of the motion event. Two other verbs expressing motion away from the speaker, *-valova-* (to start going/walking) and *-vokeya-* (to go away from s.o.), imply that the source of the motion event is known to the speaker. Only the verb *-suva-* (to go via) implies that the speakers know something about the path of

the motion or certain parts of this path. This verb, together with the expressions *-loki-* (to go and arrive), *-va-* (to go to), *-weva-* (to (habitually) go to), *-weki-* (to go and rush to), *-vekeya-* (to go and follow), *-vabusi-* (to go down to the beach), and *-valagua-* (to go up to the village) codify that speakers know something about the destination of the motion events they refer to; thus, they are telic – the verb *-weki-* even requires that the destination of a swift motion event is specified.

### 5.3.2 ENTER and EXIT verbs

S. Kita compared the semantics of verbs and verb-particle combinations that are commonly used to describe ENTER/EXIT scenes, for example, a scene where a man is walking into a room. The verbs analyzed include English *go into*, *go out of*, Japanese *hairu*, *deru*, and Spanish *entrar*, *salir*. It was found that the languages differ considerably in the *Aktionsart* of such verbs. One type encodes that a certain spatial configuration holds at Time 1, and another spatial configuration holds at Time 2. It does not encode at all how this change is brought about between Time 1 and Time 2. Let us call the predicates with this characteristic the Discrete type predicates. Japanese *hairu* (enter) and *deru* (exit) are examples of this type. In contrast, English *go into*, *go out of*, Spanish *entrar* (enter) and *salir* (exit) predicate a dynamic transition from Time 1 to Time 2. Let us call such predicates the Analogue type predicates.



Legend: DDDD = dynamic phase  
\* = a definite time point

Figure 5.1: 2 types of predicate

In the literature on spatial language (e.g., Talmy, 1991, in *Proceedings of the Berkeley Linguistics Society*, Vol. 17) it has been assumed that dynamic motion, which subsumes only the Analogue type, and stasis in a location are the only two possible temporal schemata that a spatial predicate can have without metaphorical extension (such as when change of state is a movement in the abstract space of states from State A to State B). The above analysis of Japanese ENTER/EXIT verbs suggests a wider range of possibilities in the kinds of temporal schemata which can act as primitives in the semantics of spatial language.

There are two kinds of evidence for the above typological split. Since the existence of the Discrete type of predicates is more controversial, two pieces of supporting evidence for it are presented. The first is the demonstration that a sentence with a Japanese ENTER/EXIT verb implicates but does not predicate what happens in the transition phase. The second is the impossibility of progressive meaning with the Japanese ENTER/EXIT verbs. These points are illustrated with the ENTER verb in the following sections. Exactly the same demonstration is possible for the EXIT verb.

Suppose a situation such as Figure 5.2.

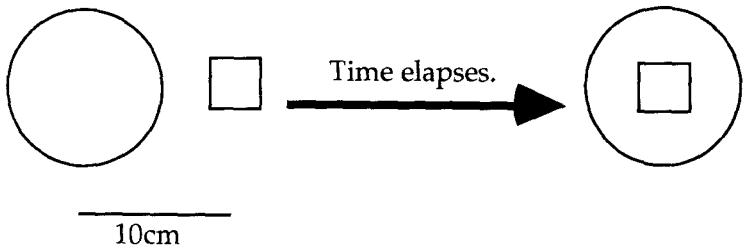


Figure 5.2: *Hairu* "enter" event

(1) *Shikaku-ga en-ni hait-ta square*

Nom circle Loc "enter" Past

- a. (Because the square moved to the left by 10cm,) the square entered the circle.
- b. (Because the circle moved to the right by 10cm,) the square ended up in the circle.

- c. (Because the circle moved to the right by 5cm, and the square moved to the left by 5cm), the square ended up in the circle

(1) is a good description of the event illustrated in Figure 2. It indicates what happened in the transition phase; to be more specific, the default understanding of (1) is that the square moved as in (1a). However, this aspect of the meaning of (1) can be annulled. As long as the square ends up in the circle, it does not matter which object moves, as shown in (1b, 1c). Moreover, it is possible that there is no movement of an object involved at all, as shown in (2).

- (2) Taroo-ga totemo ookina en-o kai-ta node,  
 Taroo Nom very big circle Acc draw Past because  
 shikaku-ga en-ni hait-ta.  
 square Nom circle Loc "enter" Past  
 Because Taroo drew a very large circle, the square ended up inside the circle.

The use of *te iru* in combination with *hairu* shows that *hairu* does not contain a dynamic phase. *Te iru* is a stativizer, which divides Japanese verbs into three classes. First, when combined with a class of predicates with a dynamic phase (such as *aruku* walk and *en o kaku* draw a circle), it creates progressive meaning. Secondly, it does not combine with stative predicates (such as *aru* exist). Thirdly, when combined with verbs with a change without a dynamic phase (such as *oreru* intransitive-bend), it creates resultative meaning. Since it can combine with *hairu* to create resultative meaning, the semantics of *hairu* appear not to contain a dynamic phase. Thus, (3a, 3b) are possible interpretations of (3), but (3c) is not.

- (3) Ushi-ga [hei-no naka]-ni hait-te iru.  
 cow Nom wall Gen inside-Dat "enter" Comp Resul.  
 a. A cow has entered the fence-enclosure (by jumping over the fence).  
 b. A cow is now inside the fence-enclosure (because the fence was built around him).

c. \*A cow is entering the fence-enclosure.

In summary, the Discrete type of *Aktionsart* of the Japanese ENTER/EXIT verbs questions the exhaustive dichotomy of continuous motion and stasis in location, which has been stipulated in the literature to be universal. It opens up the possibility of wider cross-linguistic variation of basic *Aktionsarten* of spatial expressions.

### 5.3.3 Tzeltal motion verbs

P. Brown continued her study of motion verbs in Tzeltal (see Annual Report 1994), and, using E. Danziger's Intransitive Predicate Form Class Survey (part of the 1995 "Manual" for Field Elicitation produced by the Cognitive Anthropology Research Group; CARG) added other intransitive verbs to the analysis. Tzeltal has a fairly small set of about 40 intransitive roots which includes the basic motion verb roots (a morphologically unique set of 16 verbs of motion but including aspectual notions like *begin* and *end/die*), plus other canonically intransitive motion/change-of-state notions like *fall, grow, explode, fly/jump, swim, walk* and *flee*. Also in this set are other semantically affiliated change of state notions: *get wet, be able/finish, fatten, rot, get used to, get free, become tired, fill, shrink, cry, swell, be born, sleep, blister, go down/become less*. Tzeltal thus appears conservative in what it encodes in intransitive roots, essentially motion path and change of state notions whose core meaning is GET IN STATE, and does not split them into two types of intransitives (in contrast to other Mayan languages, including Tzotzil and Mopan; see Annual Report 1994). Furthermore, each of Talmy's three "aspect-causative types" (in Shopen, ed. *Language Typology and Syntactic description*, Vol. 3, 1985) is encoded differently in Tzeltal; none are conflated. An extremely regular set of suffixes allows one to transitive or stativize these 40 or so roots, producing derived forms with the meanings PUT-IN-STATE *-(t)es* or BE-IN-STATE *(-em)*, respectively. Both the limited set of meanings and the regularity of the valence-changing morphemes should make these easy for children to acquire, and indeed Tzeltal children show no evidence of errors in the valence properties of these verbs in their different forms. A number of other meanings which are encoded in intran-



sitive roots in many languages (e.g., *bend, lie down, be on top*) are encoded in positional roots in Tzeltal; these have quite different morphological and semantic properties, and are indeed apparently harder for children to learn.

A pilot study exploring whether there are cognitive consequences of the change-of-state semantics of Tzeltal motion verbs like *enter* and *exit* (which pattern analogously to *enter/exit* in Japanese, as described above) was undertaken by Brown and S. Levinson. This took the form of video-stimuli presented as abstract motion triads (designed by Levinson and Kita), where subjects had to choose which of two motion stimuli was more like the 3rd target one. In contrast with the Dutch control group, who chose the same-path version of the event as most similar to the presentation event, Tzeltal subjects chose the same end-state version as most similar. This task is still being developed for application in other languages, but the results in Tzeltal and Dutch are encouraging.

### 5.3.4 Jaminjung verbs of change of state and motion

E. Schultze-Berndt began her dissertation research on the complex verbs in the Australian language Jaminjung. The formal relationship between motion and change of state verbs formed a major focus of this year's field research.

Jaminjung has a rather unusual verbal system where it is the unmarked case for verbal predicates to be complex expressions. These consist of one of a set of only twenty-five "function verbs", and of another component from an open lexical class called "preverbs" in some of the literature. These preverbs are always uninflected, whereas function verbs obligatorily take person and tense inflections. Function verbs can also occur without an accompanying preverb in a basic sense. When occurring with a preverb, they provide a kind of overt classification of events, which makes Jaminjung an interesting language for a theory of predicate classes.

Of the twenty-five function verbs, five occur in motion expressions, and four of those also occur in change of state expressions. Their best translation equivalents when not accompanied by a preverb are *go, come, fall, hit* and *throw/say/become*. The preverbs they combine with encode, in motion expressions, either

manner of motion or path trajectory, path shape, or region/boundary; in change of state expressions, preverbs encode the resulting state. Some examples for motion versus change of state use of the same function verbs follow:

burduj ga-ngga he goes upwards	vs.	lag ga-ngga it splits (lit. it goes split)
waldhub ga-dam he gets (lit. he falls) inside	vs.	narrng ga-dam it gets (lit. it falls) stuck
yirr gani-mam he gets out	vs.	jubard gani-mam he shuts it
burduj gan-unggum he climbs upwards	vs.	yarl gan-unggum he gets itchy

The use of the different function verbs for motion events can be explained in part by whether they occur in a complex verb referring to an event of locomotion or of boundary crossing. For example, in the 'entering' expression *waldhub gadam* given above, the 'fall' verb does not imply downward motion, but instead the moment of transition between being 'not inside' and being inside. The same preverb can be used with the verb function verb glossed as 'go' to describe the transition as a gradual one. This fits in with the observation that in actual discourse, motion events are often described by splitting them up into their phases (transitions and locomotion). For example, the event of crawling underneath a fence is described as 'going ('falling') underneath, going (moving along) in a crawling way, and getting up again'.

The question of whether the change of state uses of the same function verbs also encode different types of transition between two states cannot be answered definitely at this stage. Some data, however, are suggestive in this respect. For example, the preverb *wardooj* (lost) usually combines with the 'fall' function verb when referring to inanimate objects getting lost, and with the 'go' function verb when referring to people getting lost. It could be argued that a person losing his or her way usually involves a gradual transition while in the case of an inanimate object, 'getting lost' is more a matter of misplacing, and it is not usually possible to focus on the transition period between 'not lost' and 'lost'.

## 6. Space

The members of the space project continued to work intensively on the issue of “frames of reference” in language and cognition. It is worth just briefly recapitulating on the two prior Annual Reports that have reported selectively on activities that continue. In the 1993 Annual Report, it was shown that there appear to be three major types of coordinate systems used in the languages of the world to express locative relations between objects separated on the horizontal plane (cardinal, relative, and intrinsic). In that report, we showed how when a language favours one of these coordinate systems for the description of locative relations, then speakers of that language will generally utilize the same coordinate system in non-linguistic tasks. Since then, this tendency has been further verified in other languages and with other tasks. In the 1994 Annual Report, we described in more detail the way in which the project has explored the details of the linguistic systems for describing location in many non-European languages, by developing linguistic tasks and systems for their coding and comparison.

Both of these kinds of activities were continued in 1995, increasing both our range of languages and our analytical grasp of the differences between them. However, more effort in 1995 was devoted to understanding motion description, which had been relatively neglected in favour of an emphasis on the description of static scenes, and it is this on which we shall report here. The work on the description of motion events overlapped significantly, and usefully, with the work in the Change of State Project (see section 5.3).

### 6.1 Motion events: Lexicalization patterns and narrative style

The background to this work was the use of a number of stimuli for linguistic description of motion events. One was the wordless picture book *the frog story* used extensively by D. Slobin (U.C. Berkeley) in crosslinguistic studies of children’s language, and

now used to explore both adult and child description of spatial events in the dozen languages currently under investigation. As pointed out by Slobin, the linguistic construal of motion events – for example as one complex motion or as multiple simplex motions – is very variable cross-linguistically. Talmy's well-known typology of motion coding in language, in terms of "verb-framed" (where PATH is encoded in the verb) vs. "satellite-framed" (where the PATH is encoded in verbal particles or the like) has proved useful here. Slobin has continued carrying out crosslinguistic and developmental study of encoding of motion events in narrative, working with Talmy's analysis (see Annual Report 1992:75-77). Data consisted of elicited narratives (*the frog story*), novels, and translations of novels between types of languages. The findings suggest that some dimensions of linguistic typology have consequences for narrative style. Of particular interest is the preference of a language to encode PATH in a verb (such as *enter*, *ascend*) or in a "satellite," or element associated with a verb (such as *go in*, *go up*). In the first type of language – "verb-framed" – path segments tend to be encoded in separate verbs (e.g., *cross the field and enter the forest*), whereas in the second type – "satellite-framed" – a single verb can encode several path segments (e.g., *go across the field into the forest*). As a consequence, it is expected that speakers of verb-framed languages will mention fewer "ground elements" (e.g., *field*, *forest*) per verb, in comparison with satellite-framed languages. In a preliminary study, one complex motion event was analyzed in *frog stories* told by adults in the two types of languages. The measure was the mean number of ground elements per verb, comparing verb-framed languages (French, Italian, Portuguese, Spanish, Arabic, Hebrew) with satellite-framed languages (English, Dutch, German, Icelandic, Swedish, Polish, Russian, Serbo-Croatian, Warlpiri). Overall, the measure was lower in the verb-framed languages, reflecting tendencies to use verbs with no mention of ground (e.g., *he fell*) or with only one ground (e.g., *he fell to the water*). By contrast, speakers of satellite-framed languages often mention more than one ground element in relation to a verb of motion (e.g., *he fell over the cliff into the water*). Similar patterns are also shown in comparisons of novels written in verb-framed

(Spanish, French, Italian, Turkish, Japanese) and satellite-framed (English, German, Dutch, Russian) languages.

### 6.1.1 Typology of lexicalization patterns

However, the “verb-framed” vs. “satellite-framed” typology has proved in the end inadequate. For example, the highland Mayan languages Tzotzil and Tzeltal appear to use both strategies, allowing one to say for example both (something glossing as) ‘he ran exiting’ and ‘he exited coming’ and so on. Still, one basic generalization of Talmy’s seems to hold: languages do not combine MANNER of motion with detailed path-specification into a single verb root: thus we find verbs like *run* and verbs like *exit* but not hypothetically possible verbs, say *\*rexit*, meaning ‘run exiting’; on the other hand, where the path is encoded in a satellite, MANNER information can be coded in the verb, as in *run out*. On this basis, a corollary would seem to be that one expects verb-framed languages (following the *exit* pattern) to use additional clauses or participles (e.g., *exit running*) to indicate the manner of actions.

Slobin, working closely with members of the space project, has now proposed a more elaborate scheme, which subdivides Talmy’s main types according to further parameters of variation which have now emerged:

(1) An important initial point of clarification is that the constraints on multiple path-segments in verb-framed languages depend on whether or not a notional boundary has been crossed, as in *enter* or *cross*, as opposed to *go* or *run*. It appears that verb-framed languages allow accumulation of path segments with one motion verb, provided that none of the segments includes a boundary crossing (*enter*, *exit*, *cross*). Thus, in a range of verb-framed languages (Romance, Turkish, Japanese, Korean) it is possible to say, for example, *go along the road into the forest*, but not *go across [=boundary crossing] the road into the forest*; in the latter case, two verbs are needed: *cross the road and enter the forest*.

(2) Complex verbs: It is necessary to distinguish between “simplex” and “complex verb-framed languages.” In the latter type, a clause describing a motion event typically includes more than one verb, in various kinds of serial-verb or subordinate-verb constructions (Japanese, Korean, Chinese, Vietnamese, La-

hu, and probably all signed languages). In some types of complex verb-framed languages, it is possible to encode motion by either a path verb or a path particle, or combinations of the two (Arandic, Mayan).

(3) Motion versus change of location: the notion of path seems to include both an element of motion (i.e. a temporal span over which the mover is in transit between two locations) and a change of location which results – but both need not be encoded together. Thus we can distinguish between motion verbs (like *go*) and change-of-location verbs (like *appear*). In Japanese, and probably other languages like Tzeltal, these two dimensions are treated separately with regard to boundary-crossing verbs. S. Kita's analysis of Japanese has shown that the equivalent of a verb such as *enter* only predicates a change of location from outside to inside; in order to add the component of motion, a second verb is required (*come/go*). For the argumentation regarding Japanese, see the Change of State project (5.3).

This typology probably does not in fact capture all the necessary distinctions; for example (literary) Tamil and Japanese both have 'enter' verbs which emphasize change of location rather than motion – but they differ fundamentally because the Tamil verb focuses on the boundary crossing moment while the Japanese verb is concerned only with the pre- and post-states of the figure and ground (as described below). Nevertheless the typology certainly has a significantly better coverage than earlier proposals, and is being further refined by Slobin, N. Hoiting (Royal Institute for the Deaf "H.D. Guyot"), and members of the space project.

## 6.2 Cross-linguistic description of 'ENTER' 'EXIT' events

To explore these issues further, effort was concentrated on the description of 'entering' and 'exiting' events crosslinguistically. There were a number of reasons for this choice. One was that in seeking a bridge from our work on stasis to motion, it seemed a good strategy to explore the treatment of "topological" notions like IN (previously explored in work on stasis) in the motion domain. Another was that work for the Change of State

project had thrown up some interesting crosslinguistic differences in 'enter' notions (q.v.). A third was that the different encoding of these events in different languages was one of the central examples of the application of the verb-framed vs. satellite-framed types of lexicalization pattern, so that they have been taken both as prototype examples and diagnostics for those types. By intense investigation of this test case we hoped to further understand the range of variation and its underlying parameters.

### 6.2.1 Lexicalization and grammar of 'enter/exit' concepts

A language can be said to have a lexicalized 'enter' form if there is a verb root that can be employed to describe the path in what we will take as the prototype scene: a human entering a three-dimensional enclosure like a house. A sense of the linguistic variation may be given by some examples from a subset of the languages investigated. We first present a table that lays out the resources of each of the example languages for descriptions of this kind; for example, it is important to know whether a language has a lexicalized 'enter' verb, and if so, whether it requires or co-occurs with other path-markers (e.g., 'inside' pre- or post-positions or cases) and whether it has a true antonym meaning 'exit' or not. One may also ask whether there is more than one 'enter' verb, whether it may occur in a serial verb or adverbial construction with say a manner verb of running, and so on. In a table one can only capture an impression of the lexical and syntactic variation, but the following table will at least give some idea of the diversity involved. The data on each language here and throughout this report were collected in the field or by primary observation by the following members of the project: Arernte (D. Wilkins), English (Wilkins), German (H. Behrens), Inuktitut (S. Allen), Japanese (Kita), Kilivila (G. Senft), Mopan (E. Danziger), Pohnpeian (E. Keating), Tzeltal (P. Brown, S. Levinson), Tamil (E. Pederson), Yucatec (C. Stolz). In most cases, we have relied not just on grammatical elicitation but also on extensive interactive discourse of both task-oriented and natural kinds: some of the bases for these conclusions will be illustrated below.

Table 6.1: Grammar and lexicon of 'ENTER'/'EXIT' notions<sup>1</sup>

	T	Z	E	L	T	L	J	A	R	A	T	I	M	P	Y	K
1. Verb-framed aspects																
1.1. Existence of lexicalized 'enter'	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
1.1.1 subtypes of 'enter'	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.1.1.2 optional co-occurrence with a further 'in'/'inside' specification	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
1.2 Existence of antonym 'exit'	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
Functional antonym 'appear'	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
1.2.1 co-occurrence with 'out' specification	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+
1.2.1 co-occurrence with 'in' specification	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

<sup>1</sup> A gap in the table denotes absence of information, a question mark indicates that the analytical status is unclear<sup>2</sup> No longer colloquial<sup>3</sup> Partly but not fully analyzable as 'X-inside'<sup>4</sup> Occurs with the general preposition *tr*, which is indeterminate between Goal and Source specification



Table 6.1: (continued)

1.3 'enter' syntax	-	+?	-	-	-	+?	-	+?	+?
1.3.1 transitive root	-	+	+	+	+	+	+	+	+
1.3.2 intransitive	-	-	-	-	-	-	-	-	-
1.3.2.1 requires NP as Goal Spec	-	-	-	-	-	-	-	-	-
while 'exit' takes Source Spec	-	-	na	-	-	-	-	-	-
1.3.3 verbal participle 'enter'	+	+	+	+?	+?	+	+	+	+
(*go entering non-finite enter)	-	-	-	-	-	-	-	-	-
1.3.4 serial verb constructions	-	-	-	-	-	-	-	-	-
(*go enter' both finite)	-	-	-	-	-	-	-	-	-
2. Satellite-framed aspects <sup>9</sup>									
2.1 'go inside' pattern	-	-	+	+	+	+	-	+	+
2.1.1 'inside' = nominal	+	-	+	+	+	+	+	-	-
2.1.1 'into' = adverbial	-	-	-	-	-	-	-	+	+
2.2 'go out' pattern	-	-	+	+	+	+	na	+	+

<sup>9</sup> There are no straightforward tests for transitivity in this language

<sup>6</sup> A general syntactic pattern of omission. Where Goal does occur it would be in Locative case, unless verb is non-finite in which case the Goal would be Dative+Postposition inside

<sup>7</sup> The PP with general preposition *ce'* is potentially ambiguous between Source and Goal

<sup>8</sup> Literary register, mostly not used in colloquial speech

<sup>9</sup> In Talmy's typology the *into* of *go into* is thought of as a verbal satellite, not a preposition, here we collapse such distinctions because they are matters of fine-grained syntactic analysis

Note the following generalizations that emerge from the table:

- (1) many languages have both a lexicalized verb meaning 'enter' and a phrasal 'go into' construction. In fact this is the majority pattern. In this respect, ENTER/EXIT notions turn out to be poor diagnostics for lexicalization types of the "verb-framed" vs. "satellite-framed" kind. If frequency and idiomaticity are taken into account however, then most languages which have both constructions probably do favour the one or the other. Thus English *enter*, borrowed from Romance, is less colloquial than *go in*; while German *betreten*, not so easily explained as a borrowing (but arguably derived), is nevertheless less colloquial than the many German separable prefixed forms like *hineingehen*. When both forms occur, possible semantic distinctions between them arise, as discussed below;
- (2) very few lexicalized ENTER roots are true transitive verbs (with e.g., the enclosure entered represented by an Object NP, or transitive morphology on the verb);
- (3) ENTER verbs often, but not in all languages, require a specification of the "goal" (NP describing the enclosure entered), which must for intransitive ENTER verbs usually be introduced as an oblique phrase (e.g., with a locative or allative NP, an 'inside' or 'in' postposition, etc.); EXIT verbs on the other hand are more likely to expect a "source" specification in an oblique phrase (describing the enclosure exited). In this respect the pattern is the same as with 'GO IN/COME OUT' phrasal constructions. Note however that two Mayan languages, Mopan and Yucatec, have identical specification with an 'in' preposition for both the goal of the ENTER verb and the source of the EXIT verb, presumably because the prepositions are actually not carrying any "path" information; rather they seem to provide information about the spatial character of the goal itself;
- (4) the presence of an ENTER verb in a language does not imply the presence of a lexicalized EXIT verb, although the converse implication holds;

- (5) many apparent EXIT verbs turn out to be only functional antonyms, that is, semantically very general, with glosses including 'appear, emerge'. Thus we have the apparent paradox that in Tzeltal, for example, 'exit' is used to mean 'come on stage/screen' in describing video stimuli;
- (6) many languages with ENTER/EXIT forms utilize these not only as main verbs but also as dependent verbs or participles in complex verbal phrases; this allows such languages to combine MANNER information into the verbal phrase as the main or co-verb despite the constraint noted above that MANNER information does not lexically conflate with path-specifying verbs.

These patterns already hint at considerable complexity in this apparently narrowly circumscribed semantic area. We began the research with some initial hypotheses based on limited experience, for example:

- (1) Any language with an 'exit' verb has an 'enter' verb, but there is no converse implication;
- (2) Any verb which encodes ENTER will not encode MANNER information in the same verb (Talmy's prediction);
- (3) Although phrasal 'go to' expressions tend to conflate approach and arrival, ENTER verbs will never conflate notions like 'go inside a volume' with 'go towards a volume' (prediction based on observations of Slobin's);
- (4) No ENTER verbs also encode deictic oppositions (e.g., 'come-enter' vs. 'go-enter'), although these may be obligatorily marked outside the verb root (as in Korean).

These kinds of generalization seem to hold, but their explanation is not clear. For example, it is not the case that path information can never conflate with other information – as Talmy noted, in the Californian language Atsugewi for example, path can conflate with properties of the "figure" or object in motion. In the ENTER case, there are often further restrictions on the nature of the Goal: thus the Inuktitut verb 'enter' is restricted to entry to buildings (not to mention special roots for 'falling into water' or 'popping through hole out of ice'); Tzeltal *tik* means 'cause to en-

ter into an enclosed space through a narrow opening' and so on. In short, we still lack any general theory about constraints on lexicalization patterns in the motion verb area.

The kinds of plausible generalization that interestingly fail are those that seek universal argument structure patterns. For example, one might suppose that a lexicalized ENTER verb would be basically a two-place relation which one might expect generally to be a transitive verb, but such verbs are mostly, although not invariably (see the Tamil case), intransitive. Similarly, one might conjecture that whatever the nature of its syntactic realization, an ENTER verb would require a second argument that specified the Goal, the place entered, while EXIT verbs would subcategorize for an NP that specified the Source, the place exited. But apart from the fact that some languages (e.g., Tamil, Tzeltal) freely omit such arguments, even when such a second argument appears its interpretation is not necessarily given by such a frame: thus Yucatec has a true lexicalized EXIT verb (meaning 'go out of a 3D volume') but a local prepositional phrase with a semantically general preposition after the verb can be ambiguous in interpretation between 'exiting out of Source' and 'exiting towards Goal'.

### 6.2.2 Semantics of ENTER/EXIT verbs

For the purposes of cross-linguistic comparison, we took motion in and out of a container or enclosed void as the central "scenes" for which we would look for verbal descriptions. We had clues that even languages which have expressions with similar extensional coverage in this area could still differ systematically in the meanings lexicalized. We therefore devised tools for probing exactly what the intensional content of, for example, an ENTER verb is (actually, tools for distinguishing shades of extensional coverage). In addition, having isolated the expressions used to cover these "prototype scenes" we can go on to ask what other kinds of scenes these expressions cover – that is, how semantically general they are. To aid this investigation, elicitation of a wide range of related but distinct scenes were built into the elicitation tools (e.g., entering a filled volume (e.g., liquid), coming into view, etc.). Here we report on just a few of these methods and some preliminary results.

**The animation description task.** To explore the precise semantics of ENTER/EXIT verbs a computerized animation film was designed by Kita (and made by C. Hendriks) using a three-dimensional animation program. This allows the construction of various hypothetical, even physically impossible, scenarios, which can be viewed from different angles. Thus, for example, a man can be shown entering and exiting a house from different perspectives, and also *beaming in* (i.e. de-atomizing, fading slowly from outside the house and emerging through reconstitution magically within the house) and conversely *beaming out*. Native speakers viewed the film and then described it to another native speaker. The purpose of this was to obtain more information concerning the conditions under which in a particular language one could be said to 'enter' or 'exit' an enclosure. One particular, and it turns out crucial, issue is whether a language actually encodes MOTION in its ENTER/EXIT verbs, or whether in fact they only encode discrete Change of State (see 5.3.2 of this report for further exposition here): in other words an 'enter' verb might have the semantics 'move across a boundary into a container' or it might have the semantics 'achieve a state of being inside a container, from a prior state of being outside'. It was hypothesized that the "beaming in/out" scenes should be readily described by languages which have a Change of State semantics without a Motion component in their 'enter/exit' verbs, while verbs that encode motion might be more difficult to apply to this situation.

The findings indicate some interesting crosslinguistic differences here. Although in English it might be difficult to describe the man 'beaming in' as just *going inside*, as predicted by the motion semantics of *go*, in Japanese he may straightforwardly be said to 'enter' (using the verb *hairu*). In the same way the man 'beaming out' can be said to 'exit' (*deru*) in Japanese without difficulty. Japanese seems indeed by other tests to have a pure Change of State semantics for its 'enter/exit' verbs (see Change of State, 5.3), so the 'beaming in/out' scenes are at least one diagnostic for motion versus change-of-state without motion semantics. This impression is reinforced by Tzeltal, which also by other tests seems to have an essentially change-of-state semantics for its 'enter' lexeme: speakers accept the 'enter' verb for the "beaming-in" scenario.

This gives us some confidence that this elicitation tool is one diagnostic for a 'motion + change-of-state' versus 'change-of-state without motion' semantics. If we now apply this to Arrernte we find the following. The normal walking-in scenes are coded with an 'enter'-lexeme, *irripe-* plus "associated motion", that is a bound morpheme that indicates that the action of the verb is done concurrently with motion in a specific direction (e.g., towards deictic centre, or across the visual path). The 'enter' verb can co-occur with an 'inside' specification on the Goal NP. The walking out scenes are coded with a verb root *arrate-* that at first looks like an 'exit' lexeme, but turns out to have much broader usages. Now because the associated motion specifications occur, one might suppose that both the possible 'enter' and 'exit' lexemes are actually pure change-of-state verbs, requiring the extra motion or path information provided in the "associated motion" affixes. If so, we would expect the alleged 'enter' and 'exit' forms to be usable in the "beaming in" and "beaming out" scenes respectively. In fact, only the supposed 'exit' form, *arrate-* is so usable; it occurs as the functional antonym for a 'disappear' verb. It transpires that 'beaming in' is described as 'disappearing outside', and then *arrate-* 'appearing inside the house', from which it is crystal clear that *arrate-* does not mean 'exit', but rather means 'come into view, emerge, appear'. That it requires an associated motion suffix or additional deictic verb of motion to describe normal exiting events is thus explained – the root itself does not encode motion. The 'enter' verb however is not usable for the "beaming in" scene: it turns out to have true motion semantics, and may in fact occur without associated motion marking, as long as the motion is not towards the viewer (in which case a deictic 'come' specification is obligatory). The Arrernte examples gives some idea of the utility of this kind of elicitation device.

It is interesting then to see what happens in the case of languages that have both 'enter' and 'go in' expressions, and which use them apparently with equal freedom for canonical 'enter' events. One such language is Kilivila, an Austronesian language spoken on the Trobriand Islands: although there is a verb root meaning 'enter', it does not pre-empt a verb+satellite construction of the 'go inside' kind, indeed they seem by preference to co-occur in expressions glossing, for example, 'he enters the door,

he goes inside the house'. Again, although there is a verb root encoding 'exit', it rarely occurs alone, and in fact here a 'come outside' or simply 'come' expression is employed. The co-occurrence of the 'enter' verb with a 'go in' expression, often in a serial verb construction, is, as mentioned, a possible clue that the 'enter' verb does not properly encode motion, and is for example a pure change of state expression. We therefore look with interest at the treatment of the "beaming in" scenes: is 'enter' now used without a motion verb? On the contrary, two formulations are natural: either, most frequently, a 'go inside' locution (as in 'He disappears, he goes, he goes, he stands close to the door inside') or, less frequently, both an 'enter' and 'go inside' specification (as in 'He disappears, he enters, he will go to the house'). The explanation is that Kilivila 'enter' is in fact a boundary-crossing verb: a thread 'enters' a needle, a man 'enters' an arch, and so on. The sense of motion properly inside is not carried by the semantics of the verb, thus making the 'go inside' serial verb natural, and the 'enter' verb less natural in the "beaming in" scene than the straight walking-in scene. Crucially, 'enter' may be used to describe the "beaming in" event, but inexplicably 'come outside' is preferred for the "beaming out" event.

**'SHOEBOX': a kit for the elicitation of ENTER/EXIT and related events.** In addition to probing the exact semantics of ENTER/EXIT verbs or their 'go into', 'go out of' counter-parts, we also want to know just how broad their meaning is, and what other "scenes" beyond the canonical entry/exit of an empty container they cover. Therefore a rich set of stimulus materials was designed by Wilkins, which consists of a collection of different landmark objects and various moving objects (e.g., toy man, car, mechanical jumping kangaroo and frog), and a precise set of paths to be described. The kit also contains probes for distinctions between motion and stasis, different kinds of boundary-crossing, and for different ways in which complex motion events are broken down into their subparts. We concentrate here by way of illustration on just four of the 'enter'/'exit' scenes (the first three of which could be encoded in English *go in(to)/inside* or *go out*) which differ rather fundamentally. In Scene 1, objects of different "animacy" (kangaroo, car, ball) enter and exit an enclosure or corral through an open gate. This is close to the prototype 'go

inside empty volume' and we expect most languages with 'enter'/'exit' verbs to extend them to this scene, and similarly with languages that encode path with an 'into' pre- or post-position or case. In Scene 4, the same objects pass through an arch – here we are interested in whether the boundary-crossing or the entry into the convex-closure of an object warrants the use of 'enter' or 'go into' forms (cf. *English the bird flew into the tree*). In Scene 20, a boy jumps (first voluntarily then involuntarily) from a plank into a tub of water. Here the question is whether vertical entry into a filled volume warrants the same sorts of description as in the first scene. In Scene 24, a man builds a fence around an animal: here we ask whether the animal can be said to have 'entered' the enclosure, using the same locutions as in Scene 1. This last scene tests for 'enter' verbs with a change of state rather than a motion semantics, as described above.

The results from a selection of seven languages are displayed in Table 6.2. The first rows recapitulate some of the relevant lexical/syntactic properties from Table 6.1. Where languages have both 'enter' and 'go in' forms (and their 'exit' and 'go out' counterparts) their use is separately listed in the table; note that languages that allow more than one verb via serial verb or participle constructions may allow both forms to occur in the same sentence. (The 'go in/out' rows in fact include many examples of manner verbs plus satellite or PP constructions of the kind *run in*, *jump in* etc. as appropriate.)

From Table 6.2 one can read the following patterns.

- (1) Scene 1: *Entry into enclosure*. Languages with a lexicalized 'enter' for the canonical entry into a volume also tend to employ it for entry into an enclosure. In our sample, the Eskimo language Inuktitut is an exception, since it restricts its 'enter' verb to entry into buildings; however the corresponding 'exit' verb, though usually used for exiting buildings is also usable here for an exit of an enclosure – this is in line with a generalization mentioned below for 'exit' verbs to be at least slightly more semantically general than their entry counterparts. (The Tamil 'enter' verb was not used here because it belongs to the literary register.)



Table 6.2: SHOEBOX Scenes

	T Z E L T A L	J A P A N E S E	T A M I L	P O H N K P T E I A N	I N U K I T U T	K I L I V I L A	E N G L I S H
'enter' root	+	+	(+) <sup>1</sup>	+	+	+	+
'go-inside' forms	-	+?	+	+	+	+	+
Serial verbs	-	-	-	+?	-?	+	-
Verbal participles	+	+?	+	+	+?	-	
<b>Scene 1: corral</b>							
ENTER ROOT	+	+		+		+	(+) <sup>2</sup>
GO-INSIDE			+	+	+	+	+
EXIT	+	+		+	+	+	(+)
GO-OUT			+	+	+	+	+
<b>Scene 4: arch</b>							
ENTER	-	-	(+) <sup>3</sup>		+sub <sup>4</sup>	+	-
GO-IN			- <sup>5</sup>	+			- <sup>6</sup>
EXIT	+	-			+main <sup>7</sup>	+	-
GO-OUT			+?	+		+	+ <sup>8</sup>
<b>Scene 20: water pool</b>							
ENTER	-?/+	+/-		-		-	-/(+) <sup>9</sup>
GO/JUMP IN			+	-	+	+	+
<b>Scene 24: fence built around animal</b>							
ENTER	+	+ <sup>10</sup>		-	-	-	-
GO IN			-	-	-(be in)	-(be in)	-(be in)

1. Literary register.
2. The brackets around the plus here mean that the form was not volunteered, but was judged acceptable.
3. Literary register; used in related scenes, where boundary-crossing without extended motion was involved.
4. Two out of three speakers judged any use of 'enter' or 'go-into' irrelevant here, in favor of 'go-through' forms.
5. 'Go under' used.
6. 'Go through/under'.
7. Again, minority opinion.
8. Occurs only as *come out*, glossing 'appears, comes into view'.
9. When suggested to them, speakers accepted 'enter the water', but not 'enter the pool'.
10. Actually only OK in related scenes, where figure is inanimate (e.g., fence around tree).

From the table one can read the following patterns.

- (2) Scene 4: *Entry through archway*. Here languages with 'enter' lexemes in many cases cannot (or at any rate do not) use them. Exceptions are Kilivila and the literary Tamil 'enter' verb, both of which can be seen also on other grounds to have a 'boundary-crossing' rather than 'enter into midst of volume' semantics. One of three Inuktitut informants considered it possible to use a subordinate form of the 'enter' lexeme (restricted as mentioned to buildings), as in 'he walks through while entering'. Neither Tzeltal nor Japanese speakers considered 'enter' the appropriate form, preferring 'go through' formulations. The use of 'exit' lexemes when leaving the archway is notably freer, Tzeltal and Inuktitut permitting 'exit' here as main verbs.
- (3) Scene 20: *Vertical movement into water*. The use of 'enter' lexemes is not preferred by any language in the sample for this scene. Languages with both 'enter' and 'go in' possibilities prefer the 'go in' forms, but even here Pohnpeian resists this locution. In some languages vertical movement specification (as in 'descend') pre-empts 'enter'.
- (4) Scene 24: *Enclosure built around figure*. Here, surprisingly, both Tzeltal and Japanese permit the use of 'enter' lexemes (e.g., in Japanese a tree could be said to have entered a corral if a fence has been built around it). This again reveals a likely change-of-state rather than motion semantics for 'enter' verbs in these languages. For the same reasons, 'go in' locutions are inapplicable.

### 6.2.3 Conclusions regarding ENTER/EXIT notions

1. Verb-framed 'enter' verbs differ semantically from their satellite-framed 'go inside' verbal phrases:

- (a) 'enter' verbs have tighter restrictions towards a prototype 'motion towards inside of hollow 3D container' – for example, they may not always be used to 'enter water' (which is not a void) nor to 'enter the convex closure of an object' (e.g., arch);
- (b) 'enter' verbs (as in Japanese and Tzeltal) may have a semantics that allows change-of-frame without motion (as when a

cow can be said to have 'entered' an enclosure when a fence is built around it). Thus many 'enter' verbs may turn out strictly not to be motion verbs at all. In contrast, 'go inside' verbal phrases always encode motion.

- (c) some 'enter' verbs may encode motion, but refer just to the boundary-crossing phase of entry – thus in Tamil one tends to supplement the 'enter' verb (if used at all, because it belongs to the literary register) with a 'go' auxiliary verb.

2. Nevertheless, 'enter' verbs share some semantic peculiarities with 'go into' expressions:

- (a) both tend to require or implicate or encode deictic specifications: 'go into' vs. 'come into' encodes the distinction, but in many languages 'enter' verbs either implicate 'go into' unless further specified, or require further deictic specification, while 'exit' verbs either implicate 'come out of' or are on closer inspection semantically general over 'come into view' meanings.
- (b) both tend to expect the Goal specified in an oblique NP; this expectation seems stronger than for the corresponding Source NP with 'exit' or 'go out' expressions (e.g., in Arrernte the Goal must appear with 'enter' but the Source need not appear with 'exit'; in Mayan languages an NP with a semantically general preposition seems harder to interpret as a Source with 'enter' than as a Goal with 'exit').

3. 'Enter' and 'exit' verbs are rarely exact antonyms. In a number of languages (e.g., Tzeltal, Arrernte), the 'exit' verb in fact embraces the semantics 'appear', 'emerge', 'come on-stage', while the 'enter'-form does not cover the corresponding 'disappear' notions. 'Appear' semantics are transparently 'change-of-state' rather than 'change of location' or motion-encoding: thus in Arrernte a change of state expression is the functional antonym to an 'enter' motion verb. In Tzeltal, however, the 'enter' form may also be construed as a change of state verb, yet still the 'exit' verb has much broader usages: the 'exit' verb can be used as 'appear, materialize, come on-stage', but the 'enter' verb has none of the corresponding antonym range (it cannot mean e.g., 'disappear'). Even when 'exit' verbs appear to be exact antonyms, as in Inuk-

titut, where both seem to be restricted to movement in/out of buildings, still the 'exit' verb but not the 'enter' verb seems to be extendible to movement with respect to a fenced enclosure. Thus 'exit' notions are typically broader in meaning, and more frequent in use (Mopan, Tzeltal). In fact the Mayan languages show a corresponding diachronic pattern: the root *ok* (enter) is shared across the entire family, but the 'exit' roots are various, and seem diachronically to generalize to 'leave' meanings, allowing the introduction of further 'exit' roots. It should be clear then that when a language has a genuine 'enter' verb, this does not imply the existence of a genuine 'exit' counterpart; but the converse does probably hold.

Problems for the Verb-Framed typology:

4. Despite the fact that the treatment of 'enter/exit' scenes are often taken as good indicators of whether a language belongs to the verb-framed vs. satellite-framed pattern, many languages have *both* an 'enter' and a 'go into' form. The 'enter' forms are then likely to be much more restricted in their use than 'go into' expressions. For example, in Inuktitut (Allen), as mentioned above, the 'enter' and 'exit' forms (which in this case are perhaps near to true antonyms) are restricted to motion in and out of buildings – note though that the 'exit' form appears to have wider uses (being usable for exit from a fenced enclosure for example).
5. Many true 'enter' verbs can co-occur with satellites marking IN notions. Thus: Mopan *ok ich*, (enter into), or Arrernte *irrpe + ak-wene* (enter inside). The behaviour of these satellites can be puzzling: thus in Mopan one also 'exits into X' meaning one exited from X – perhaps a better gloss would be 'exited-from inside X'. When the path-encoding satellite, for example, a preposition, is semantically general over 'to/from', as can be the case in Yucatec or Tzeltal, both a Source and Goal interpretation tends to be possible, especially for the 'exit' verbs. These patterns thus show considerable flexibility from an argument-structure point of view, and are a serious challenge to simple claims about the universal nature of the argument structure of these kinds of verbs.

## 6.3 Studies of 'topological' and related spatial concepts

### 6.3.1 'Inside' and 'down' in Australian languages

Wilkins, together with N. Evans (U. Melbourne), as part of a wider project on polysemy and semantic change in Australian languages, has investigated the distribution of certain spatial meanings across the different languages of the continent. One curious fact concerning spatial description in Australian languages is that it is common for one and the same morpheme to be used to describe containment (e.g., 'in, inside, within', as in *the apple is in the bowl*) as well as being used to describe lower vertical relations (e.g., 'down; under; below', as in *the dog is under the table*). For example, Arrernte *kwene* corresponds to English 'in, inside, within; down, under, below; low', Warlpiri *kaninjarra* to 'inside; down, underneath; steep downward; deep down'; Rembarrnga *yarra* to 'inside; underneath; down', and Eastern Kunwinjku *kururrk* to 'inside, within; below, under, down'. This pattern of lexicalisation, where both the notions of 'INSIDE' and 'DOWN/UNDER' are covered by one form, has not yet been attested in any language outside of Australia. Three preliminary questions have been pursued: (i) exactly how widespread is the pattern of "polysemy" in Australia?; (ii) do the relevant forms consistently fall within the same formally-defined lexical class?; and (iii) do the forms which apparently cover the notions 'INSIDE' and 'DOWN/UNDER', in fact have the same extensional range?

Of the 53 Australian languages for which there are relevant data 20 languages [38%] manifest the "polysemy" discussed above; 19 languages [36%] have distinct lexemes for 'INSIDE' and 'DOWN/UNDER' (e.g., Thalalnyji *jalyura* (inside), *yirra* (down; under) and Guugu Yimithirr *wawu* (inside; breath; soul), *bada* (down), *muunhdhirr-gu* (underneath)); 9 languages [17%] have a form which is polysemous in the way described, and another form which specifically indicates just one or other of the relevant notions (e.g., Djapu *djinaway* (inside; under) and *dhirripi* (inside)); and, finally, 5 languages [9%] show a derivational relation between the lexical item for the 'DOWN/UNDER' notion and that for the 'INSIDE' notion (e.g., Walmajarri *kaniny* (down) and *kaniny-kaniny* (inside)). In all the cases of derivational rela-

tion, the DOWN/UNDER lexeme is the base for the derivation of the INSIDE lexeme. Importantly, the pattern of distribution of these four “lexicalization patterns” is non-random, in the following way: (a) languages along the east coast and languages along the west coast of Australia have distinct lexical items for the relevant notions; (b) languages of the central desert region (e.g., Western Desert languages, Arandic languages, and Ngarrkic languages) manifest the polysemy, (c) languages around the borders of the desert region tend to show intermediate behaviour by having either a derivational relation between forms, or both a polysemous and a distinct form, and (d) the languages of the far north show a truly mixed pattern (some languages having polysemy, others distinct forms, others a derivational relation, and still others a polysemous and a distinct form).

With respect to the second question, it should be emphasized that the forms being investigated are all lexical items which manifest both nominal and adverbial properties. So, these are not grammaticalized forms like prepositions. To form spatial descriptions, such lexemes generally co-occur with spatial cases, but they are not obligatory in spatial description. For the handful of languages for which we have sufficient detail to ascertain the specific lexical subclass the polysemous ‘INSIDE/DOWN’ form belongs to, we find two different patterns of affiliation. In languages such as Jaru and Warlpiri, the polysemous lexeme is part of a formally identifiable set of six forms which identify the six cardinal regions of 3D space – *north, south, east, west, up, down; inside*. In languages such as Arrernte, the relevant form is not part of the set of cardinal terms (which is only a four-term set in the language), but is part of a formally identifiable ten-term set of items which can be used to identify the spatial parts of an object – *top, front, back, side of, middle, this side of, that side of, the other side of, outside, inside; bottom*. Using evidence from word association tests and patterns of association in auxiliary languages, it appears that in languages where the “polysemous” term is part of the six-term cardinal system, speakers see the term as having only one antonym (the ‘up’ term), whereas in languages where the term is part of a system of “object-part” forms, speakers treat the “polysemous” form as having two antonyms (the ‘top’ term, and the ‘outside’ term).

Table 6.3: Inside Under

PICTURES		Arerrete kwene	Eastern Kunwinjku kururrk	Dalabon yirrh+	Kayardild yarki
I	apple in bowl	+	+	-	-
N	large box in open purse	+	+	+	-
S					
I	fish in water (in fish bowl)	+	+	+	-
D	owl in hol- low of tree	+	+	+	+
E					
	rabbit in cage	+	+	+	+
U	cat under ta- ble	+	+	+	+
N	ball under chair	+	-	+	+
D	gum stuck un- derneath table	+	-	+	+
E					
R	spoon under napkin	+	-	-	-
	table beneath lamp	+	-	-	-

(+ = 'form used in the description of scene; - = form not used in the description of scene)

As for the final question regarding the extensional range of such "polysemous" forms, a close examination of four languages, Arerrete, Dalabon, Kayardild, and Eastern Kunwinjku, reveals that forms that have been loosely equated as covering both the notions of *INSIDE* and *DOWN/UNDER* cover quite distinct extensional sets. Using the set of picture stimuli in the Bowerman and Pederson Topological Relations Picture book (cf. Annual Report 1992) as one elicitation tool, we find the following patterns

of extension for the terms under investigation (see Table 6.3). Note that for the ten scenes given in Table 6.3, there are only 3 scenes which fall in the extensional set of all of the four distinct “polysemous” forms under investigation (namely *owl in hollow of tree*; *rabbit in cage*; and *cat under table*).

Although the puzzle of why it is only Australian languages which appear to manifest this pattern of lexicalization has not been solved, we have made the problem more tractable. The fact that the distribution of lexicalization patterns in Australia is non-random makes it easier to investigate possible patterns of cultural and diffusional influence more systematically. Moreover, both the fact that the forms in comparison can belong to different lexical sets which are dedicated to different aspects of spatial description and the fact that such forms do in fact have distinct, although overlapping, extensional ranges provide a useful foundation for further exploration of the precise semantic and pragmatic factors involved in associating ‘containment’ and ‘down/underness’ so closely.

### 6.3.2 Polysemy in German spatial prepositions

Continuing his PhD research on polysemy in the German prepositions *an*, *auf*, *in* and *unter*, R. Nüse investigated further implications of the so-called “object-shifting-model” (cf. Annual Report 1994). In this model, the meaning of a preposition is assumed to specify a region of an object in which the theme is located, and objects differ with regard to the location and special nature of the region in question. *Auf* for example “says” that the theme is in contact with the *surface* of the relatum, and objects differ with regard to the location of their surface and its orientation with regard to the vertical. Different readings of a preposition like the “on-top-reading” and the “on-front-reading” of *auf* in *Der Vogel auf der Straße/auf dem Wegweiser* (the bird on the street/ on the sign-post) and *Die Schrift auf dem Plakat/auf dem Wegweiser* (The writing on the poster/ on the sign-post) are thus due to the different orientation of the surfaces in question (which can vary “between objects” and “within objects”); they do not constitute different, albeit related, *meanings* of the preposition.

If the meaning of a preposition contains, as it were, an “instruction” to select a certain region of an object like a surface, ob-



jects in the world differ with regard to the “applicability” of this “instruction”. On the one hand, there are those objects which have only one surface and thus allow for an easy and clear application of the “surface selection instruction” regardless of how their surface is oriented; objects like a poster or a street belong to this class. On the other hand, there are those objects with two or more surfaces like sign-posts, cars or cans, which have a top and a front (or side) counting as surfaces; thus, they are “ambiguous” with regard to the question where their surface is, while posters and streets are “unambiguous” in this regard. Objects like sign-posts, cars and cans, however, are not only “ambiguous”. They also differ with regard to the *saliency* of their surfaces. In cars, for example, the top is the salient surface, while the salient surface of sign-posts is the front. By contrast, cans (and buses, planes etc.) have no salient surface, since both front and top of the can are equally salient. Consequently, when it comes to the question of where the surface of an object is, objects in the world split into five classes: those which have only one surface, which can be the top or the front; and those which have both a top and a front, where one of the two or neither is the more salient surface. Similar classes of objects can be reconstructed for the other prepositions investigated.

The “psychological reality” of these object classes was tested with two different methodologies. First, a simple sentence completion task was used in which subjects were given PPs like *auf dem Wegweiser* ‘on the sign-post’ or *in dem Schrank* ‘in the wardrobe’, and had to complete them such that a meaningful German sentence was produced. If the meaning of a preposition is an “instruction” to select a certain region of an object, the readings of PPs should depend on the nature and saliency of these regions of the object denoted by the NP in the PP. And the (preferred) reading of a PP should manifest itself in the kind of completions subjects choose.

The results are as predicted (see fig. 6.1). There are “ambiguous” objects whose corresponding PPs can have both of the two readings in question (sign-posts, cans and cars); and there are “unambiguous” objects whose PPs allow only for one of the two readings in question (posters and streets). Moreover, in PPs involving “ambiguous” objects, there is also a correspondence of

the *distribution* of readings with the saliency of object regions (in this case surfaces). Similar results were found for all prepositions investigated.

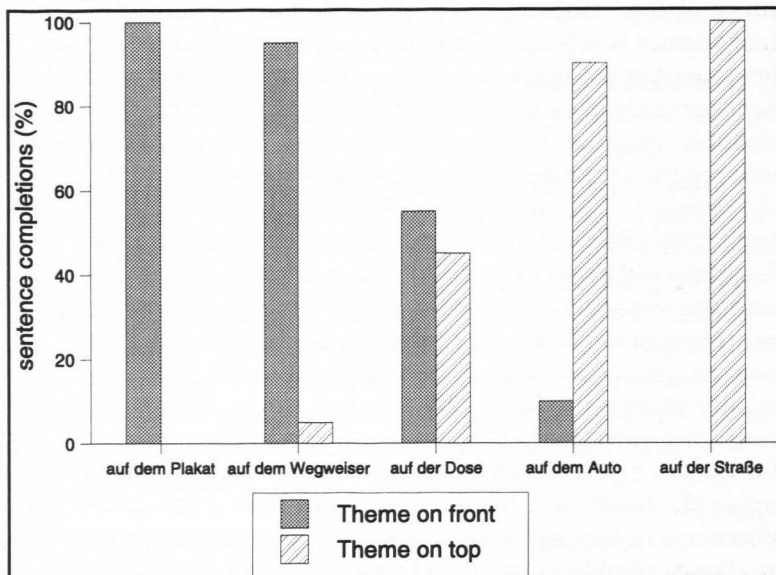


Figure 6.1: Sentence completions presupposing the 'on top' or the 'on front' reading for five representative PPs with *auf*.

The second methodology used to test the saliency of object regions was a predicate verification task (see also Annual Report 1993). Subjects were shown NP-PP-strings like *Der Vogel auf dem Wegweiser* or *Der Vogel auf der Straße* and had to decide whether a predicate like CONTACT WITH SURFACE applied to the situation described by the NP-PP-string (or not). Since this decision presupposes an answer to the question of where the surface of an object is, verification times in this task should depend on the nature and saliency of the surfaces of the objects denoted in the PPs, too.

Again, the results confirm the predictions. Verification times were longer for NP-PP-strings involving ambiguous objects compared to those strings denoting unambiguous relations. Additionally, there was an interaction effect in those PPs with ambiguous objects which differ in the saliency of their surfaces:

differences between ambiguous and unambiguous objects in this case only show up if a non-salient region, but not if a salient region of the ambiguous object is involved (e.g., *Der Vogel auf dem Wegweiser* vs. *Der Vogel auf der Straße* compared to *Die Schrift auf dem Wegweiser* vs. *Die Schrift auf dem Plakat*). Summing up, the results of these studies confirm the implications of the object-shifting-model with regard to the object classes described above.

## 6.4 Spatial language and honorific registers in Pohnpei

Keating has continued the systematic analysis of spatial language and thinking in the Austronesian language Pohnpei, using the techniques developed by the space project. The interactive spatial description tasks have thrown up an interesting phenomenon in this language which is well-known for an elaborate system of honorifics and "chiefly" language. Data from the photo-photo matching and photo-object matching tasks revealed that Pohnpeian speakers use a relative system (i.e., a 'left'/'right'/'front'/'back' system of coordinates) for spatial description for these tasks, and by and large this is matched in independent non-linguistic cognitive tasks (see 1993 and 1994 Annual Reports). The data also revealed an interesting phenomenon of the Pohnpeian spatial description resources, namely, the existence of two pairs of terms for left and right: *pali maun* (honorific right) and *pali meing* (honorific left) and *pali koahiek* (right) and *pali sokoahiek* (left). The terms mark social position as well as spatial position, and some subjects in the matching tasks utilized these resources, that is, shifting between the two registers, even though participants in the task remained the same and even though the subjects did not use any other socially marked terms in the interaction. It seems that these Pohnpeians were using an alternation between social registers to signal something to their partner about the spatial array that could be communicated using an index which usually communicates relative social rank. The shifts between left and right systems are in some cases strikingly systematic, as for instance during the Men and Tree Game (see 1994 Annual Report), the status-marked term for 'right' (*pali maun*) is used by a participant for the direction the man is looking, while the status-

unmarked 'right' (*pali koahiek*) is used for the position of the man used, for example, to describe a man on the right of a photograph. In Pohnpei this link between gaze direction and status is created in another way – gaze direction and status are semantically linked in the term *sohpeidi* (lit. facing downwards), the most common term for the highest status people. This refers to the facing relation of the chiefs and the commoners in the traditional feasthouse: chiefs and those of high status sit on a platform looking down on others.

The finding that some Pohnpeians utilize a shift between social indexes to categorize differences in spatial relationships suggests that linguistic resources which continually force Pohnpeians to attend to social rank (honorific speech) may be influencing how they think about a) differences between gaze direction and the point from which gaze emanates as a marker of social status, as in the traditional feast house where the chief gazes down from a high place, whereas the people gaze up from a low place, and b) differences that could be called mirror image or point-of-view shifts.

Specific tasks were then designed to investigate this phenomenon further in a second field trip. Further evidence shows that Pohnpeians link gaze direction and social status difference in linguistic tasks, and some speakers use this relationship to describe differences in spatial arrangements. New evidence was also provided for a link between "mirror" images, or images with their parts arranged in a reverse order, and a shift between honorific 'left' and 'right,' and another lexical pair of 'left' and 'right' terms. Further work will be done on the relationship between the existence of an honorific register which entails a certain flexibility and attention to point of view and the specific ways that shifts in points of view relate to organizing and communicating spatial relationships in Pohnpei.

## 6.5 Dissertations

### 6.5.1 Dimensional terms in Yucatec

In 1995, C. Stolz finished her dissertation on *Spatial dimensions and orientation of objects in Yucatec Maya*. The semantic analysis of dimension terms and orientational terms is based on extended

field research in Mexico. Dimension terms are defined as those terms of a language which refer to dimensional properties of an object. Yucatec dimension terms are, for example, *chowak* (long), *kòoch* (wide) or *píim* (thick). A dimension is defined as a symmetric axis (or radius) of an object which has a particular extension and (as for multidimensional objects) is roughly orthogonal to another object dimension. Although no previous assumptions about formal properties of dimension terms were held initially, it turns out that Yucatec looks very "European" in this respect because most of its dimension terms are antonymous adjectives. Only two numeral classifiers (CL), *ts'íit* (CL. OBLONG) and *wáal* (CL. FLAT) refer exclusively to dimensional object properties.

In the thesis, Yucatec dimension terms are analysed with respect to their combinatorial properties, that is, the ability or disability to co-occur in a dimensional description of a particular spatial object, regardless of the syntactic complexity of that description. One result is that those dimensional adjectives which almost exclusively describe 3D referents (*píim* thick (of brick-shaped objects), *polok* thick (of roughly cylindrical objects) and *taam* deep) are mutually incompatible. *Píim* (thick) and *taam* (deep) never co-occur in the dimensional description of a single object, referring to different object dimensions. They only rarely refer to one and the same object dimension in a dimensional description of one object, either. A similar incompatibility holds for the two 'thick'-terms *píim* and *polok* which, apart from borderline cases, can never refer to one and the same object. Yucatec dimension terms can be interpreted within three different frames of reference (FoRs), namely object-basedness, verticality-basedness and observer-basedness. Most dimension terms have a fixed association with one FoR, but some of them shift their interpretation between two FoRs, one of which is generally object-basedness. The different interpretations that some dimension terms allow can be at least partially related to a shift between different FoRs. This is the case for *kòoch* (wide) which can, among other interpretations, refer to the axis which is orthogonal to the maximal object axis (i.e., object-based interpretation), but also to an axis which is orthogonal to a vertical object axis, regardless of its extension (i.e., verticality-based interpretation). *kòoch* (wide), however, in contrast to its German or English translational

equivalents, can never be interpreted with respect to an observer. The diverse usage of *taam* (deep) is not related to a shift between FoRs, but to the semantic interference due to extended language contact with Spanish.

Orientation terms are defined as those terms of a language which refer to orientational properties of spatial objects. Orientation is the alignment of a symmetric object axis or edge with a reference entity of the environment. This can be the line of vision of an observer (observer-basedness), the vertical plane (verticality-basedness), or neighbouring elements if the object is part of a larger configuration (configuration-basedness). Generally, most orientation terms which are not dimension terms can be interpreted within two FoRs. Disambiguation is most often achieved by co-occurrence with other orientation terms in one object description. Observer-basedness seems to be the weakest FoR in Yucatec: apart from the dimensional adjective *taam* (deep) and its antonyms, all other orientational terms which can be interpreted with respect to an observer are shared with another FoR.

On a typological scale of dimension assignment recently developed by E. Lang, Yucatec can be located near the object-based end of the scale, that is, Yucatec focuses mostly on object properties and proportions when identifying the dimensions of spatial objects.

As a follow-up project to her dissertation, Stolz began a cross-linguistic analysis of dimension terms. In this project, she wants to analyse the formal and semantic properties of dimension terms across languages, as well as the implications that an analysis of the semantics of dimension terms holds for a typology of dimension assignment. Since there are hardly any non-Indo-European data on dimension terms available, the first necessary step for cross-linguistic research was to compile a preliminary elicitation tool, namely suggestions for the elicitation of dimension terms. This elicitation device names classes of objects which could prove particularly useful in elicitation, and it alerts the researcher to dimensional contrasts which may trigger descriptive variation. Several researchers of the Cognitive Anthropology Research Group have already used this tool in their respective field sites in 1995 and have elicited data on dimension assignment.

Since most of the data are still in the processing stage, their semantic and typological analysis has only just begun.

### 6.5.2 Space in Tongan language, cognition and culture

G. Bennardo finished the draft of his dissertation on *A Computational Approach to Spatial Cognition: Representing Spatial Relationships in Tongan Language and Culture*, in which an attempt is made to address the triadic relationship between language, culture and cognition. Linguistic, psychological, and cultural data were collected in the Kingdom of Tonga, South Pacific.

Attention was devoted to lexico-semantic and intensional analyses of the linguistic representations of spatial relationships in Tongan language. The analyses of the three Tongan spatial prepositions was followed by an analysis of a group of two sets of adverbs labelled "directionals". Finally, a number of Tongan nouns called "spatial", insofar as they represent a specific set of spatial relationships, was investigated. A major hypothesis was advanced in which spatial relationships are represented both in Tongan "directionals" and in Tongan "spatial nouns", as organized "radially" from a well-defined "center" (e.g., the directional *mai* means towards a (presupposed) center).

There followed the examination of the linguistic and psychological data obtained by the administration of a variety of tasks in order to investigate if one of the three types of frame of reference (relative, intrinsic, or absolute) has any specific status within Tongan spatial cognition. The analysis of the linguistic data showed how the three types of frame of reference are used according to specific needs and contexts. The analysis of the psychological data instead highlighted a specific preference for the absolute frame of reference. The possibility that the nature of this preference lies within the peculiarity of the Tongan cultural milieu led to the administration of further tasks.

From the results of some "drawing" tasks a peculiarly Tongan or 'radial' representation of spatial relationships was hypothesized. In the analysis of some "memory" tasks administered after salient cultural events (e.g., a *fono*, or traditional village meeting) it was seen how spatial representations intertwine with cultural parameters (e.g., in how seating arrangements were recalled). Finally, three relevant cultural events

in which patterns of exchange are instantiated were described and analyzed. The hypotheses suggested so far about features of Tongan spatial cognition were supported by characteristics of these salient cultural events. These findings concerning the representations of spatial relationships in Tongan language, spatial cognition and culture, are taken to support a general computational approach to the nature of language and culture, which frames the dissertation.

## 6.6 Acquisition of spatial language

M. Bowerman continued her crosslinguistic research, together with S. Choi (San Diego State U.) and L. de León (Reed College), on children's acquisition of spatial morphemes. This work explores how the organization of space displayed in the input language interacts with children's prelinguistic spatial biases to produce knowledge of the spatial semantic categories of a particular language. In 1995, Bowerman and Choi conducted crosslinguistic comprehension studies using the "Preferential Looking Paradigm" (see Annual Report 1994; this research is funded in part by the U.S. National Science Foundation). In this technique the child sits on a parent's lap in front of two TV monitors. Previous research has shown that when two scenes (e.g., a ball and a boat) are shown simultaneously, accompanied by a verbal stimulus that matches only one scene (e.g., "Find the ball!"), children as young as 13 months look longer at the matching screen. Bowerman and Choi have adapted the technique to explore the emergence of sensitivity to language-specific categories of spatial actions.

In one study, learners of English and Korean between 17 and 20 months saw four pairs of actions, grouped into two sets of two. For example, the first pair of one set showed (1a) putting books INTO a fitted case and (1b) putting books ONTO a pile of books. For this pair the matching scene was (1a), a scene that combines two features: 'containment', which is criterial for the English stimulus word (*put*) IN, and 'tight fit', which is criterial for the Korean stimulus word *kkita* (roughly: 'fit, mesh'). The stimulus words are embedded in short carrier sentences such as "Where is she putting it in". In the second pair of the set, these features were split apart: (2a), putting rings INTO a basket,



showed containment but not tight fit, while (2b), putting rings ONTO a pole, showed tight fit but not containment. When shown the first pair, learners of both English and Korean should look significantly longer at scene (1a) than (1b) if they understand the stimulus word, but for different reasons: English learners because it instantiates 'containment,' critical for *in*, and Korean learners because it instantiates 'tight fit,' critical for *kkita*. The second pair checks whether subjects' looking behavior is guided by sensitivity to the language-specific principle of categorization: English learners should look significantly longer at (2a), since it instantiates 'containment', and Korean learners should look significantly longer at (2b), since it instantiates 'tight fit.' These looking patterns were indeed obtained. The results corroborate and extend Bowerman and Choi's findings from earlier studies of spontaneous speech, which suggested that children categorize spatial configurations according to language-specific principles before they are two years of age. A further preferential looking study examined Dutch toddlers' understanding of spatial particles in the context of putting on clothing: (put it) *op* (on) is used for hats and glasses; *aan* (on) for clothing on the trunk, hands, and feet, and *om* (around) for encircling clothing such as scarves, belts, and capes. This study permits us to evaluate two alternative views of semantic development. According to one view, children are highly contextbound in the early stages of word learning, that is, they understand and produce words only in contexts very similar to those in which they have been learned. One such context is donning clothing. In this context, children hear *aan* by far the most often, and so could be expected to understand it first. But if, counter to this view, children attempt to build meanings for spatial morphemes on the basis of a wider range of evidence, they could be expected to understand *op* before *aan* for manipulations with clothing; this is because outside the clothing context, as previous work by Bowerman and her colleagues has shown, children gain productive control over *op* before *aan*. In fact, *op* was indeed understood first (it could, for example, direct a child's attention to a scene of putting on a hat as opposed to putting on a coat). This suggests that children do not treat the donning of clothing as a domain separate from other spatial manipulations of objects, but rather attempt to construct

fairly abstract (i.e., object-independent) semantic representations for spatial morphemes from the start (see also immediately below).

In further work on early spatial semantic development, Bowerman, de León, and Choi compared how children between about 18 months and three years of age learning English, Dutch, Korean, and Tzotzil (a Mayan language of Mexico) talk about motion. Analyses of longitudinal spontaneous speech samples and utterances elicited with a standardized set of stimulus actions (see Annual Report 1993) revealed the early influence of both prelinguistic, universally shared biases for spatial organization and experience with the semantic structure of the input language. For example, on the one hand, all the children focused initially on morphemes for expressing topological spatial relations such as 'separating' and 'joining' objects in various ways, they tended to underdifferentiate especially events of 'separation' relative to the adult target, and they often focused on the local geometrical relations between two objects where adults take a more global perspective (e.g., learners of Korean and Tzotzil typically described manipulations with clothing with abstract geometrical terms such as *ppayta* (remove from a tightfitting/meshed configuration) [Korean] or *xoj* (bring about the encirclement of a long thing by a ring or tube) [Tzotzil], where adults normally use verbs specific to the doffing or donning of clothing). On the other hand, the way the children classified topological relations was strongly influenced by the input language (e.g., learners of English and Dutch made a strong early distinction between containment [*in* in both languages] and contact/support [*on, op*]; this distinction is crosscut by the category of *kkita* fit/mesh in Korean, and both these distinctions are crosscut again by the category of *xoj* bring about encirclement... in Tzotzil). The children were also highly sensitive to where in a clause spatial meanings are typically expressed (verb, "satellite", or both), a dimension on which the four languages under study show typological variation.

The longitudinal study of one Tzotzil (Mayan) girl starting at the one-word utterance stage by de León revealed a higher rate of acquisition of verbs over nouns. The early verbal roots were of the kind that conflate path with other information such as con-

tainment, shape, position and orientation. In general, pure motion verbs emerged at a slower pace. Among the motion verbs a noticeable late acquisition of the verbs denoting vertical motion of the kind 'ascend'/'descend' was found. By contrast, the verbs denoting 'enter'/'exit' were acquired earlier. This finding confirms previous findings with other Tzotzil children at the two-word stage about early universal concerns regarding topological space.

P. Brown continued her longitudinal data collection of six-weekly videotaped samples from four Tzeltal children from age 1;6 to 4;0, aiming to document the semantic development of spatial language. Examination of the input and children's production of motion verbs involved in the Tzeltal Absolute system of spatial reckoning (the 'ascend'/'descend'/'go across' verbs) was begun: in the adult language these can be used both on the vertical and on the horizontal (where e.g., 'ascend' equates with 'south'). It emerged that these are not high frequency verbs in the input to small children, but do reliably occur to describe certain specific activities of animate beings: along the vertical dimension for, for example, ascending into or descending from trees, or up and down from beds, and along the horizontal dimension for moving across household compounds from house to house, as well as motion to and from particular geographical places (the family's cornfields, the local town). Children's first uses of them (starting around age 2;0) are semantically restricted either to vertical movements or to these household-specific contexts where they appear to be place-specific motion verbs. This corresponds to de León's findings for Tzotzil and for the Australian language Guugu Yimidhirr, that children begin their development of the Absolute system by anchoring it in local places.



## 7. Gesture

Gesture is a multifaceted phenomenon. Social, interactional, cognitive, and linguistic factors all seem to play a role. Accordingly, the project covers a wide range of issues. For the sake of presentation, they are categorized into four sections. Note, however, that the different areas of inquiry are interconnected, and that some of the studies presented here cross-cut these areas. The first section reports on the studies concerning the cognitive processes that underlie gesturing and speaking, and how the two might be related. The second section reports on studies concerning semiotic properties of gestures, where functions of recurrent gesture-shape properties are investigated through detailed context analysis. The last section consists of a study on the socio-interactional function of gestures.

### 7.1 Cognitive processes underlying gesturing and speaking

#### 7.1.1 Three forces that shape representational gestures

S. Kita continued research on factors that influence the shape of representational gestures in narration (i.e., iconic gestures and abstract pointing gestures). Three such factors have been identified: the shape of gestures are influenced by (1) what constellation of information is readily and concisely codable in the language being spoken, (2) what is important in the discourse, and (3) what spatial features are present in the stimulus event being described. The evidence comes from the comparison of English and Japanese narrations of the same stimulus cartoon. Two scenes in the cartoon for which the two languages provide different possibilities were analyzed.

The first scene represented a cat and a bird on window sills of different high-rise buildings, which are separated by a street. In an attempt to catch the bird, the cat swings across the street on a rope. The Japanese language does not provide any straightforward ways to express an agentive change of location with an arc

trajectory, whereas English has an intransitive verb *swing*. Japanese speakers verbally encoded change of location with manner, such as *fly to the other side*, and *sneak in*. In the description of this scene, 53% of the Japanese speakers produced a straight gesture in which the trajectory shape was abstracted out, whereas virtually no English speakers produced such gestures. All of the English speakers produced an arc gesture. These results support (1). Furthermore, 80% of the Japanese speakers also produced an arc gesture (some of them in addition to a straight gesture) which supports (3).

The second scene represented a cat who, having swallowed a big bowling ball, rolls down a hill, leading to the comical ending of the cat hitting pins in a bowling alley. The English description of the cat's motion requires only one verb with a particle, namely *roll down*, whereas the Japanese description requires two verbs, namely, a descend-verb and a roll-verb. This difference in linguistic packaging of information is also reflected in gestural packaging of information. Japanese were more likely to produce pure-rotation gestures (i.e., without a change of location) typically accompanying the roll-verb (62% of the Japanese speakers and 18% of the English speakers), which supports (1).

The prediction based on the linguistic packaging pattern would predict that the Japanese speakers are more likely to produce pure change-of-location gestures accompanying the descend-verb; however, English and Japanese speakers were found to produce such gestures equally often (92% of the Japanese and English speakers). This result is interpreted such that both groups gesturally represented pure change of location because of its importance as discourse information, namely, the change of location leads to the comical ending. Thus, (2) is posited. Finally English and Japanese speakers were equally likely to produce gestures that simultaneously represented rotation and change of location (62% of the Japanese speakers and 46% of the English speakers), which supports (3).

In sum, representation gestures are shaped by three competing factors: linguistic codability, discourse significance, and what the described event really was like.

### 7.1.2 How gesture might help speaking

J.-P. de Ruiter continued to study the way in which gesturing might help speaking. The experiment tested the hypotheses that gesturing helps the speaker by (1) facilitating the retrieval of visual information from memory and (2) facilitating the process of encoding spatial information into a linguistic format. Subjects were asked to describe geometrical pictures to another subject, while they could not see each other. Evidence was found for the hypothesis that gesturing helps the retrieval of visual information from memory (cf. Annual Report 1994). No evidence was found for the second hypothesis; pictures that were hard to verbalize did not evoke a higher gesture frequency than pictures that were easy to verbalize. However, the easy to verbalize pictures could still have been relatively hard to verbalize for subjects. Therefore, de Ruiter performed a second experiment in which the easy pictures were even easier, and the hard pictures harder. The results still showed no difference in gesture frequency between the “easy” and “hard” conditions, indicating that gesture does not facilitate the encoding of visual imagery into linguistic format.

### 7.1.3 Synchronization of pointing gestures and speech

De Ruiter carried out an experiment to investigate the synchronization of pointing gestures and speech. In an experiment by Levelt, Richardson, and LaHeij (see Annual Report 1982) subjects pointed to one of a few lights, saying “*dit lampje*” or “*dat lampje*” (this light or that light). These data showed that the timing of the speech adapts to the timing of the pointing motion. Specifically, the onset of the deictic term (*dit* or *dat*) was synchronized with the apex (endpoint) of the pointing motion. In their experiment performing a pointing gesture was obligatory in the sense that the deictic expression “this light” without an accompanying gesture is semantically incomplete. De Ruiter used the Zebris 3D motion analyzer to investigate the synchronization of pointing and speech when pointing is not obligatory, namely, in the situation where speech is sufficient to disambiguate the referent. Subjects had to point at one of four pictures, while naming the picture at the same time, saying for instance “*de krokodil*” (the crocodile) if the picture indicated by a light was a picture of a

crocodile. The three hypotheses were that (1) the onset of the article, (2) the onset of the noun, or (3) the stressed syllable of the noun synchronizes with the apex of the pointing. The results clearly indicated that hypothesis 2 is the correct one: there was a clear synchronization between the onset of the noun and the apex. The localization of the stressed syllable of the noun did not have any influence on the synchronization. Another finding from the experiment was that the right-handed pointing motion to a picture on the right side started later than a right-handed pointing motion to a picture on the left. A separate reaction time experiment showed that this difference cannot be attributed to perceptual effects, suggesting that motoric planning of right-handed pointing to the right side of the body takes more time than to the left side.

### 7.1.4 Utterance structuring dynamics in Chinese and English

S. Duncan investigated the relationship between the real-time utterance structuring dynamics of Mandarin Chinese and English, and the linguistic typological feature of topic- versus subject-prominence, said to distinguish the two languages (Li & Thompson, *Mandarin Chinese*, 1982). For these purposes, the timing of speech and gesture within units of narrative speech production was coded to within-syllable accuracy. Both speaker groups produced broadly similar speech-accompanying gestures, at comparable rates of gesture production per unit of speech; however, close examination showed that the character of speech-gesture synchrony of the Mandarin speakers' productions differed from the English speakers'. An English speaker saying, "*the cat rolls around on the street*", would typically synchronize an iconic gesture depicting PATH and MANNER of motion with the phrase "*rolls around*" in speech. A Mandarin-speaker, in contrast, while saying (Mandarin syntax), "*the cat TOPIC MARKER on the street rolls around*", would synchronize such an iconic gesture, not with the predicate verb phrase, but with the topicalized element *cat*. This suggests a different conceptual unity at the center of the unit of speech production; one with the same degree of semantic coherence, but a coherence of a different kind. In the presence of linguistically overt topicaliza-



tion and in its absence, Mandarin speakers overall tended to produce utterance-initial speech+gesture bundles of information that differed in character from the predicate-focused productions of the English speakers.

In keeping with this pattern, Mandarin speakers produced a wealth of utterance-initial, densely-encoding onomatopoeic speech forms. It has been documented that such onomatopoeia are timed with iconic gestures. These combinations were subsequently unpacked using more standard linguistic forms. These findings are interpreted as evidence for different utterance-structuring dynamics in the two languages, related to the typological difference between the two, that appears to influence the discourse *scope* of units in the utterance, as well as the character of their initial organizing impulses.

### 7.1.5 Gesture as an indicator of underlying conceptualization

In an earlier study Duncan found that variations in the ordering of surface constituents within spoken Mandarin clauses have specific gestural correlates. An instance of this difference was the timing of gestures with SVO (subject-verb-object) structure vs. "object-fronted" structure, the "BA-construction". Here, a "BA"-marked direct object of a verb appears *before* the verb in the utterance rather than *after* it, as in SVO. The BA particle in Mandarin has undergone a well-documented diachronic grammaticization from a content form, a verb meaning 'grasp', to its status today as an object-marking particle.

General facts of speech-gesture timing in English and Mandarin SVO utterances (without onomatopoeas) create an expectation that an iconic action gesture will most frequently synchronize with the verb of the accompanying spoken utterance that is most closely co-expressive of that action. In the case of BA-constructions, however, frequently (60% of the time) a gesture depicting the "action performed" on the BA-marked element was timed with the fronted BA-marked NP itself.

Analogous facts, in the case of the alleged content item NA (to take, pick up, or hold), suggest that this verb in some contexts may also have grammaticized to become a particle. The sentence:

lao tai-tai na yi-ge da *bang* gei ta da-xia-qu  
 old lady pick-up one-CL big *stick* give him hit-dow-go  
 The old lady picks up a *board* and knocks him down

has the stroke of a <knock down> gesture synchronized with *bang* (board). A two-clause gloss means that the gesture occurs one clause “earlier” than the one with whose content it is most closely co-expressive. However, given a “single” gesture and the facts of its timing and semantic content *vis-a-vis* speech, the underlying conceptualization may be similar to that of a single-clause utterance analogous to the BA-construction cases. A gesture depicting the “action performed with” an instrument times with the ‘NA’-marked NP. Thus the English gloss would be, the old lady apparently knocks him down with a big board. On this reading, ‘NA’, on analogy with BA, is an instrument-marking grammatical particle.

Duncan furthermore collaborated with D. McNeill (U. Chicago) to elaborate a theoretical framework within which to consider processes of language production. The chief idea is that of the “growth point” (GP) of thinking and speaking, meant as the initial organizing impulse of an utterance viewed in its development over an extremely short real-time interval. To infer GPs, the totality of communicative events are examined: an analysis that crucially includes the spontaneous, unwitting gestures that co-occur with speech in discourse. A GP theoretically is a combination of imagery and language-categorical information and claims as ancestor Vygotsky’s notion of an irreducible, essentially dual-natured basic unit of analysis of thinking and speech.

Speech-plus-gesture productions from narrations by adult native speakers of Spanish, Mandarin-Chinese, and English were compared. The initial impetus for selecting these comparison languages were two: (i) Lexical semantic analyses (Talmy, in Shopen, ed. *Language Typology and Syntactic description*, 1985) in support of a linguistic typology of different patterns of conflation of the components of motion events (e.g., MOTION, PATH, MANNER) in verbs and adjuncts to verbs. In this framework, Spanish exhibits a different conflation pattern from Mandarin and English; (ii) the linguistic typological feature of topic- vs. subject-prominence according to which topic-prominent Manda-

rin differs from both Spanish and English in the ordering and connectivity of reference and action.

It was found that gesture and speech did pattern together in significantly different ways across the three languages, and although these typologies have well-known flaws, the notions with which they are defined have nevertheless proven promising guides to characterizing the gestural differences among the three groups of speakers. Within a framework that takes advantage of the enriched view gesture gives of cognitive processes in speech production, the micro-genesis of different kinds of GPs in these languages are seen. Thus, Duncan and McNeill distinguish different patterns of “thinking for speaking” (Slobin) crosslinguistically.

## 7.2 Semiotic properties of gestures

### 7.2.1 The gesture-shape properties of absolute and relative gesture systems

S. Levinson continued work on gesture systems used by speakers of languages where “absolute” co-ordinates (rather than body-centered left/right/front/back co-ordinates) are used in spatial descriptions. Traditional stories in Tzeltal and Guugu Yimithirr were analyzed in some detail for a number of features, and compared to accounts of gesture in English and Dutch. It is suggested that we can distinguish between “absolute” gesture systems (Tzeltal and Guugu Yimithirr) and “relative” gesture systems (Dutch and English). In “absolute” systems pointings are predominant, and they point in the actual correct direction either from the place of speaking or the location of protagonists in narrative. Furthermore, they exhibit systematically different morphological properties.

In absolute gesture systems,

- (1) gestures are large and expansive;
- (2) both hands seem more often involved, and in any case are used in different ways, for example, with one hand beginning a trajectory and the other finishing it;
- (3) the gesture space is 3D right around the body, while the one in relative gesture systems is a 2.5D ‘flattened dish’ in front of the torso;

- (4) gestures can represent complex multi-directional vectors in one flow;
- (5) gesture and gaze are more independent systems: absolute gestures both in front and behind the body are often not accompanied by gaze, and when simultaneous gaze in the pointed direction occurs it seems to have special discourse import;
- (6) despite the use of a 3D gesture sphere around the body, the trunk remains remarkably static, which contrasts with directional pointings (e.g., in route-directions) by relative-gesturers who tend to orient the trunk in the direction pointed;
- (7) despite being from quite unconnected cultural traditions, Tzeltal and Guugu Yimithirr speakers share a number of special conventions; for example, height of a pointing indicates degree of distance, while big sweeps have a ballistic interpretation (the direction indicated is equivalent of the release point in a throwing motion);
- (8) gesture bears high communicational loading. For example, one can note: (i) verbalization or correction of a prior gestural specification of direction by the interlocutor, (ii) the use of gesture in place of words, (iii) the holding of gestures while seeking for agreement with the interlocutor.

These features of absolute gesture systems are probably all largely explained by their semiotics, that is, the use of fixed bearings as spatial co-ordinates. This motivates (1) and (2), allowing better estimation of direction; it also explains (3). "Instinctive" knowledge of fixed bearings shared by the speaker and interlocutor explains (4), (5), and (6). Various natural metaphors are suggested by, for example, the correlation of distance and height in the visual field, or direction indicated by throwing, providing an explanation for shared conventions (q.v. (7)). The semiotic import of fixed-bearings along with instinctive knowledge of them make monitoring of gestures communicationally important, with many resultant interactive properties (q.v. (8)).

### 7.2.2 Gestural frame of reference

G. Senft started to investigate Trobriand Islanders' gestures, continuing on the above mentioned theme of absolute vs. relative

frames of reference in gestures, as investigated by Levinson and Kita in Dutch and Tzeltal speakers (cf. also Annual Report 1994). It is observed that Trobriand Islanders produce relative and not absolute gestures.

### 7.2.3 Case study of Arrernte pointing gestures

As a preliminary to the investigation of "pointing" gestures among the Arrernte of Central Australia, D. Wilkins undertook a detailed case study of the deployment of gesture by one narrator, WR, in the telling of a short personal narrative (consisting of 82 clauses, accompanying 56 pointing, iconic, and metalinguistic gestures, and 11 significant gaze turns).

In this narration, each of the gaze turns and almost all deictic gestures pointed absolutely in space to regions, landmarks and places which were not visible. The vast majority of places indicated were at a distance of 5-25 km away, and WR pointed over an area of 300 square kilometers. The following systematic properties of WR's gesturing were observed: (i) All deictic gestures were made with the elbow raised up and arm extended, all iconic and metalinguistic gestures were made with the elbow down in the lap. (ii) In all cases, WR systematically selected his left or right hand for oriented (deictic) gesturing depending on which side of his body the place he wanted to point to fell. Non-oriented gestures (iconic or metalinguistic) were predictably left-handed or right-handed depending on which hand the preceding deictic gesture was made with. There was no evidence of a dominant hand effect in WR's gesturing, although he is a dominant right-hander (in writing and throwing). (iii) In pointing to places that were not visually available, WR employed a convention whereby the degree of upward or downward angling of the outstretched pointing arm indicated relative distance. The higher the angle was, the farther away the place referred to was. (iv) Gaze and pointing function independently of one another, although they could align. Most of the "oriented" gesturing was done without accompanying gaze. A consistent use of gaze without accompanying deictic point was used to identify the direction of the region that formed the deictic center for his narrative (which was distinct from his interpersonal deictic center). Gaze and pointing did align when significant new places were being introduced for

the first time in the narrative. (v) The neatest way to describe how the apex of pointing gestures was timed with speech is to say that they timed with spatial phrases, as opposed to being timed with specific lexical affiliates.

The data help extend Haviland's arguments against pointing being regarded as a primitive referential gesture. Deictic gestures can be highly conventionalised in system, form, meaning, and use.

#### 7.2.4 The semiotics of southern Italian gestures with Open Hand

A. Kendon (U. Philadelphia), using video recordings of naturally-occasioned conversations in a small town near Salerno, Italy, explored the occurrence of what he called the Open Hand, in which the hand is held so that all the fingers are fully extended and adducted (held together). It appears in four distinct orientations: Palm Up (forearm supinated), Edgewise (forearm "neutral" – neither supinated nor pronated), Palm Down (forearm pronated), and Away, in which the forearm is prone but the wrist is extended (or the forearm is raised) so that the palm of the hand faces away from the gesturer. It was found that there was mutually-exclusive coupling between the hand orientation and the Semantic Theme of the discourse context: broadly speaking, (i) Palm Up Open Hand is coupled with either Offering or Openness to the Reception of Something, (ii) Edgewise Open Hand with Separating or Dividing or Delimiting, (iii) Prone Open Hand with at least (a) Object Placement; (b) Measurement of Vertical Height; and (c) Process disablement, and (iv) Away Open Hand with Stopping or Halting an ongoing process, or of Holding something Away From Speaker. These gestures always occurred in conjunction with a movement component of the hand or of the arm, and this makes a crucial contribution to the further specification of the Semantic Theme that is expressed.

The rather promising consistencies suggest that gesture forms may be created from an assembly of components and that we might be able to speak of a gesture morphology. However, it seems that these components are not arbitrary in origin. Rather, they seem to be derived from forms of manipulative action – extending a Palm Up Open Hand forward, for example, is also

done when the hand is held out to receive some object being offered by another. This may be more than a matter of metaphorical extension. Alternatively, acts of utterance may be derived from forms of action in a phylogenetic sense.

### 7.3 Socio-interactive function of gestures

Kita investigated nodding and *aizuchi* (a back-channel-like vocal signal; e.g., *un*, *ee*, *hai*) in Japanese conversation. In past studies, nodding and phatic signals in English conversation (e.g., *uh huh*, *yeah*) are considered to indicate to the speaker (floor-holder), either encouragement to continue speaking or some reaction to the speech content (such as understanding, agreement, addition to and correction of the speech content, and expression of emotion aroused by the speech content). There are a couple of findings that indicate that nodding and *aizuchi* in Japanese conversation have quite different functions from English nodding and back-channel-signals.

First, it was observed that nodding and *aizuchi* are performed not only by the listener (non-floor-holder) but also quite frequently by the speaker. This shows that the function of the *aizuchi*-forms is something more general than encouragement or reaction targeted toward the floor-holder. Second, it was found that *aizuchi* and nods are “free-standing”; that is, they are not always parasitic on an utterance by the floor holder that conveys some propositional content. *Aizuchi* can be uttered in response to another *aizuchi*, creating a chain of alternating *aizuchis*. A rhythmic sequence of nods can be performed in synchrony by both the speaker and the listener, and this sequence can be sustained through a considerable duration of silence.

These indicate that the function of Japanese nodding and *aizuchis* is at least partly independent of the exchange of speech content. Rather, their main function is at the level of conversation as a social encounter. Participants of conversation co-create a regular pattern in interaction, using *aizuchis* and nodding. *Aizuchis* create alternation in the vocal channel, and nodding creates simultaneity in the visuo-kinesic channel. These regular patterns establish and acknowledge social bonding among participants.





## 8. Sentence and Discourse Integration

Language understanding requires the processing of information at different linguistic levels. The representation the language user constructs in understanding the message depends on lexical, syntactic, semantic and pragmatic factors. It is quite conceivable that the information at the different levels is not equally quickly available in language understanding. Accordingly, one may assume that not all information plays an equally important role at each moment in time. In addition, one may ask how the information at different linguistic levels is integrated. Do the processes at the different levels operate autonomously or do they interact? If there are more or less autonomous processes, one may ask how these develop in language acquisition.

This project deals with these issues in sentence and discourse understanding. The central assumption is that different kinds of information are available at different moments in time, and that therefore different integration processes take place at these moments. Different issues depending on the level of linguistic information are investigated in the project. One issue deals with the role of semantic biases in the initial structuring of syntactic ambiguities. In this research different on-line experimental techniques, in particular the registration of eye movements and event-related brain potentials (ERPs), are used in order to obtain converging evidence on the integration processes. The relation between morphological and semantic information in understanding is investigated in lexical processes underlying particle verbs. The role of structural preferences in the assignment of pronouns to noun phrases is investigated in a study that focuses on the relation between structural and pragmatic factors and on the development of these structural preferences in child language. In addition, the role of structural factors is studied in modifier attachment preferences. Integration processes at the discourse level are investigated in the understanding of causal conjunctions.

The focus is on the role world knowledge plays in inferencing and discourse integration.

## 8.1 Semantic and syntactic integration processes during comprehension

In the collaboration between the Neurocognition of Language Processing and the Sentence and Discourse Integration projects started in 1994 (see Annual Report 1994), two structural ambiguities were investigated: Conjoint NP vs. Sentence Conjunction, and Subject Relative clauses vs. Object Relative clauses. In separate experiments, but with exactly the same materials, reading time data as well as ERPs were recorded. A first set of eye movement data has been obtained which are currently being analyzed.

### 8.1.1 Conjoint NP vs. sentence conjunction

The first ambiguity was investigated in semantically neutral and biasing contexts. For example (the original materials are in Dutch):

- (1) *without lexical bias* The sheriff saw the cowboy and the indian noticed the horse in the bushes.
- (2) *with lexical bias* The helmsman repaired the mainsail and the skipper varnished the mast after the storm.

For both bias contexts the control condition consisted of exactly the same sentences, but with a comma inserted after the first of the two consecutive NPs (i.e., *cowboy*, and *mainsail*,).

In the reading time experiments, carried out by J. Hoeks (U. Nijmegen) and W. Vonk, subjects read the sentences in a word-by-word moving window paradigm. The first experiment (see Annual Report 1994) showed a clear preference for the NP-coordination, but did not show a difference between the lexical bias context and the context without lexical bias. Therefore, a second experiment was conducted. Subjects had to perform an additional task, in which they had to verify statements with respect to the content of the sentences. This task was included to force subjects to pay attention to the stimuli. Again there was a clear preference

for the NP-coordination for both bias contexts, indicated by a longer reading time for the disambiguating verb (*noticed* and *varnished*), but no significant interaction between bias context and disambiguation (by comma) on the second of the two consecutive nouns (*indian* vs. *skipper*), nor on the disambiguating verb (*noticed* vs. *varnished*). This interaction was only found at the word after the disambiguating finite verb.

A third experiment tried to gain further insight into the effect of the control manipulation. Instead of a comma after the first of the two consecutive nouns an adverb was inserted after that noun (*the cowboy nowhere/the mainsail skillfully*). In the ambiguous sentence the adverb was inserted after the finite verb (*saw nowhere/repairs skillfully*; note that this adverbial position is acceptable in Dutch). Obviously, different reading time patterns were observed between experimental and control conditions for the words preceding the second of the two consecutive nouns, but more interesting were the differences later in the sentence. The results were essentially the same as in the previous experiments: a clear preference for the NP-coordination in both bias contexts; no interaction between bias context and disambiguation (by adverb position) on the second noun, nor on the disambiguating verb; only at the word following this verb was this interaction (highly) significant. It seems that lexical bias does not play an important role in disambiguating the conjunction. Even combining the results of the experiments did not show an effect of lexical bias on the disambiguation (by comma or adverb position) at the second noun. However, combining the experiments did show an effect on the disambiguating finite verb: the interaction between lexical bias context and disambiguation (by comma or adverb position) was at that point significant.

The ERP experiments on the conjoint NP vs Sentence conjunction materials, carried out by J. Haasen, K. Remmerswaal, C. Brown, and P. Hagoort, were run in a Rapid Serial Visual Presentation paradigm. The first experiment on the Conjoint NP vs. Sentence Conjunction sentences used a presentation rate of 4 words per second (see Annual Report 1994). In a second experiment the presentation duration was increased to 686 ms per word, in an attempt to minimize possible problems due to overlapping ERP components. As in the first experiment, a Syntactic

Positive Shift (SPS) was observed on the second verb in the sentences with no lexical bias. However, the scalp topography of the effect was different from the standard SPS observed when subjects are presented with outright syntactic violations. The results for the lexical bias materials were unclear. A diffuse pattern of negative and positive shifts was seen, with no distinct long-latency components. In order to gain further insight into the possible effects of lexical bias, a third experiment has been designed, on which data are currently being acquired. In this experiment the animacy of the two actors in the complex NP is varied, such that the semantic variable no longer creates an anomaly on the second actor, but only a bias within the NP. For example: *The sheriff saw the smoke and the cowboy noticed the horse in the bushes*. Perhaps in these circumstances inherent syntactic preferences (such as predicted by the Minimal Attachment Principle) will be more readily visible.

Because the size of the ERP effects in these experiments was relatively small, a further experiment was performed. Here, in contrast to the previous experiments, subjects had to perform an additional overt task, namely to indicate with a push-button response whether they judged the sentence to be easy or difficult to comprehend. This task was included because of indications in the literature that overt tasks that additionally focus subjects' attention on the stimuli can enhance the size of ERP effects. No such enhancement was observed.

### 8.1.2 Subject relative vs. object relative clause

The second structural ambiguity concerned sentences as in (3) and (4) (the original materials are in Dutch; the English examples obey Dutch word order).

- (3) *Subject Relative* In the middle of the ocean received the captain, who \_1 the sailors \_2 seen has, a bottle of rum.  
 (4) *Object Relative* In the middle of the ocean received the captain, who \_1 the sailors \_2 seen have, a bottle of rum.

The first reading experiment (see Annual Report 1994) revealed a preference for the Subject Relative reading, on the auxiliary (i.e. *has/have*) that disambiguates the relative clause. In this

experiment the main verb preceded the auxiliary, but did not bias towards one of the two readings. In a second experiment the auxiliary preceded the main verb. (This is a natural word order in Dutch, as natural as the opposite order.) The preference for a Subject Relative reading did show up on the main verb following the auxiliary, but not on the auxiliary itself. There are several possibilities to account for these findings which will be explored in further research: either the effect may be delayed in the word-by-word paradigm; or it may need time to build up (in the first experiment an additional word, the main verb, preceded the auxiliary); or the effect may only show up at the clause boundary.

A third experiment investigated the semantic information of the main verb preceding the auxiliary. In contrast to the first experiment, the main verbs were biased towards a Subject Relative or an Object Relative reading. For example, a positive-biasing main verb *fired* in (3), or *served* in (4), or an negative-biasing main verb *served* in (3), or *fired* in (4), replaced the neutral verb *seen*. Although almost no effect was observed on these main verbs (only in the F1 analysis a significant Subject Relative preference reading was obtained), significant effects of relative clause type and bias of the main verb were observed on the following auxiliary. There was, however, no interaction between these factors.

In the first ERP experiment with the Subject Relative vs. Object Relative sentences (see Annual Report 1994), no differential processing was observed on the critical auxiliaries (i.e., *has/have*). This could in part be due to the presentation rate of four words per second, which might result in overlapping components that obscure subtle processing differences. In a second experiment, therefore, the presentation duration was again increased to 686 ms per word. Here, an SPS was observed on the auxiliary in the Object Relative sentences, indicating that subjects had a parsing preference for the Subject Relative structures. However, as in the Conjoint NP vs. Sentence Conjunction experiment, the scalp topography of the SPS was different from that observed for syntactic violations.

To test the specificity of the response to the auxiliary, a third ERP experiment was performed in which the auxiliary preceded the main verb, as in the series of reading-time experiments. Although from a syntactic point of view the same Subject Relative

vs. Object Relative ambiguity exists, this experiment revealed a larger *negative* shift for the Object Relative auxiliary. This is a puzzling finding, and requires further research.

An interesting additional finding in the second experiment on the Subject Relative vs. Object Relative sentences was a significant negative shift for the sentence-final words of the Object Relative sentences. These words were on average some 3 to 4 positions downstream of the auxiliary. This sentence-final effect indicates an additional processing consequence of going against the preference for Subject Relative clauses, perhaps related to “wrap-up” integrational processes, and will be an interesting subject for further research. As in the series of experiments on the Conjoint NP vs. Sentence Conjunction materials, a fourth experiment was performed using an overt judgment task. Again, this did not lead to different results compared to the experiments without an overt task. During 1995 a fifth experiment on the processing of Subject Relative and Object Relative clauses was prepared. Here the focus is on the (additional) effect of semantic information of the main verb preceding the auxiliary. The ERP data are currently being acquired.

## 8.2 Modifier attachment

L. Frazier (U. Massachusetts, Amherst) and Vonk began a study of modifier attachment preferences in Dutch to investigate three questions. First, do modifiers associate into the current thematic processing domain, as has been argued for Spanish and English (Gilboy, Sopena, Clifton and Frazier, *Cognition*, 1994)? If so, more attachments of relative clauses (such as *who is in the garden*) should be found to the lower potential head of the relative clause (e.g., to *colonel*) in a complex NP when that head is introduced by a theta-assigning preposition (e.g., *with*, as in *the friend with the colonel who is in the garden*) than when it is introduced by a nontheta-assigning preposition (e.g., *of*, as in *the friend of the colonel who is in the garden*).

Secondly, in German a preference for high attachments of a relative clause (e.g., to *friend* in *the friend of the colonel*) has been observed, one that is equally strong following ordinary lexical NPs and following proper names. This suggests the existence of a preference to interpret a relative clause as non-restrictive – the

only choice following a proper name – presumably due to the pronominal features of the relative pronoun. Frazier and Vonk are examining various examples where a non-restrictive interpretation is grammatically eliminated, for example, attachment of PPs and relative clauses to quantified heads which allow only restrictive interpretations (*\*every friend of the man, who is here, ... vs every friend of the man who is here*). Because non-restrictive modifiers cannot attach to the lower NP in a complex NP, the question about height of attachment and perceivers' preferences can only legitimately be asked in cases where it is known that perceivers are assigning restrictive interpretations to the modifier.

Finally, in another set of materials, Frazier and Vonk will investigate whether attachment preference in ambiguous NPs containing genitive structures is influenced by the grammaticality of *alternative* genitive structures. In Dutch, there are two genitive constructions (e.g., *de vriend van mijn oom*, the friend of my uncle, and *mijn ooms vriend*, my uncle's friend), but there are tight restrictions on where the -s marker can apply (e.g. *de vriend van de actrice*, the friend of the actress, but *\*de actrice's vriend*, the actress's friend). There may be a greater tendency to attach a relative clause to the lower NP in a complex NP when there is an alternative genitive available (e.g., in *de vriend van mijn oom die heel oud was*, the friend of my uncle who was very old) than when there is no alternative available (e.g., in *de vriend van de actrice die heel oud was*, the friend of the actress who was very old). The same questions are also being asked of alternative possessive structures in Dutch.

### 8.3 Semantic and syntactic integration of lexical information

A. Bolwiender and P. Zwitserlood (U. Münster), together with E. Drews and E. Noongar (both T.U. Braunschweig) continued their research sponsored by the Deutsche Forschungsgemeinschaft. In 1995, C. Kuijpers also participated for 6 months. The project is concerned with the processing and representation of complex verbs, so-called particle verbs. These verbs are interesting because stem and prefix are separated in finite form (e.g., *optillen*, to lift; *hij tilt de doos op*, he lifts the box). Moreover, parti-

cle verbs provide an opportunity to disentangle morphology from semantics. Although all particle verbs are morphologically complex, some are semantically non-compositional (e.g., *wegbrengen*, to take away, versus *ombrengen*, to kill; where the stem verb *brengen* means to take or to bring). The current aim of the project is to find out how particle verbs are processed in ongoing speech. The separability of verb stem and particle, together with the semantic transparency issue, creates a semantic ambiguity. It is often not clear what will follow when the finite verb form is heard (*Omdat hij woedend is, brengt Jan zijn moeder ...* (1) *weg* (2) *om* (3) *naar huis*; Because he is angry, Jan ... (1) takes his mother away (2) kills his mother (3) takes his mother home).

A series of crossmodal priming experiments was designed to investigate whether the lexicon makes available more than one continuation when the finite verb is heard. Finite verb forms were auditorily presented at the end of a neutral clause or adjunct, as in the above example. In the first experiment, presentation was stopped after the subject noun (e.g., *Jan*), at which point one of two targets was presented visually for lexical decision: a semantically transparent or a semantically opaque particle verb (*wegbrengen* or *ombrengen*). Relative to a control condition, responses to both targets were facilitated, and no interactions were found with semantic transparency. This was interpreted as positive evidence for semantic ambiguity and multiple activation. When encountering a verb stem in an ongoing sentence, the lexical system makes available all possible continuations of that verb stem. In a second experiment, presentation was stopped after the direct object (e.g., *zijn moeder*) and again a transparent or an opaque particle verb was presented for lexical decision. In half of the materials, the same object noun was used, compatible with both target words (transparent and opaque; see the above example). In the other half, two different object nouns were used, one congruent with the transparent particle verb and the other with the opaque verb (*Heel voorzichtig kleepte Anna* (1) *haar baby ... (aan)kleden*) or (2) *haar vraag ... (in)kleden*); Very carefully Anna ... (1) dressed her baby or (2) framed her question). This second group showed reliably more facilitation for congruent than for incongruent conditions. Apparently, the processing system has made a selection as to which verb will follow on the basis of the infor-



mation provided by the object noun. In the other set of materials, in which the direct object was congruent with both targets, facilitation was expected for transparent as well as for opaque targets. However, a significant effect was found for the opaque particle verbs only. This result was unexpected, because experiments with words as primes had shown reliable effects for both transparent and opaque particle verb targets, but consistently with more priming for the transparent verbs (see Annual Reports 1992-1994).

Apparently, the sentence contexts were not as neutral as expected, and it was therefore decided to check the materials. A cloze test was carried out in which the contexts including the nouns in object position were presented for completion. Results showed that subjects produced "opaque" continuations in some (20%) of the cases. Also, a control experiment in which all visual targets were subjected to a simple lexical decision task showed that some of the verb targets were often treated as pseudo-words. These last items were removed, and the biasing contexts, as shown in the cloze test, were made more neutral for a replication of the first experiment, in which the sentence ended after the subject noun (*Jan* in the example). Results were the same as before: facilitation for both targets and no interaction with semantic transparency. The experiments which include the object nouns are currently under way.

## 8.4 Pronoun resolution and pragmatic knowledge

G. Flores d'Arcais continued his project on some of the main principles regulating the assignments of pronouns in sentences with two NPs. Given simple sentences such as,

The doctor examines a patient. He wears a white coat.

the language processor can assign the pronoun to the first NP because of the "primacy" of the agent, or to the second NP because of "clause recency". Pragmatic factors would tend to assign the pronoun *he* to the first NP, because speakers know that doctors wear white coats. Previous work (see Annual Report 1994) indi-

cated that there is a differential use of pragmatic and structural factors in the assignment of the pronominal reference in adults and in children. Small children tend to be more strongly dependent on pragmatic factors, while older children and adults rely relatively more on structural factors. In the continuation of the project in 1995, Flores d'Arcais examined the influence of structural and pragmatic factors in more detail. Among the results obtained, an interesting finding is the relation between the strength of the pragmatic constraints and the pragmatic influence on pronoun assignment. Strong and very weak constraints seem to make pronominal assignment faster. However, some experiments have shown a differential effect of the two: decisions based on strong pragmatic constraints are rather fast and uniform, while very weak pragmatic constraints lead to more variation in the latencies, as if readers are uncertain about which factors to rely on for the pronoun assignment. In some cases readers rely efficiently on structural factors only, while in others they seem to search in the first place among the possible pragmatic elements to assign the pronoun, and this makes latencies longer. Further experiments try to specify the origin of the effects in the "weak" pragmatic condition.

## 8.5 Inference processes and discourse integration

Previous studies have suggested that the presence of a causal conjunction (e.g., *because*) can function to trigger an inference: the reader constructs the major premise relating the main and subordinate clauses. Evidence for such an inference process is an increase in the reading time for the subordinate clause and a decrease in the time to recognize a probe word from the main clause after reading the subordinate clause. However, Vonk, together with L. Noordman and R. Cozijn (both U. Tilburg), found for plausible causal relations that both reading time and probe recognition time were speeded up by the presence of a conjunction. One interpretation is that the inferences are made but do not require time. This is not very likely. An alternative interpretation is that the conjunction *because* has another function, an integrating function, in understanding. As an integration device, the con-

junction may speed up processing, but as an inference trigger it may slow down processing. The facilitation of the integration effect is supposed to occur immediately during the reading of the subordinate clause, the inference effect only at the sentence wrap-up at the end of the clause, when enough information is available to draw the general premise. In a word-by-word moving window paradigm short texts were presented that contained either a causal relationship marked by the conjunction *because* or a "negative" causal relationship marked by the conjunction *although*. In the control condition, the conjunctions were absent. An increase in reading time was predicted for the last word of the subordinate clause, due to inferential processes, but a decrease for the earlier words in the clause, due to integration. Probe recognition time was predicted to be shorter when the conjunction was present, on the basis of both the integrating and the inferencing functions of the conjunction. The results only partly supported the hypotheses. The presence of a conjunction decreased the reading time of the subordinate clause, in particular in the first part of that clause. On the other hand, probe recognition times were slower when a conjunction was present than absent, and there was no effect on the last-word reading time. These results can be interpreted assuming that the inferential process was delayed until after reading the subordinate clause, and interfered with the probe task. An explanation for such a delay could be that this behavior is elicited by the word-by-word, subject-paced reading task: subjects may press the button before they actually "wrap-up" the sentence. Currently an experiment is being conducted with the less obtrusive method of eye-movement registration.

Previous studies on inferences have pointed out that inference processes are to a large extent controlled by the knowledge of the reader. In these studies knowledge representations of experts and novices in a particular domain have been obtained. Vonk started to work together with Noordman and M. Weeber (U. Nijmegen) on a simulation model of text comprehension that ultimately has to incorporate knowledge representation. J. Myers (U. Massachusetts, Amherst) collaborated to develop a computer simulation model of text comprehension. The starting point is the assumption that text comprehension requires the reader to

construct a coherent memory representation, one which integrates what is currently being read with the representation of the previously read text. It is assumed that each new input – a sentence or clause being read – serves to activate elements of the discourse representation that have been constructed up to that point. This activation stage is essential because it enables the reader to link current inputs with what has previously been read. Within this framework, various representational devices and issues were considered, as were alternative processes that might operate upon the representation. Simulations led to the rejection of several possible models.

As a result of these developments, Myers arrived at a model which has been successfully applied to the simulation of results obtained in his laboratory. The relevant experiments have investigated reactivation of backgrounded anaphoric antecedents and causes of events currently described by the text. The availability of such information depends upon referential distance, the presence of contextual cues which point to the backgrounded information, and the degree to which the backgrounded elements were elaborated upon when introduced in the text. The simulation model accounts for these results by representing the activation of antecedent information not as a search process (as it is so often characterized) but as a passive, automatic process dependent on the same factors that generally influence the memory system.

# 9. Neurocognition of Language Processing

The Neurocognition of Language Processing research group is primarily sponsored by a grant from the Netherlands Organization for Scientific Research (NWO). In the second full year of the grant various subprojects were completed, and a number of new experiments initiated. On the technical side, the project's scientific programmer R. de Bruin significantly extended the possibilities for analysis and graphical display of the PET and fMRI data that are collected as part of the project's research programme on the neural architecture of the language system.

Almost all of the required brain-imaging analyses can now be performed at the Institute, providing more flexibility and efficiency for the coming years. In addition, de Bruin further developed the project's ERP analysis software, and incorporated more extensive graphical facilities. With respect to the aphasia research, the project's language and speech pathologist A. Nevejan maintained and expanded the subject pool of aphasic patients and patients with a right hemisphere lesion.

## 9.1 The neural architecture of language processing

### 9.1.1 Involvement of the visual cortex in the processing of word-like stimuli

In 1995, P. Indefrey in collaboration with A. Kleinschmidt and J. Frahm (both MPI für biophysikalische Chemie, Göttingen) conducted an fMRI experiment on the involvement of the occipital cortex in the processing of visual stimuli varying in length and complexity. In a previous PET experiment (see Annual Report 1994), bilateral medial and lateral extrastriate activation had been found for the reading of words and pseudowords when compared to looking at a fixation cross. The aim of the fMRI study was to determine which aspect of word-like stimuli was

associated with activation of the visual cortex and, in particular, whether only word-like stimuli induce medial extrastriate activation, as postulated by Petersen et al. (*Science*, 1990).

Five kinds of stimuli were used (for examples see Images 1 to 3 in Figure 9.1): Single fantasy letters (false fonts), strings of equal (homogeneous) false fonts, strings of different (heterogeneous) false fonts, unpronounceable strings of real consonants (letter strings), and pseudowords. In condition 1, pseudowords were always contrasted with the simplest and shortest other stimulus – single false fonts – giving rise to a maximal signal in medial and lateral extrastriate areas (see Image 1). In condition 2, pseudowords were contrasted with homogeneous false font strings (matching on length only), heterogeneous false font strings (matching also on complexity), or letter strings (matching also on recognizability) thereby extinguishing that part of the maximal signal that was associated with the additional stimulus properties (length, length + complexity, length + complexity + recognizability).

In five out of six subjects the matching of stimulus length alone (pseudowords vs. homogeneous false font strings) resulted in extinction of the medial extrastriate signal components, whilst sparing the lateral components (see Image 2). In control condition 3 (direct comparison of strings of equal false fonts with a single false font), the medial extrastriate signal component reappeared (see Image 3). Contrasting pseudowords with heterogeneous false font strings or letter strings led to complete signal extinction. In two subjects, the control contrast of heterogeneous vs. homogeneous false font strings resulted in reappearance of lateral signal components.

It can be concluded from these data that medial extrastriate activation associated with the processing of visually presented words reflects the processing of word length only. Lateral extrastriate activation may be associated with some aspect of visual complexity. There was no evidence for language specific processing in the visual cortex.

DEBAM vs. P

Image 1. Maximal contrast (pseudowords vs. single false fonts)



DEBAM vs. P/P/P/P/P

Image 2. Elimination of length contrast (pseudowords vs. homogeneous false font strings)



P/P/P/P/P vs. P

Image 3. Length contrast only (homogeneous false font strings vs. single false fonts)

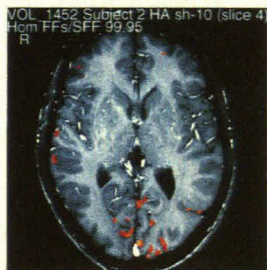


Image 4. Sagittal slice taken from the same subject with volume coverage indicated. Images 1 - 3 are measured in the lowest plane.

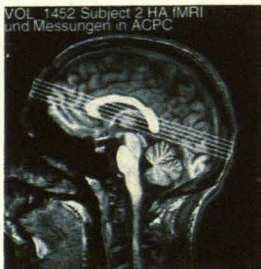


Figure 9.1: Functional MRI experiment on the involvement of the visual cortex in the processing of word-like stimuli. Responses of the same subject to different stimulus contrasts. All slices taken in bicommissural orientation 4 mm above AC-PC plane. Color coding indicates temporal correlation with stimulation.

### 9.1.2 A PET study on sentence processing

Indefrey, C. Brown and P. Hagoort, in collaboration with H. Herzog (Institut für Medizin, Forschungsanlage Jülich) and R. Seitz (Heinrich-Heine-U. Düsseldorf), completed the data acquisition of a new PET experiment on sentence processing. The experiment aimed at finding localized areas of the brain that subserve the ability to construct a syntactic representation for an utterance.

The crucial stimuli of this study were pseudoword sentences with embedded relative clauses, presented on a monitor with correct word-order but inappropriate agreement and/or case markings, as in the following example, where a grammatically correct sentence can only be achieved with a 3rd person singular marking of the second pseudo-verb (*grohmen*).

(das Schlaser) (das) (die Leideln) (delgen) (grohmen) (der Fump)

Subjects had to pronounce the sentences in their correct form. In an easier condition there were subject relative clauses only, in a more difficult condition there were subject and object relative clauses. Basic control conditions were the silent viewing of false font strings grouped like the words in the sentences, and groups of pseudo-nouns or pseudo-verbs with no syntactic relation, which had to be read out. Two further conditions were designed to control for general error detection and decision processes. One of those involved the detection of phonologically illegal words, the other the detection, but not correction, of agreement and case marking errors in sentences.

The main finding of a first analysis of the data was left lateralized prefrontal activation for the three syntactic conditions (easy and difficult sentence production, syntactic error detection) with a maximum increase of the regional cerebral blood flow (rCBF) in the middle frontal gyrus, adjacent to but more frontal and dorsal than Broca's area. Both error detection tasks (phonological and syntactic) but not the sentence production tasks showed extensive right prefrontal activation. General processes involved in error detection, therefore, seem to be associated with an activation pattern that is different from the one associated



with genuine syntactic processing. Further analyses of the rCBF data are ongoing.

### 9.1.3 European multi-centre study on verb generation

Indefrey in collaboration with Seitz and Herzog participated in a European multi-centre study using the silent verb generation paradigm developed by Wise et al. (*Brain*, 1991), where subjects have to find semantically appropriate verbs for given nouns. The principal aims of this study were the assessment of the reproducibility of results between centres, and an increase of statistical power by pooling the data. Results were strikingly similar between centres, with activations found in the left inferior frontal gyrus and middle temporal gyrus. Additional activations were found in the left inferior temporal and superior frontal gyri, the left SMA and the cingulate. Pooling the data revealed significant activations in homologous areas of the right inferior frontal gyrus.

## 9.2 Semantic and syntactic integration processes during comprehension: ERPs and parsing

Part of the sentence processing research of the Neurocognition of Language Processing project is carried out in collaboration with W. Vonk and J. Hoeks (U. Nijmegen), working in the Sentence and Discourse Integration project. This collaboration enables a comparison of ERP data with reading time and eye movement data, collected on exactly the same materials. For purposes of presentation, the ERP data that are gathered as part of the collaboration will be presented in the section on the Sentence and Discourse Integration project.

During 1995, J. Groothusen, Brown, and Hagoort completed the analysis of ERP data acquired in a connected speech version of the visual modality syntactic violation experiment in which the Syntactic Positive Shift (SPS) was originally observed (see Annual Report 1993). In this visual experiment, subjects were presented with three different kinds of syntactic violations: (1) subject-verb agreement violations (e.g., *The child throw the toy on the ground*), (2) subcategorization violations (e.g., *The boy boasts the car of his father*), and (3) phrase structure violations (e.g., *The*

*man was surprised by the emotional rather response of his wife*). The auditory experiment used exactly the same materials and was primarily performed to investigate the modality specificity of the SPS.

The full analysis of the connected speech ERP data yielded two interesting results. First, in contrast to the two visual modality experiments (one using a slow presentation rate of 600 ms per word, and one a fast rate of 250 ms per word), an SPS is observed to subcategorization violations. As in the visual experiments, the two other violations also elicit an SPS. Second, in contrast to the N400 (a component that is particularly sensitive to semantic processes), the onset latency of the SPS remains constant between modalities. This latter finding provides an explanation for the absence of an SPS to subcategorization violations in the visual experiment. The onset latency of the N400 is known to be earlier in the auditory modality than in the visual modality, whereas the research we report here has shown a constant onset for the SPS. The temporal separation between components in the auditory modality allows both the N400 and the SPS to be observed (by hypothesis, both are associated with violations of subcategorization information). The temporal overlap between components, however, obscures the SPS in the visual modality.

A. Deckers, Brown, and Hagoort worked on the design and stimulus construction for an experiment on the relationship between the N400 and the SPS. The focus is on the additivity and/or interactivity of the processing effects of syntactic and semantic constraints in sentence contexts. The main comparison is between single or combined semantic and syntactic violations, occurring either in sentence-initial or in sentence-final position. The experimental design requires a large number of sentences (over 800) to be constructed and validated. This work is almost complete; the actual experiment will be performed during 1996.

### **9.3 An ERP study on the time course of phonological and semantic processes**

M. van Turennout continued her research on using the ERP technique to track the time course of lexical access in speech pro-

duction. As reported in the 1994 Annual Report, an experimental paradigm was created in which the Lateralized Readiness Potential (LRP) was used to assess the time course of the semantic and phonological processing stages in speech production.

The subjects in the experiment were presented with pictures, which they had to name. In half of the trials a frame appeared around the picture, indicating that a semantic-phonological classification task had to be performed before naming. This classification task consisted of a conjunction of a go-nogo decision and a pushbutton response with the left or right hand. The decision whether or not to give a response was determined by the first phoneme of the word describing the picture. This go-nogo decision necessitates the retrieval of the word-initial phoneme. For go-trials, individuals were asked to respond with one hand for animate, and with the other hand for inanimate picture referents. Since animacy is a basic semantic feature, this decision requires the retrieval of semantic information.

During the performance of the task, ERPs were recorded and LRPs were derived. The LRP is a movement-related brain potential that is directly related to the differential preparation of, for instance, response hands. The LRP has been shown to develop as soon as task-relevant perceptual and cognitive information is transmitted to the motor system. As such, the LRP can be used to detect the relative moments in time at which distinct kinds of information, in the present case word meaning and word form information, become available for response preparation.

If, during picture naming, semantic activation precedes the retrieval of word form information, the results of the semantic evaluation will be available to the response system earlier than the results of the phonological evaluation. The results of earlier experiments (Annual Report 1994) have already shown that if the response hand decision is based on the animacy of the picture referent, and the go-nogo decision is based on the word-*final* phoneme of the picture name, preparation of the response hand starts before information about the word-*final* phoneme informs the individual whether or not to respond. In the experiment performed during 1995, the go-nogo decision was based on the word-*initial* phoneme, and a similar pattern of results as in the previous experiment was obtained. An LRP developed not only

for go-trials but also for nogo-trials, in the absence of an overt response. The early availability of semantic information enabled response preparation, but when information about the word-initial phoneme became available further response preparation was cancelled on nogo trials.

As can be seen in Figure 9.2A, the LRP developed at the same rate on go- and nogo-trials, from 360 ms to 400 ms after picture onset, and then started to diverge. This indicates that at 40 ms after LRP onset, sufficient phonological information was already available to make the go-nogo distinction. When this period is compared with the 120 ms period in which the go- and nogo LRP developed simultaneously when the go-nogo decision was based on the word-final phoneme (Figure 9.2B), it is evident that word-initial information was available at an earlier moment in time than word-final information. These results suggests that for words of, on average, 1.5 syllables and 4.5 phonemes, it takes an additional 80 ms to retrieve the full wordform once the word-initial phoneme is available.

Together these results demonstrate that in naming pictures, the retrieval of conceptual-semantic information clearly precedes the retrieval of word-form information. Furthermore, the results provide a new source of evidence for the idea that the wordform is constructed in a left-to-right manner.

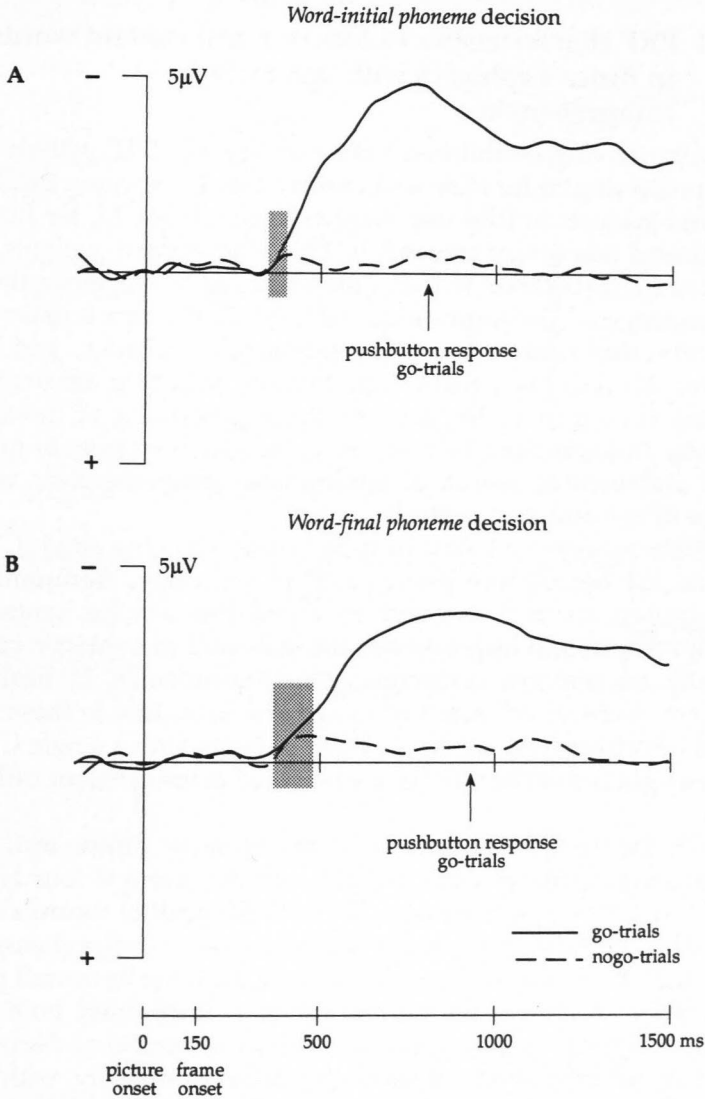


Figure 9.2: LRPs on go- and nogo-trials. The semantic decision determined the response hand. In the upper waveforms (Figure A), the *word-initial phoneme* determined the go/nogo decision. In the lower waveforms (Figure B), the *word-final phoneme* determined the go/no decision.

## 9.4 ERP studies on language disorders

### 9.4.1 ERP characteristics of function and content words in Broca's aphasics with agrammatic comprehension

After having established a clear differential ERP pattern for the processing of function and content words in young healthy control subjects in 1994 (see Annual Report 1994), M. ter Keurs continued this line of research in 1995 with aphasic patients, as part of a collaboration with P. Praamstra and D. Stegeman (both U. Nijmegen). Ter Keurs examined the ERP characteristics of function and content words in agrammatic aphasics, and explored the possibility that comprehension deficits in agrammatics are related to an impairment in the processing of function words. This was done by comparing the ERP responses to function and content words of agrammatic comprehenders with those of age-matched controls.

Nine patients with Broca's aphasia secondary to a single CVA in the left hemisphere participated in the study. Agrammatic comprehension was assessed by an off-line test for syntactic comprehension, which assesses the influence of syntactic complexity on sentence comprehension. Additionally, 15 healthy subjects were tested, matched in age and education to these patients. Furthermore, six non-aphasic patients with a single CVA in the right hemisphere (RHs) participated in the syntactic offline test.

On the basis of the results for the syntactic offline test, the agrammatic patients were divided into two groups: four High and five Low Comprehenders. For both the healthy controls and the RHs, syntactic complexity had no effect on comprehension, although the RHs did show a significant decrease in overall performance, relative to the normal controls. In contrast, both the High and the Low Comprehenders show a significant decrease in comprehension with increasing syntactic complexity, with the Low Comprehenders performing significantly worse than the High Comprehenders. These results suggest that the syntactic comprehension deficit of the aphasic patients is language specific, rather than a general result of brain damage.

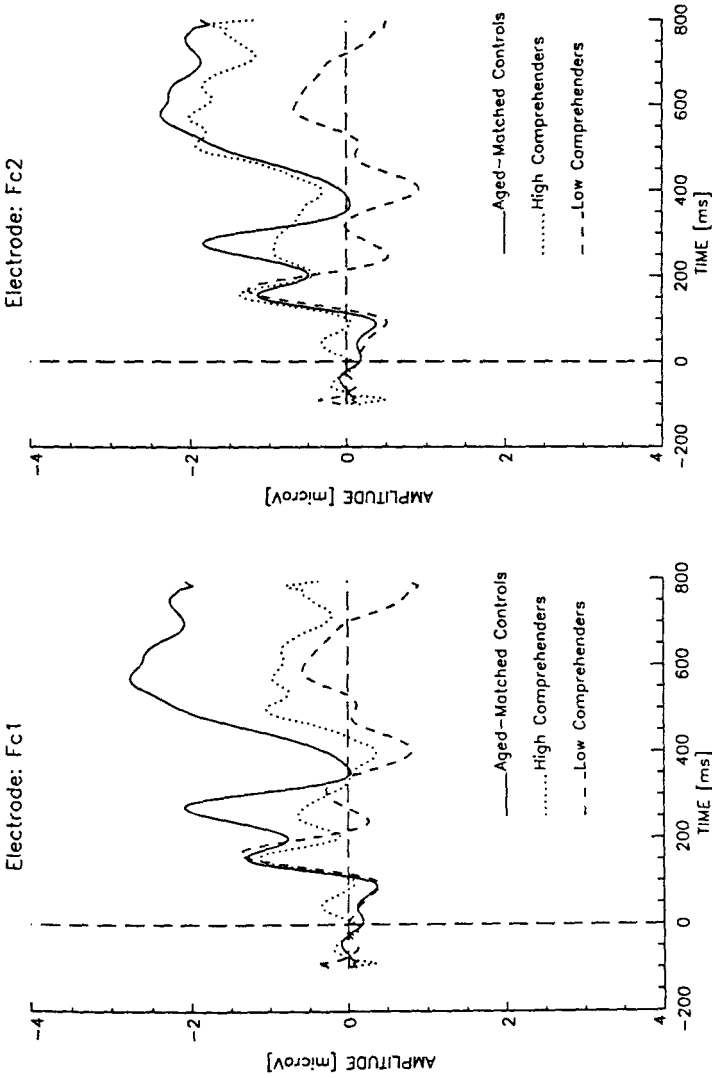


Figure 9.3: Difference waveforms between grand average ERPs to function and content words for two representative electrode sites.

The ERP experiment consisted of the reading of a short story, which was constructed such that it allows for systematic comparison of ERPs elicited by function words and content words. The story is presented word by word on the centre of a screen at a relatively slow rate (SOA = 800 ms). Figure 9.3 shows the difference waveforms between grand average ERPs to function and content words (function minus content words) for the three subject groups for two representative electrode sites, i.e., left anterior electrode site Fc1 and right anterior site Fc2, respectively. A deviation from the baseline indicates a differential processing of function and content words. Two epochs have been specifically associated with the processing of function words, namely 200-300 ms and 400-500 ms after target onset.

The age-matched control subjects show a clearly distinct, broadly distributed, differential processing of function and content words in both epochs, which is consistent with previous research. The early epoch might reflect the processing of the lexical-syntactic characteristics of the two word classes, whereas the late difference might reflect the integration of lexical-syntactic information into the sentence structure, since it seems to be elicited only in sentence context.

The aphasic patients with high syntactic comprehension show a focally deviant pattern, which is similar for both the early and late epoch: At left anterior electrode sites they show no significant differential processing of function and content words, but at the other electrode sites they do. This difference is similar, albeit reduced, to the difference for the normal controls. The aphasic patients with low syntactic comprehension show no significant differential processing of function and content words in either time epoch. These results suggest that, to some extent, the High Comprehenders are still able to process the grammatical information conveyed by function words, and to integrate this information during sentence processing, whereas the Low Comprehenders are deficient in these aspects.

In collaboration with Stegeman and Praamstra, ter Keurs attempted to characterize the neural generators underlying the scalp-recorded activity of the young and age-matched control subjects. The initial focus was on separating the early visual components from the endogenous language components, by dipole



modeling using BESA (cf. Scherg, in Grandori, Romani, and Hoke, 1989). Despite the good quality of the ERP data, the best fitting model for the visual components (which requires eight dipoles) does not present a robust solution. Minor changes in parameter settings result in large differences in the configuration of the endogenous components. One of the major underlying problems is the complex overlap of visual and cognitive components. The conclusion is that for the full array of exogenous and (long-latency) endogenous components that is typically elicited by language stimulation, simple assumptions about independent neural sources are untenable. Hence a more realistic neuronal source model is required. Towards the end of 1995, various new source characterization approaches have come under consideration, in part within the Working Group on Neuronal Source Characterization (an initiative of Stegeman, bringing together different research teams within The Netherlands; ter Keurs, Brown, and Hagoort are members).

#### **9.4.2 Semantic and syntactic effects in agrammatic comprehenders**

M. Wassenaar completed the full ERP data acquisition and analysis of an experiment on on-line sentence-level syntactic and semantic processing in agrammatic patients. In all, nine agrammatic patients, twelve age-matched control subjects, and twelve young control subjects have been selected for statistical analysis from among a considerably larger number of tested patients and subjects. In addition, Wassenaar completed data acquisition on an off-line sentence picture matching test, that was developed in-house for patient selection purposes (see Annual Report 1994). Finally, Wassenaar created an off-line sentence acceptability judgment test, which she administered to all patients. This test provides important information on the patients' differential sensitivity to the syntactic and semantic variables manipulated in the ERP experiment, and thereby provides a means with which to assess possible dissociations within patient groups.

The ERP experiment focussed on syntactic integration processes across and within phrasal boundaries, in syntactically complex and simple constituent structures. The subjects were presented with spoken sentences containing violations of phrase

structure rules (transpositions of adverbs and adjectives in Adv-Adj-N sequences), selectional restriction violations, and violations of subject-verb agreement. The latter violations were presented in either a simple or a complex constituent structure.

The ERP responses for the control populations showed mainly the predicted pattern of effects: An increased amplitude of the N400 for semantic violations (although attenuated, in particular for the older population), and a Syntactic Positive Shift (SPS) for the phrase structure and agreement violations. The latter effect was not modulated by syntactic complexity.

The ERP responses for the agrammatic patients exhibited a qualitative separation as a function of their performance on the off-line sentence picture matching test. Whereas those patients who performed well on the off-line test (the High Comprehenders) showed an essentially normal SPS response to the phrase structure and agreement violations (albeit not at all electrode sites), the Low Comprehenders showed a (marginally significant) *negative* shift for the phrase structure violations. The same negative shift was visible for the agreement violations, but did not reach significance. Given the relatively small number of patients in each subgroup, caution is called for in interpreting these data. Nevertheless, the pattern of results does indicate that the High and the Low Comprehenders are processing the sentences in a qualitatively different manner. The High Comprehenders are in line with the control populations, but the Low Comprehenders seem to be using a more semantically driven process, indicative of their more severe agrammatic deficit.

## 10. Structure of Learner Varieties

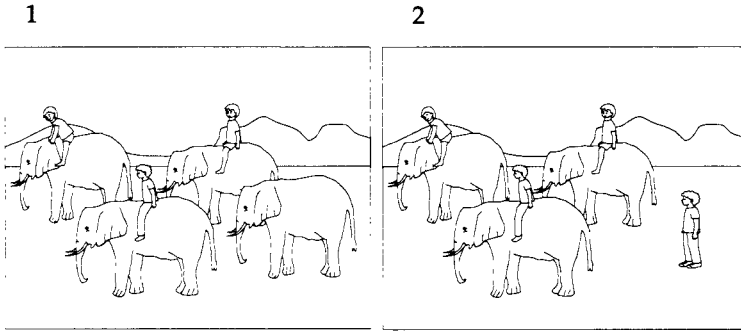
This project involves a cooperation of several European research centers and continues work that was started in the European Science Foundation (ESF) project *Second language acquisition by Adult Immigrants* (see also previous Annual Report). Two aspects of learner languages are being studied and reported on here: (a) scope phenomena, in particular focus particles and negation, and (b) referential movement, that is, the way in which information from various cognitive domains is introduced and maintained in coherent texts. Although the project mainly deals with second language acquisition, a project on quantification and scope in first language acquisition is connected to the sub-project of scope. We first report on the scope sub-project, and then on referential movement.

In this scope sub-project, K. Drozd, U. Brinkmann, and I. Krämer, in cooperation with W. Klein and J. Weissenborn (U. Potsdam) continue to investigate two topics on the acquisition of scope in Dutch and German: (1) the acquisition of universal quantification, and (2) the acquisition of focus particles.

### 10.1 Distributivity, individuation and universal quantification

Previous results obtained by Drozd show that Dutch children, like native English-speaking children, commit overexhaustive search and underexhaustive search errors when asked to judge sentences with universal determiners like *Iedere jongen rijdt op een olifant* (Every boy is riding an elephant). When asked if this sentence matches Pictures 1 and 2 in (1), normal adults commonly respond *yes* to Picture 1 and *no* to Picture 2. Children with the overexhaustive search reading respond *no* on Picture 1, and typically refer to the fact there is an extra elephant in the picture to explain their answers. The underexhaustive search reading is characterized by a *yes* response to Picture 2, which suggests that the child has disregarded the extra boy as relevant to the interpretation of the sentence. While some children perform like

adults on these tasks and others commit only one type of error, other children commit both kinds of errors consistently.



is every boy riding an elephant?  
NORMAL ADULT READING

YES

NO

TWO ERRORS

OVEREXHAUSTIVE  
SEARCH ERROR

UNDEREXHAUSTIVE  
SEARCH ERROR

NO

YES

Two studies, the distributivity study and the individuation study investigated which kinds of quantification children might use when they make overexhaustive search errors. The results of both studies indicate that overexhaustive search readings do not involve dependent or scope-based quantification, as previously proposed, but a kind of quantification resembling independent cumulative quantification.

### 10.1.1 The distributivity study

Two hypotheses try to explain this acquisitional phenomenon. The standard distributive quantification reading of sentences like *every boy is riding an elephant* allows a 1-1 correspondence reading in which every boy is riding a different elephant. Distributive quantification is described by giving the *subject* NP *every boy* wide scope over the indefinite object NP *an elephant* (another reading would be the collective one, in which the indefinite *object* has wide scope, and where one only gets the reading of one ele-

phant and every boy riding it). It has been claimed that children might extend the standard distributive reading in a non-adult-like way so that the interpretation of the universal determiner *every* applies to both the meaning of the subject noun *boy* and the meaning of the object noun *an elephant*, effectively capturing the common assumption that children expect the *extra elephant* in (1) to be distributed to a fourth *boy* for the sentence to be true. In fact, however, Drozd has shown that the absence of a 1-1 correspondence in (1) does not seem to be a necessary or sufficient condition for the overexhaustive search error to occur. Rather, it is the presence of the extra elephant in (1) which children find objectable. The question then arises if children can fix distributive dependencies between two NP meanings at all when the extra object is present.

Recent crosslinguistic research has further indicated that inherently distributive universal quantifiers like *ieder*, and *elk* (every/each) differ from *alle* (all) in that the former include two functions: a distributive function, for example, assign one elephant to each boy, and a quantification function, for example, consult the entire set of boys. Although previous research has shown that children can perform the quantification function correctly with simple universally quantified sentences, there is no evidence that they can set the distributive function consistently in the way that adults can. The distributivity hypothesis claims that some children may have problems with the appropriate direction of the distribution given a lack of context, as in the above mentioned experiment. Thus, some children may set the distributive function incorrectly by distributing a boy to each elephant rather than by distributing an elephant to each boy, as adults do. Note that the incorrect distributive pattern would account for both types of errors mentioned above.

To test this hypothesis, Dutch adults and children were given picture verification tasks with not only sentences including universal determiners such as *ieder*, and the quantifier *alle*, but also simple nonquantified plural and conjoined subjects (*the boys/Michael, William and Peter are riding an elephant*). Pictures with (1) an equal numbers of boys and elephants and (2) more elephants than boys were shown. If children have difficulties fixing distributive relations generally, than they should make overexhaustive

search errors on all tasks. However, if they have a specific difficulty fixing the distributive function of inherently distributive quantifiers, they should commit errors on sentences with *ieder* much more often than on sentences with *alle*, since only the former quantifier is essentially distributive.

The results show, contrary to the distributivity hypothesis, that children responded like adults on trials with definite plural (the boys are riding an elephant) and conjoined subjects (Michael, William and Peter are riding an elephant), giving the correct answer in 96% of the cases. This clearly shows that children do not have a general difficulty fixing distributive relations between two NPs. In contrast, children answered incorrectly equally often (71% of the trials) on sentences with *ieder* subjects and sentences with *alle* subjects. These results make it unlikely the overexhaustive search error is only due to a problem in interpreting inherently distributive quantifiers. Rather, the difficulty appears to occur with universal quantification generally. In any case, these results would undermine any account that pins the overexhaustive search error on children's difficulty with distributive quantification.

These results suggest instead that children interpret *iedere jongen rijdt op een olifant* (every boy is riding an elephant) using cumulative quantification. Rather than making the interpretation of one NP dependent on the interpretation of the other NP (standard distributive quantification), the hypothesis is that children interpret each NP independently, then relate the interpretations, making minimal commitments as to how the extensions of each NP are to be related. More specifically, the hypothesis is that children interpret the sentence *Every boy is riding an elephant* as true, given picture 1, if the relation *a boy x is riding an elephant y applies to all 3 of the x's and all 4 of the y's*. Since the fourth elephant is not involved in the relation, this interpretation of the sentence is not verified.

### 10.1.2 The individuation study

Brinkmann, Drozd, and Krämer conducted a study aimed at determining which factors influence children's misinterpretation of sentences containing a universal quantifier (for example, *every* and *all*; cf. (1)). In particular, they were interested in the relative

contribution of the linguistic properties of the object NP (*a pony*) and the physical properties of its referent.

(1) Every boy is riding a pony

As mentioned in the previous section, children often incorrectly judge these test sentences to be false when there is an additional pony presented not ridden by a boy (an error which can also be called *symmetrical interpretation*).

Test sentences in previous studies always contained object NPs that require physically individuated referents (bounded objects) and that individuate this referent linguistically (describe it as a countable entity), for example, NPs like *a pony*.

To assess the role of physical and linguistic individuation (PI and LI) of the object NP's referent, children were presented with picture stories and test sentences yielding one of three conditions: (a) the referent was an unportioned mass and referred to by a mass term (e.g., *hay*) [-PL/-LI]; (b) the referent was a portioned mass but referred to by a mass term (e.g., *hay*) [+PI/-LI] or (c) the referent was a portioned mass referred to by a count term (e.g., *a haystack*) [+PL/+LI]. They had to judge whether sentences like *Have all the gangsters burnt hay /a haystack?* correctly described what had happened. Subjects were 109 Dutch-speaking and 84 German-speaking children aged between four and six years.

Children responded more often correctly in the Condition -PL/-LI than in the Conditions +PL/-LI and +PL/+LI; no difference was found between the latter two conditions. Thus, the referent of the nonquantified NP only needs to be individuated physically, but not linguistically, in order to evoke symmetrical interpretations of quantified sentences. This result cannot be explained by current linguistic accounts of the symmetrical interpretation since according to these accounts, it is the incorrect analysis of the linguistic input that evokes this interpretation.

The cumulative quantification hypothesis, however, does help to explain these results, as well as those in 10.1.1. Children performed better on the Unportioned Condition because nonindividuated masses provide children with no opportunity to count more than one referent for *hay*, for example. Since all 3 agents, for example, gangsters, and the one hay mass are in-

volved, the truth conditions for cumulative quantification are satisfied. In contrast, portioned masses (+PL/+LI) provide countable referents. The presence of extra unused portions prevents the verification of the cumulative quantification reading, accounting for the rise in symmetrical errors on these conditions.

## 10.2 The acquisition of focus particles

The acquisition of focus particles (e.g. *alleen* only, *ook* also) is a virtually unexplored area in first language acquisition research. The focus particle study begun in November 1995 investigates whether Dutch children, like native English children, misanalyze simple sentences with the focus adverb *alleen* (only). The results of two previous studies (picture verification tasks) using American children suggest that while some children (11%) correctly interpreted the different meanings and scope of *only* when it occurred in various positions in unstressed sentences, for example, Pre-Subj: *Only the bird is holding a flag*, Pre-VP: *The bird is only holding a flag*, Pre-Obj: *The bird is holding only a flag*, other children either (1) assigned subject scope to *only* regardless of syntactic position (28%), or (2) assigned object scope to *only* regardless of syntactic position (61%).

Our first study failed to replicate these results with Dutch children. Eleven Dutch children (five and six years old) were given a series of twelve picture verification tasks using Pre-Subj (*Alleen het meisje houdt een ballon vast*, Only the girl held a balloon) and Pre-Obj (*Het meisje houdt alleen een ballon vast*, The girl held only a balloon) sentences, as in the previous studies. These children correctly targeted the subject NP as the scope of *alleen* on Pre-Subj trials 84% of the time, while correctly targeting the object as the scope of *alleen* on Pre-Obj trials 73% of the time, suggesting that Dutch children may find object focus assignment more difficult than subject focus assignment in *alleen* constructions. Further research will explore how children (and adults) use stress and topic/focus articulation at the discourse level to build unambiguous interpretations of focus constructions.



## 10.3 Referential movement

### 10.3.1 Reference to space in narrative discourse: First and second language acquisition

H. Hendriks continued work on a project comparing the development of discourse cohesion in child first vs. adult second language acquisition. The work focused on the acquisition of German and Chinese linguistic devices necessary for the expression of spatial reference. Particular attention was paid to how both types of learners represent the locations and changes of location of animate referents at the sentence and discourse levels.

At the sentence level, spatial information must be expressed in grammatically well-formed utterances. At the discourse level, the flow of spatial information must be regulated across utterances, for example, speakers must introduce, maintain and switch spatial reference points as utterances unfold. Although both levels of organization are central for all learners in all languages, systematic differences across languages present them with different problems to solve during the acquisition process. In addition, two kinds of knowledge are involved in different ways during first (L1) vs. second (L2) language acquisition. The first kind of knowledge roughly corresponds to the capacity to organize discourse according to universal pragmatic principles, while the second kind consists of the capacity to retrieve the linguistic procedures (often language-specific) necessary to realize the discourse operations. The study tries to test if these two kinds of knowledge play a different role in L1 vs. L2 acquisition. Thus, whereas children definitely have to acquire both kinds of knowledge, the assumption is made in the study that adults L2 learners have already acquired the first kind of knowledge. If such a difference indeed exists, it should be reflected in the results of the present study, in that adults should follow a different course of acquisition from children.

The data consist of narratives produced on the basis of two picture sequences, a HORSE and a CAT story, by the following groups of speakers: (1) four- to ten-year-old monolingual Chinese and German children; (2) monolingual Chinese and German adults; and (3) Chinese adults learning German at four different proficiency levels. The monolingual data were collected

by M. Hickmann (CNRS France; cf. previous Annual Reports). In order to ensure the absence of mutual knowledge, all learners were presented with the picture sequences for the first time in the presence of a naïve and unfamiliar interlocutor.

Hypotheses predict that the child should show a developmental progression in both languages with respect to the first kind of knowledge, as reflected by the gradual ability to set a spatial frame at the beginning of the narrative, and to mark new vs. given spatial information according to adult standards. This marking involves an indefinite form of the noun phrase (German) and postverbal position (Chinese) when the introduction occurs at the beginning of the narrative. In comparison, the adult data should not show a general developmental progression with respect to the first kind of knowledge, but rather the gradual acquisition of the language-specific means offered by the target language, that is, the appropriate form of the indefinite noun phrase including, for example, the right gender and case, and appropriate phrase structures such as existential phrases.

As far as the introduction of spatial information in discourse is concerned, the hypothesis that children gradually acquire the ability to set a spatial frame at the beginning of the story and to mark newness the way adults do was supported. However, this is a late development (ten years). This had been shown already in earlier studies by Hendriks (cf. Annual Report 1993) and by Hickmann et al. and was confirmed once again in this study. Newness marking for reference to space is clearly a later development than for reference to person. This difference can be accounted for, primarily, because the spatial system is less transparent than the person system. Thus, the use of an indefinite marker for new spatial information depends heavily on the place in the discourse where the spatial element is introduced. That is, when introduced at the beginning of the narrative, native adult speakers of both Chinese and German are more likely to mark an introduced tree with indefinite markers, whereas, when this tree is only introduced towards the end of the story, it is more likely to get definite marking. Secondly, some spatial entities are more likely to be marked with indefinite markers than others. Thus, the tree in the CAT story, which is a countable 'object', is much more frequently introduced with an indefinite noun than the

meadow in the HORSE story. Spatial reference furthermore mainly occurs in the background information of the stories, which might cause it to get less attention from the speaker.

As was also hypothesized, L2 learners do not go through a development of gradually setting more spatial frames in the appropriate way in discourse. This is in contrast to what other studies have found. It has to be studied why this different finding occurs.

As far as the language-specific means used are concerned, it was found that Chinese L2 learners of German only gradually learn to use the appropriate means to introduce and maintain reference to space. At all stages they have problems with the case and gender system of German, and they furthermore use certain phrasal constructions which are not really "wrong" in the target language, but not very frequently used, causing the story as a whole to sound non-target-like. An example are frequent introductions with the existential verb *es gibt* (there exists) where native Germans most frequently use *da ist* (there is). These constructions tend to occur very frequently at the first level of proficiency, decreasing with proficiency. Another example are full locative phrases at the beginning of an utterance as in *auf der Wiese es gibt eine Pferde* (on the meadow there exists a horse) where native speakers of German much more frequently use phrases like *da ist in Pferd auf der Wiese* (there is a horse on the meadow). Note that both the target and non-target like constructions force a possible introduced protagonist (foregrounded information) to occur in postverbal position, the universally more appropriate position for new information.

In sum, results show that 1) newness marking differs depending on the information introduced; 2) children gradually learn to introduce spatial information according to the adult system, but have more trouble learning it than to learn to introduce protagonists; and 3) the results show that, in contrast to what has been reported in other studies, adult L2 learners from the earliest proficiency level onward know that a distinction should be made between new and given information and that German uses the article system to make this distinction in combination with position. They do not overextend the use of definite markers for new information, and the proposed hypothesis is thereby confirmed.

### 10.3.2 The organization of temporality in learner language

M. Starren continued her dissertation research (funded by NWO) on the organization of temporality in learner second language acquisition (SLA) and native speaker discourse. Particular concern was paid to clarifying the interaction of lexical, grammatical and contextual devices in both the learner and in the target language in question. On the basis of the assumptions of the cross-linguistic project *The structure of learner varieties* analyses were performed – both from a semantic-cognitive and a discourse perspective – on data from a longitudinal database (ESF) in which both the source languages (Turkish and Moroccan-Arabic) and the target languages (Dutch and French) vary. In order to capture the way in which learners progressively encode temporal notions a first step was made in describing the semantics and the structural embedding of different types of Temporal Adverbials (TADV) in interaction with lexical verbal aspect. Further analyses will be concerned with grammatical tense and aspect, and with the (syntactic) structure and the intonation contour of the utterance.

With respect to differences in the order of acquisition of TADVs between Moroccan and Turkish speakers of French and Dutch, the following interesting findings can be mentioned here:

- Moroccan (and Turkish) learners of Dutch do not acquire the lexical device *ervoor* (before it), used for the anaphoric BEFORE relation; however, Moroccan learners of French do use the equivalent *avant* (with anaphoric relatum) already in the middle stages of acquisition.
- Moroccan learners of Dutch do not all acquire the deictic device *geleden* (ago) to indicate a BEFORE relation (in contrast to the three other groups of learners).
- In contrast to Moroccan learners of Dutch (and French), Turkish learners of Dutch do not acquire the TADV *nog* (still) to indicate the extension of a time-span.

With respect to the ways learners make use of this interplay we found differences and convergences between learners of different source/target language pairs. In describing the “clever

handling" of for example the very productive adverbial *altijd* (always), Starren found that there is a strong tendency for all learners to embed this scope-sensitive element close to the infinitive verb form in order to quantify over Times of Situation

- (1) die vrouw heeft geen tijd altijd drink drink  
 that woman has never time always drink drink  
 That woman never has time, she always drinks, drinks

In order to quantify over Topic Times, *altijd* is placed in initial position:

- (2) altijd vanmorgen 10 uur wakker  
 always this morning 10 o'clock awake  
 as always I woke up at ten o'clock this morning

Moroccan learners of Dutch typically double the verb form (1) in case they want to repeat Tsit (Time of situation) explicitly, whereas Moroccan learners of French double the adverbial itself in order to repeat the Topic Time explicitly in order to get the same habitual aspect:

- (3) toujours toujours je mange au resto  
 always always I eat in restaurant  
 I always but always eat in a restaurant

The fact that learners place TADV in the topic component to locate, quantify, shorten or extend Topic Times and in the focus component to do the same with Times of Situation shows that they are sensitive to structural constraints of embedding TADV in the utterance structure.



# 11. Research Group on Structural Grammar

Research activities of the group continued essentially along the guidelines characterized as “Minimalism and the lexicon” in the Annual Report of 1994. In general, research within the group explored different aspects and realizations of the notion of economy, taken in a flexible, but by no means arbitrary theoretical interpretation.

## 11.1 Constraints on lexical idiosyncrasy

Based on his research on the organization of lexical entries, M. Bierwisch was concerned with general conditions restricting the possibilities of idiosyncratic specifications that constitute lexical information. A particular case in point is the nature of improper argument positions, that is, positions in the Argument Structure of a lexical entry that are not related to semantic variables, which are saturated by the semantic information of the arguments in question. The so-called weather-verbs are a well-known example of a fairly general character:

- (1) (a) Es regnet It is raining
- (b) Es ist kalt It is cold

The obvious property of these cases is the lack of any proper argument position (except the referential role providing the event reference – Higginbotham’s E-position), such that the syntactically obligatory subject is filled by the dummy pronoun carrying only unmarked specifications. Assuming the event-instantiation by means of the operator INST, the general schema of weather verbs is given by (2), where ‘P’ is a proposition characterizing the situation in question:

- (2)  $\lambda x \lambda e [ e \text{ INST } [ P ] ]$

The predictable information about the improper argument position  $\lambda x$  is that it requires unmarked values for all pertinent morphological parameters (Singular, 3. Person, Neuter for German or English). As (1b) indicates, this naturally carries over to predicative “weather-adjectives”. What is idiosyncratic in these cases is the existence of a lexical item representing the proposition P (such as *rain, snow, cold, hot* etc.), while the assignment of the relevant morphological conditions on  $\lambda x$  follows from general principles – given the morphological parameters of the particular language.

A somewhat more complex condition applies to improper arguments involving the object position, as in (3):

- (3) (a) Hans schämt sich John is ashamed  
 (b) Eva wundert sich Eve is surprised

The so-called “absolute reflexives” of German (as opposed to simple intransitives like *er staunt*, he is surprised) seem to involve an improper object position that must be realized by the appropriate reflexive anaphor. If one takes into account pairs like (4), where (b) provides the intransitive counterpart of the causative in (a), the proper treatment of improper reflexives is indicated by (5), where Q is a one-place predicate.

- (4) (a) Hans ärgert Eva Hans vexes Eve  
 (b) Eva ärgert sich Eve is vexed  
 (5)  $\lambda x \lambda y \lambda e [ e \text{ INST } [ Q x ] ]$

The predictable consequence of the configuration given in (5) is that  $\lambda x$  is associated with the feature [+ Reflexive], by means of which it is made referentially dependent on its antecedent, viz. the argument saturating  $\lambda y$ , which in this way becomes a proper argument, providing the value for the variable x. The details of this analysis follow from the properties of reflexives and the agreement conditions applying to them, the idiosyncratic information on which cases like (3) and (4b) rely is the presence of the improper subject position  $\lambda y$  in (5).



The conditions applying to (2) and to (5) combine in highly idiosyncratic cases such as (6), where two improper argument positions are registered in the lexical entry of *handeln (um)*:

- (6) Es handelt sich um einen Versuch  
It is an attempt

The properties of absolute reflexives just outlined also account for the German version of so-called middle constructions illustrated in (7b) and (8b):

- (7) (a) Man kann das Buch leicht verkaufen  
It is easy to sell the book  
(b) Das Buch verkauft sich leicht  
The book sells easily
- (8) (a) Man kann hier bequem schlafen  
One may sleep here conveniently  
(b) Es schläft sich hier bequem  
It is possible to sleep here conveniently

The middle-construction blocks, so to speak, the semantic subject position by generic (or arbitrary) reference, leaving the syntactic argument position for the mechanisms applying to improper arguments like those in (2) and (5).

What these cases illustrate is a more general pattern: Even though the triggering information of the lexical items in question is idiosyncratic, it is subject to general constraints in two respects: First, it is not arbitrary which idiosyncratic information shows up and where it shows up, and second, the consequences of their showing up are subject to systematic constraints such as those described above.

## 11.2 Approaches to underspecification in lexical semantics

### 11.2.1 Lexical pragmatics

Lexical pragmatics is a research field that tries to give a systematic and explanatory account of pragmatic phenomena that are intimately connected to the semantic underspecification of

lexical items. Cases in point are the interpretation of compounds, systematic polysemy, the distribution of lexical and productive causatives, blocking phenomena, the pragmatics of adjectives and many phenomena presently discussed within the framework of Cognitive Semantics.

Continuing work on the organization of the semantic-conceptual interface, R. Blutner has started to work out a formal account of Lexical Pragmatics. The approach combines a constrained-based (compositional) semantics with a general mechanism of conversational implicature. The basic pragmatic mechanism rests on conditions of updating the common ground and allows a precise explication of notions such as (generalized) conversational implicatures and pragmatic anomaly to be given. The integrative and unifying character of the basic account is demonstrated by solving puzzles with regard to Atlas and Levinson's Q- and I-principles, Horn's division of pragmatic labor, and so on.

The basic mechanism has been extended by an abductive reasoning system guided by subjective probability. It is illustrated how this framework can be used to solve two of Quine's riddles concerning the pragmatics of adjectives: The first one concerns the observation that the (preferred) interpretation of the adjective seems to affect different parts of the subject term in cases like (1) and (2). The second riddle has to do with the explanation of pragmatic anomalies in examples like (3).

- (1) The apple is red [interpretation: its peel is red]
- (2) The apple is sweet [interpretation: its pulp is sweet]
- (3) ?The tractor is sweet. ?The tractor is pumped up.

In order to sketch how the mechanism solves the riddle let us concentrate on example (1). Input of the analysis is an underspecified representation expressing that a certain part of the apple is red. The specification of the relevant part(s) is guided by parameters of subjective probability (cue validity, diagnostic value). For example, it is plausible to assume that the color of the peel is more diagnostic for classifying apples than the color of other apple parts (such as the color of the pulp). It follows from this assumption that the *red peel*-specification is the most economical

possibility. Consequently, the I-principle selects the *red peel*-interpretation (and blocks the *red pulp*-interpretation). In the case of (2), analogous considerations give the *sweet pulp*-interpretation as the preferred interpretation.

Furthermore, the proposed mechanism predicts examples like *?The tractor is pumped up* as pragmatically anomalous (in contrast to examples like *The wheels of the tractor are pumped up*, which are acceptable). This prediction results from the fact that those parts of tractors that may be pumped up (the wheels) are only marginally diagnostic for identifying tractors and therefore the corresponding interpretation can be blocked by specifications that refer to more salient parts. These specifications, however, would suffer from sort conflicts and therefore violate Grice's Quality Maxim, such that (3) is correctly ruled out.

### 11.2.2 Semantic form and fixation of parameters

Earlier work by J. Dölling showed how relevant cases of systematic meaning variation (in particular, versatility of nominal meaning and metonymic extension) can be treated within a unified framework relying on the interplay of compositional and contextual factors in computing the conceptual content of utterances. Essentially, the approach is based on two assumptions: first, due to specific schemata that obligatorily insert predictable information, semantic representations are commonly underspecified, and second, they can be completed by means of abductive inferences exploiting world and discourse knowledge. Dölling applied this approach to further phenomena involving contextual variability of interpretation: (a) partitive and pseudopartitive constructions and (b) distributive versus non-distributive mode of predication. Looking at sentences like

- (1) A group of the students left.
- (2) A bottle of wine broke.

Dölling argues that we need several devices for interpreting the nominal constructions adequately. Whereas *of* in (1) expresses the (improper) "part-of" relation, the *of* in (2) must be construed as the "container" relation. Hence the lexical entry for *of* must be underspecified, including merely an open parameter to be fixed

in appropriate ways. The partitive relation occurring in (1) furthermore requires an account of the fact that groups considered as entities in their own right are constituted by the individuals in question. To this effect, another parameter is assumed to be obligatorily inserted into the Semantic Form which can then be specified as the operation of constitution. In line with these general assumptions, examples like (3) are to be analysed in corresponding fashion:

(3) Three students ate a pizza.

Since (3) has both a distributive (each of the three students ate a pizza) and a non-distributive reading (three students ate a pizza together), Dölling supposes a particular semantic schema that is obligatorily applied this time to the VP. More specifically, besides displaying explicitly some logical constants and variables, the schema contains three open parameters which can be fixed in parallel either as universal quantifier, material implication and relation of atomic part, or as existential quantifier, conjunction and relation of identity. If the respective context allows for corresponding abductive interpretations, we get the distributive reading in the first case of (3), whereas in the second case, its non-distributive reading is derived.

### 11.2.3 Abductive lexical interpretation

Continuing work on the semantic-conceptual interface, A. Strigin has been exploring the hypothesis that comprehending the communicative sense of a sentence consists in part of interpreting syntactic relations in terms of conceptual knowledge about the world via abductive inference. Abductive inference is reasoning from the result to a possible cause leading to this result. In particular, the topic of investigation was the possibility of using abductive inference to give a more general cognitive status to linguistic rules. Observations show that formation of contextual variants of a regularly polysemous verb is sometimes subject to strict systematic constraints, called verb alternations or diatheses, for example, the causative alternation illustrated in (1), which are usually claimed to belong to the language module of

the mind. They are formulated as rules relating such notions as the acting participant of the event and the grammatical subject.

- (1) a. Peter broke the vase  
b. The hammer broke the vase  
c. The vase broke  
d. Peter broke the vase with the hammer  
e. \*Peter broke with the hammer  
f. \*The vase broke with Peter  
g. \*The hammer broke the vase with Mary  
h. ?The vase broke with the hammer  
i. \*The hammer broke the vase with the knife

The hypothesis tested closely follows the abductive treatment of polysemy suggested by Blutner and Strigin in earlier work which represented polysemous lexemes by underspecified logical forms provided by the grammar. It assumes that these underspecified structures have to be interpreted in the conceptual background. The theory proposed solves this *completion task* by hypothesizing the interpreting semantics for the verb. For verb alternations, it resorts to systematic extensions of interpretation hypotheses set by abductively coded rules. The theory explains the occurrence of syntactic relations *subject of the verb*, *complement of the verb*, and *verbal with -adjunct* by their basic hypothetical semantic counterparts in the situation scheme associated with the verb, that is, relations like *individual carrying out the breaking*, *the thing being broken*, and possible roles of the referent of the *with*-phrase. It does this, however, not directly, but via the rules. These constitute an abductive inference system defined in terms of intermediate notions often referred to as thematic roles, for example *agent*, *theme*, etc., achieving the degree of generalization across the verb classes necessary for alternations. The coding uses thematic roles to disjunctively collapse different situations underlying sentences in (1), that is, those which have *agent* with those which have not. The abductive system of thematic roles arranges the explanation in terms of their compatibility. The hypothetical nature of abductive rules allows the implementation of default reasoning.

The research reported here was conducted with the help of a programming interface to an abductive inference engine. The interface was developed by D. Wang (U. Amsterdam), during her stay as a visiting scientist. The theory postulates a minimal involvement of the grammar in verb alternations, that is, the grammar merely specifies exportable underspecified predicates which are interpreted by typically conceptual mechanisms, in contrast to a number of other proposals. It could be interpreted as supportive evidence to the conjectures that a) the language faculty probably uses a lot of general cognitive resources, as could be expected of a system that originated through evolution, and b) that the meaning of a sentence is flexibly constructed in the context, as a growing body of recent work in the cognitive psychology of language suggests.

## 11.3 Syntactic problems

### 11.3.1 Antecedents contained ellipsis

C. Wilder examined configurations in which an ellipsis site (a dependent element) is contained in its antecedent. According to current thinking, “antecedent containment” is prohibited only at the covert “logical form” (LF) interface of grammar with interpretive systems. Investigation of “wide scope VP ellipsis”, where the ellipsis site takes the VP of a superordinate clause as its antecedent, provides evidence that antecedent-containment is also prohibited at the “phonetic form” (PF) interface (i). Extraposition in (ii) ensures that the ellipsis site “\_\_” is not contained at PF in the terminal string corresponding to its LF-antecedent “[...]”.

- (i) \* John [thinks everyone that I do \_\_ is intelligent]
- (ii) John [thinks everyone is intelligent] that I do \_\_

Potential counterexamples like (iii) actually involve two independent adjacent ellipsis sites – one following its antecedent string and one preceding its antecedent string at PF, as in (iv); and not a single ellipsis site contained in its antecedent at PF, as in (v):

- (iii) John gave everyone that I did two dollars

(iv) John [gave everyone] that I did \_\_ [two dollars]

(v) \* John [gave everyone that I did \_\_ two dollars]

The consequence to be drawn from these observations is that there must be a condition banning antecedent containment both at LF and PF.

### 11.3.2 Parallelism of clause and NP-structure

Extending earlier research on the structure of noun phrases and its parallelism to clause structure, I. Zimmermann compared possessor expressions in Russian and Bulgarian. The possessor phrase is shown to act as a structural argument of the head noun, realized as a DP with structural Case (which comes out as Genitive in Russian, and Dative or PP with *na* in Bulgarian). The interesting observation concerning the analogy of NP and clause structure relates to the phenomenon of clitic doubling characteristic of Bulgarian: clitic elements that duplicate structural arguments show up in the “Wackernagel” position in both NP- and clausal constructions, a non-trivial property that naturally follows from the parallel structure assumed for clauses and noun phrases.

## 11.4 Presupposition, background, and related phenomena

### 11.4.1 Presupposition and anaphora

During his research stay, R. van der Sandt (U. Nijmegen) extended previous work on presupposition and anaphora to the treatment of focus and quantification. He claimed that

1. the focus/background distinction is fundamentally distinct from the presupposition/assertion dichotomy, and that
2. the computation of focus/background takes priority over the computation of presuppositions.

He argued for these claims by showing that domain restriction in quantified constructions comes about as a result of two different mechanisms. Consider (i) and (ii):

- (i) Most Germans love their car.
- (ii) Most Germans drive a [powerful] car.

On the preferred reading of both (i) and (ii) we tend to restrict the domain of the quantifier to a set of car-owning (or driving) Germans. (i) tends to be read as (i') and (ii) as (ii'). Neither of these sentences seems, moreover, to be falsified by untypical non-car-owning Germans.

- (i') Most car-owning Germans love their car.
- (ii') Most car-driving Germans drive a powerful car.

The puzzle derives from the fact that in such cases lexical material which is syntactically generated in the nuclear scope of the quantified construction ends up semantically in its restrictor.

Taking the anaphoric account of presupposition as a starting point, van der Sandt observed that the reasons for these preferences in (i) and (ii) are fundamentally different. With respect to (i) presupposition theory predicts accommodation of the presuppositional material in the restrictor. In constructions such as (ii), however, we first resolve the focus structure. Computation of the background of this focus construction yields a set of car-driving Germans. It is with respect to this background that the actual interpretation of (ii) is determined. Being a presuppositional construction, "most Germans" is an anaphoric expression. It thus searches for a suitable antecedent and resolves to the pre-established set of car-owning Germans. Here the relevant interpretation does not come about as a result of accommodation of presuppositional material, but by anaphoric uptake of background information which has already been established independently by a prior resolution of its focus structure.

#### 11.4.2 Information splitting; repetition and restitution

C. Fabricius-Hansen (U. Oslo), studying the phenomenon of informational density within the framework of (Segmented) Discourse Representational Theory, found that paraphrasing or translating a text showing a relatively high degree of syntactic complexity and informational density (e.g. typical German ex-



pository prose) into a text characterized by a less complex, more paratactical style (e.g. typical Norwegian expository prose) is governed by two principles – *information splitting* and *discourse structure fidelity* – that are, to a certain degree, in conflict with each other. The more information splitting is done, the more difficult it will be to reconstruct the Segmented Discourse Representational Structure (SDRS) of the original text, that is, the overall discourse/text structure in the more traditional sense. Translation from “paratactical” into “hypotactical” texts calls for *information collecting* instead of information splitting; the main difficulty lies in assigning a SDRS to the text and determining which part of the information given in the text should be syntactically downgraded, and how that should be done.

Fabricius-Hansen also compared different ways of accounting for the “repetitive” and “restitutive” readings of the German adverb *wieder* (again). The purely structural account proposed, for example, in Generative Semantics, by Dowty, and in recent articles by von Stechow, which syntactically or by way of semantic decomposition reduces restitutive *wieder* to repetitive *wieder* with narrow scope, was compared with the genuine polysemy account propagated above all by Kamp and Roßdeutscher. She argued that *wieder* is in fact polysemous between a strong “contradirectional-restitutive” reading that corresponds to the “contra”-meaning of the etymologically identical preposition *wider* (against) – cf. also the adverbs English *again*, Danish/Norwegian *ig(j)en* and the German preposition *gegen* (against) – and weakenings like the purely temporal repetitive reading and the non-temporal, purely contrastive reading that are found under conditions where the stronger reading is excluded for structural and/or lexical-semantic reasons. This also accounts for the different behaviour of *wi(e)der* and *abermals* (once more); the fact that *abermals* has the repetitive meaning is only unexplicable if restitutive *wieder* is reduced to repetitive *wieder* in a structural position with narrow scope.

### 11.4.3 Topics in dynamic semantics

G. Jäger finished his dissertation *Topics in Dynamic Semantics*, following the approach of Dynamic Semantics developed by Groenendijk, Stokhof, Veltman and others which attempts to ac-

count for non-truthconditional aspects of meaning in a compositional way. Major topics dealt with in this approach are anaphoricity, epistemic modalities, and presuppositions. Jäger's dissertation tries to extend the coverage of this framework to Topic-Comment articulation. After a demonstration that existing theories of definite and indefinite expressions fail to explain certain characteristic properties of these elements, Jäger argues that an account is required that (a) is based on a dynamic setup, and (b) relies on a notion of context that is more complex than usually assumed. The formal structure of a theory that meets these requirements is presented, an analysis of a number of apparently heterogeneous phenomena like bridging is offered, and the strong/weak ambiguity of cardinal expressions and the proportion problem are discussed.

#### **11.4.4 Exhaustivity and "common ground"**

During his stay at the research group, H. Zeevat (U. Amsterdam) worked on two topics. The first one was a generalised account of exhaustivity as it shows up in the semantics of questions and answers, in certain accounts of the topic-focus distinction and in the treatment of scalar implicatures. The second topic was updating common grounds. Such updates are central in those theories that start from Stalnaker's conception of pragmatics as the changing of the common ground between a number of conversational partners. The approach conceives of common grounds as certain kinds of information states in an update semantics, and develops a notion of updates for these common grounds, applying it to the analysis of speech acts.

## 12. Other Research

### 12.1 Aphasia

#### 12.1.1 Production of elliptic constructions in agrammatics and normals

C. Heeschen has investigated ellipsis in the conversational speech of normal and agrammatic speakers. The term "ellipsis" is used here, as in previous reports, to refer to expressions without any finite verb with or without further omissions and which cannot be integrated in the preceding or following linguistic context (i.e., regular ellipsis). Ten normal German speakers (approximately matched for age and education with the available sample of agrammatics) were invited to have one hour of free conversation with an experimenter. They were told that the experimenter was interested in the phonetic details of "natural" speech. The conversation was not entirely "natural", however, because the experimenter behaved as s/he had behaved when conversing with aphasics: using very few interruptions, generally holding back, and using conversational turns which were designed primarily to elicit long stretches of speech from the subject/patient.

Heeschen inspected the speech of the subjects for any expression in which an element was missing, given the normative standard form of a sentence. Only the regular ellipses, however, were evaluated and classified according to a scheme developed by B. Hofstede and H. Kolk for Dutch ellipses. This scheme contains ten types of constructions, five with and five without a subject. The results of the German investigation showed a high parallelism to the results obtained for Dutch: an overwhelming majority of the ellipses were without a subject (82% in German, 92% in Dutch), and within the subjectless expressions the majority were mere NP's (39% in German, 45% in Dutch) followed by a substantial number of expressions with non-finite verbs (21% in German, 19% in Dutch). There were only two real differences between Dutch and German. First, constructions of the type

"SubjectNP PP" (for example, *und ich in die Klinik*, and I in the clinic) occurred more often in German than in Dutch. This might have to do with the enormous popularity in colloquial German of constructions of the type "subject plus directional" which are used to express a hasty and urgent movement. Secondly, the overall percentage of occurrences of ellipses was higher in Dutch than in German: in Dutch approximately 8% of all utterances were elliptical, in German only 4%.

In the 1994 Annual Report, Heeschen reported on an experiment where agrammatic patients had to tell picture stories first to the experimenter, who behaved in a totally non-interactive way, and then to friends or spouses, who were allowed to behave in an interactive way. In the first condition, the percentage of elliptic constructions radically decreased, while in the second condition the elliptic-telegraphic style of the patients reappeared. It was concluded by Heeschen that the factor "interaction" played a crucial role for the elliptic-telegraphic style. However, an argument can be raised that in this experiment there were two confounded factors: non-/interactive setting, and the interlocutor (experimenter versus a familiar person). In order to disentangle these two factors the German patients who had participated in the experiment were asked to tell the stories once again, this time to their friends or spouses who were instructed by Heeschen, however, to behave in a non-interactive way. The results were clear: the number of elliptic-telegraphic utterances again decreased. Thus, it can be safely concluded that the factor "interactionality" is more relevant than the factor "relationship to tester" for the way in which the patients express themselves.

Seven agrammatic German patients were videotaped in ordinary conversations with highly familiar partners (confidants). Three of them could be taped two times, each time with another confidant. While the percentage of elliptic-telegraphic utterances of the patients in conversations with professional aphasiologists remained reliably the same over long periods as well as over several aphasiologists, the situation in natural ordinary conversations was quite different. The percentages of telegraphic expressions varied dramatically from one episode to another even within one and the same conversation. For example, patient

A in conversation with his social worker had 10% telegraphic utterances in one episode, but more than 80% in another. However, the reliable average proportion of telegraphic utterances in conversations of that patient with Heeschen, over a span of more than five years, was 40%.

Comparisons with other patients exhibiting an equally variable pattern showed that the episodes which either enhanced or diminished the trend to telegraphic speech could not be characterized in terms of global properties such as “cooperative vs. confrontational” or “atmosphere of agreement vs. atmosphere of disagreement”. Instead, the concrete interactional practices of the healthy interactants seem to be the decisive factor. To mention just three of them: as was to be expected, the healthy interactants were very cooperative and helpful to the patients in the sense that they applied means of co-constructing the propositional meaning of what the patient wanted to express, (a) by completing the incomplete utterances of the patient, (b) by summarizing in their own words what they believed the patient wanted to express, (c) by giving the patient a lot of time for a long turn, including repairs, rephrasings and repetitions. The two first practices enhanced the tendency of the patient to speak in telegraphic style, while the third practice led to a decrease in telegraphic utterances.

The most remarkable fact about these practices of co-construction, however, is that they have a dual function. For example, a completion of what the patient has said can also be, at the same time, a social action such as disagreement, criticism, or approval, depending on subtleties of wording, intonation, gestures, or body position or on a combination of these. Equivalently, the expressions of the patient cannot only convey propositional meaning, but also constitute social actions (justification, contradiction, rejection, etc.). Thus the interplay of the various means of co-construction of a propositional meaning is at the same time an interaction in the sense of Conversation Analysis.

### **12.1.2 Grammatical morphology in Spanish and English agrammatic patients**

To account for cross-linguistic differences in agrammatism, Bates, Wulfeck, and MacWhinney (*Brain and Language*, 1991) pro-

posed the Competition Model, in which the information carried on a grammatical morpheme and the processing costs of the morpheme itself will directly affect how agrammatism is manifested in a particular language. Using English and Spanish versions of Goodglass, Christiansen, and Gallagher's Morphosyntax Battery (*Cortex*, 1993), J. Christiansen, together with M.J. Benedet (U. Complutense Madrid) and H. Goodglass (Boston U.), analyzed the ability of seven monolingual English-speaking and six monolingual Spanish-speaking agrammatic Broca's aphasics to process: a) three types of noun phrase morphology (singular/plural nouns, noun possessives, and possessive adjectives), b) three types of verb phrase morphology (subject/verb agreement, verb tense, and low-content verbs such as *estar*, to be, and *tener*, to have), and c) word order in active and passive sentences.

Similar order of difficulty in both production and comprehension of these grammatical constructions were found for both the Spanish- and English-speaking agrammatic patients. However, two main differences emerged: 1) the Spanish speakers were relatively better at producing subject/verb agreement, but no better than the English speakers at comprehension, and 2) the Spanish speakers were significantly worse at comprehending both active and passive sentences. The Competition Model would predict that the Spanish speakers would produce subject/verb agreement better, because of the pro-drop nature of Spanish and the vital subject information carried on the verb. However, this cannot explain why the Spanish speakers were equally as impaired as the English speakers at comprehending subject/verb agreement. The Competition Model might also predict the Spanish speakers to be worse at comprehending active and passive sentences as word order is not a clue to active or passive voice in Spanish. However, voice is morphologically marked in Spanish as clearly as it is in English. These results raise questions as to how precisely the Competition Model should apply to language production and comprehension in aphasia.

### 12.1.3 Agrammatic comprehension

M. Haverkort (Boston U.) continued work on a long-term project aimed at developing a formal processing account of patterns of breakdown of comprehension (and production) in

agrammatics in a number of typologically unrelated languages. The account is based on insights from the principles and parameters framework of generative grammar. One of the goals is to give a formal account of a number of generalizations and observations of the adaptation theory (Kolk & Heeschen). In the course of this research, some parallels between the syntax of agrammatics and young children in a number of languages (especially with respect to functional projection, licensing of subjects and verb movement) were also investigated.

## 12.2 Cliticization

Haverkort investigated the differences in syntactic behavior of dative/accusative and prepositional clitics in French. Prepositional clitics, unlike dative/accusative clitics, do not necessarily occur adjacent to the verb, can license parasitic gaps in extraction islands, display pseudo-opacity effects, are sensitive to overt possessors when extracted from DP, and diachronically allowed clitic climbing much longer. These different properties of the two types of clitics were related to a different status in terms of bar-features: whereas dative/accusative clitics are genuine heads, prepositional clitics have a number of properties in common with maximal projections (they are [+maximal, -projection] in terms of Muysken's features for syntactic projection), and thus resemble Germanic clitics. These differences raise a number of non-trivial questions with respect to linear order and movement properties of clitic clusters, as well as processing, which are part of ongoing research.

Haverkort also worked on the interaction of scrambling and cliticization in Germanic, especially its relevance to the question as to whether scrambled elements are base-generated in their surface position (as proposed by Neeleman), or not. The interaction with clitics argues against a base-generation approach to scrambling: if a scrambled element can occur on either side of an adverb, and a clitic can occur on either side of a scrambled element, then the clitic would be expected to be able to follow an adverb, contrary to fact.

## 12.3 Applicatives

In collaboration with A. van Hout (Niels Stensen Foundation and U. Massachusetts, Amherst), Haverkort started investigating Germanic parallels of applicative constructions in Bantu languages. This research has shown that applicatives are not restricted to Bantu: Dutch and German have some quite productive counterparts to Bantu applicatives. The Bantu language Chichewa, for example, has applicative suffixes (here, *-ir-*), as in:

Mavuto a-na-umb-ir-a mfumu mtsuko  
 Mavuto SP-PAST-mold-APPL-ASP chief waterpot  
 Mavuto molded the waterpot for the chief

Dutch has the applicative prefix *be-*, as in:

De kok be-strooit de taart met poedersuiker  
 the cook APPL-strews the cake with icing sugar  
 The cook strews icing sugar over the cake

In either case, when there is no applied affix on the verb, the object closest to the verb has to occur with a preposition (e.g., as in the English translation of the Dutch example, or in *de kok strooit poedersuiker over de taart*). The study of Dutch and German has shown that the clustering of properties (especially case properties) associated with applicative constructions are much looser than assumed in the literature up until now.

## 12.4 Tenses in texts

H. Vater (U. Köln) worked on a project on the tenses of German. The main results of the project will be published in a book and two articles, one of them in cooperation with W. Klein. During his previous work on the tense system of German (including an article in cooperation with V. Ehrich (U. Tübingen) on the perfect tense in German and Danish), Vater became interested in the functions of tenses in texts. In the book "Textfunktionen der deutschen Tempora", M. Marshall obtained some interesting results concerning the textual functions of the German tenses, but did not take their literal meanings into account. Vater decided to



base his investigation of the textual functions on the studies of tenses by W. Klein, V. Ehrich, C. Fabricius-Hansen, R. Thieroff and himself. Tenses in 70 short texts from German newspapers were analyzed, in addition to four long texts by Franz Werfel, taking the literal (context-invariant) meanings of the tenses into account, as they had been established by the aforementioned linguists.

Vater found that the German perfect indeed occurred often in the first sentences of short texts (as stated by Marshall) – 34 times in 70 sentences, that is, almost 50% (as compared to 22 present tense, seven past tense, two future tense, among others) – but that the occurrence of perfect forms was restricted to texts where the first sentence contained a summary, e.g.:

Heftige Sommergewitter haben in der Nacht zum Mittwoch Schäden in Millionenhöhe angerichtet. In Dortmund brannte eine Kirche nach einem Blitzeinschlag ab.

Violent summer storms have caused damages in the millions on Wednesday night. In Dortmund a church burnt down after being struck by lightning.

In cases where authors went in *medias res*, they usually began with the past tense. The present tense in first sentences usually referred to generic (“timeless”) statements. Thus, the perfect tense is not a “first sentence tense” as Marshall suggests, but its frequent occurrence in first sentences is bound to its summarizing function. This in turn can be explained by the perfect tense’s literal meaning within the German tense system (cf. Ehrich/Vater, 1989), designating a past event where the time of speech is its primary reference point.

## 12.5 Formal semantics

P. Seuren (U. Nijmegen) visited the Institute in the spring of 1995, during which period he wrote a text (60-plus pages) “Principles of Discourse Semantics”. The text contains, as part one, a detailed and fundamental critique of logic-based model-theoretic formal semantics in the tradition of Richard Montague. Part two is an outline approach to a more cognition-based formal se-

mantics, which regards each utterance as a contribution to a mental representation of a situation or a restricted state of affairs.

## 12.6 Language contact

C. Stolz has continued her joint research with T. Stolz (U. Bremen) on language contact and grammatical borrowing from Spanish in Mesoamerica. Since in most Mesoamerican cases of Amerindian-Indo-European language contact, the superstrat language is Spanish, it seemed promising to analyze languages outside of the Mesoamerican area which also have Spanish as superstrat language. A look at several languages of South America and the Pacific (particularly Indonesia) shows that the patterns of grammatical borrowing are quite similar in all areas under consideration: diachronically, grammatical borrowing starts on the level of texts or paragraphs (discourse markers), proceeds on sentence level (conjunctions) and further on clause level (adpositions and adverbs) and only then enters the level of words (bound morphemes). On a synchronic level, this process can be described on an implicational hierarchy: a language which has borrowed bound morphemes also has borrowed adpositions or adverbs, and so on.

## 12.7 Discourse factors in the use of epistemic modal expressions

J. Nuyts (U. Antwerp) and W. Vonk continued their research on the role of information structure (saliency of pieces of information) in the use of epistemic modal expression forms (adverbs, predicative adjectives, mental state predicates, auxiliaries, particles, etc.). They used an experimental design in which conditions were varied such that alternative kinds of discourse situations were created. In particular, they compared situations in which the probability factor (the epistemic evaluation – EE) was in focus with situations in which the state of affairs (SoA) as such was focal. The hypothesis (based on a linguistic corpus study of these forms by Nuyts) was that adjectives would be bound to the EE-focal condition, and adverbs to the SoA-focal condition, while forms such as the mental state predicates and auxiliaries would occur in both, but with different syntactic properties.

Subjects were invited to comment on cartoon strips which were likely to cause uncertainty regarding what happens in them, and thus were likely to trigger the use of epistemic expressions. The experiment was performed in spoken and in written form. The data thus consist of transcripts of the spoken responses (66 subjects, 31,533 words in total) and the written protocols (63 subjects, 20,698 words in total). The EEs (1565 in the spoken and 631 in the written version) and their contexts were analyzed and coded for all possibly relevant factors and properties. Statistical analysis is under way, but the major tendencies are clear. The spoken and written versions have produced roughly the same results, even in very fine detail – only the relative frequencies of certain forms are different (e.g. adjectives are relatively much more important in the written than in the spoken data, and the opposite is true for the mental state predicates), and a few minor tendencies are different. Overall, there is a clear line in the findings, roughly confirming the hypothesis. In the EE-focusing conditions the predominant forms are the adjectives (more so in the written than in the spoken version) and the auxiliaries. Also the mental state predicates are frequent, but they turn out not to be in focus in such conditions: rather, they are used in support of a positive or negative polar expression, which itself is focal. In the SoA-focusing conditions the major forms are (again) the auxiliaries (but then used in a different type of construction as compared to the EE-focusing conditions), the mental state predicates (at least in the spoken version), and the adverbs (the latter are nearly completely absent in the EE-focusing conditions).

## **12.8 Acquisition of syntax and morphology**

### **12.8.1 Acquisition of verb placement in German**

I. Lasser (CUNY) continued her dissertation work on the acquisition of verb-placement in German. The study investigates why German children – at an age when they have already acquired verbal affixes at least for the present tense paradigm – produce matrix clauses like the following examples, which are characterized by non-finite clause-final verb forms occurring to the right of any objects, adverbs, or the negation marker:

Mone auch ada *gehn*. (age 2;02;21)  
 Mone also out go

Nee Mone nich heia *machen*. (age 2;11;11)  
 no Mone not sleep make

Ich erst das Buch *angucken*. (age 2;11;11)  
 I first the book look-at

The approach of the dissertation involves a direct comparison between child speech and parental speech. Investigating 7.5 hours of parent-child interaction, Lasser found that in most parental utterances containing at least one verb, one verb occurs in the finite form. However, there is also a non-negligible amount of matrix clauses containing exclusively a non-finite verb form. These structures occur as declaratives, interrogatives, or imperatives:

Die Nudeln noch 'n bisschen *zudecken*. (parental declarative)  
 the noodles still a little cover-up

Auch noch 'n bisschen Suppe *essen*? (parental interrogative)  
 also still a little soup eat

Immer erst unten *abstreifen*. (parental imperative)  
 always first on-the-bottom wipe

Parental matrix infinitival (MI) structures are interpreted as finite, but can be analyzed as compatible with the so-called Verb-Second (V2) requirement, if that requirement is interpreted as a requirement on finite matrix verb *forms* only. The analogue conclusion is possible for children's MI structures. If, as much previous literature has suggested, children at the relevant stage know where to place finite forms in the clause, and there is no absolute need for a matrix clauses to contain a finite verb form, then children's MI behavior is in no way in contrast with the V2 requirement.

A second empirical result of the study concerns the use of complex verbs such as in the following examples:

Mone *will* auch Decke *haben*. (age 2;02;21)

Mone wants also blanket have

Mone wants to have a blanket too.

Du *sollst* nicht mehr den Max *beissen*. (age 2;07;23)

you should not anymore the Max bite

Stop biting Max now!

While the two-year-old child in the study clearly uses these forms productively, she uses them proportionally less than her parents. This result is interesting in the context of a third observation which is that in three-constituent utterances with only a simple theta-marking verb, the child uses finite verb-second structures to a degree comparable to the parents' usage.

A linguistic analysis (based on previous work by Klein and Ehrich) of how the semantic notion finiteness is realized on the verb in German, suggests the conclusion that the gradual convergence on adult behavior with respect to V2 behavior should be sought in the language-specific aspects involved in the morpho-syntactic realization of the semantic notion of finiteness. The particular realization that a given semantic notion of finiteness finds in the morpho-syntactic component depends on the following factors: verb type, tense value of the clause, aspect value of the clause, illocutionary force of the clause, intonation contour of the clause, and discourse properties of the clausal subject. Both the conceptual considerations and the empirical observations of Lasser's study speak against accounts in which matrix infinitives are the result of a genuine optionality in the grammar (Wexler, Rizzi). They support theories which claim that MI structures are like finite structures in which a tensed element, for reasons under investigation, has not been realized overtly (as proposed in different forms by various researchers).

### 12.8.2 Sentence comprehension in children

While a visitor at the Institute, K. Lindner (Ludwig-Maximilians-U., Munich) completed the analysis of sentence comprehension data from two experiments which were carried out in the project "Funktionale Determinanten im Spracherwerb" sponsored by the Deutsche Forschungsgemeinschaft. The experi-

ments tested participants' interpretation of the cues animacy, word order, and subject-verb-agreement along with ambiguous case marking (feminine nouns) in one experiment and non-ambiguous case marking (masculine nouns) in the other. Following other findings on local and topological processing, two hypotheses were tested: (1) monolingual German children will first orient towards animacy, then towards case, and then towards agreement, and (2), if case marking is ambiguous, then children will choose "a-first-noun-as-agent-strategy".

The participants were 84 two- to nine-year-old normal children, twelve adults, and 23 language impaired children age four to six. All children had passed a standardized comprehension task (Part C of the "Logopädische Sprachverständnistest", Wettstein 1983; abbreviated LSVT); their performance was within the normal range. The language-impaired children, furthermore, were grouped according to their performance in a production task (also from the LSVT). Children with scores more than two SD below the mean were assigned to a group with severe impairment, those with scores between one and two SDs below the mean were assigned to the group with light impairment. Thus all impaired children had problems producing correct case marking and/or agreement; some of them also had difficulties with the position of the verb, and some with word order in general.

With the assistance of H. Baayen a logit analysis combined with tree-based modeling was chosen. The first hypothesis was confirmed: two and three year old normal children orient clearly towards animacy, while four year olds favor case. From five years onwards participants chose agreement as the most important cue. The impaired children roughly showed the same trend but delayed by one to two years: Four and five year olds still followed animacy while the sixth year olds oriented towards agreement. Case as a main factor was only chosen by some individual five year olds. Thus, despite the fact that the impaired children performed similarly to their normal peers in the comprehension task a closer look reveals that they still differ from them in their utilization of particular grammatical markers. The second hypothesis was not confirmed. For none of the groups was the first NP the decisive factor. However, the analysis of individual chil-

dren showed that in the experiment with ambiguous case marking, of the control children, 1/12 of the four year olds, 4/12 of the five year olds and 5/12 of the six year olds used the first NP strategy. Of the impaired children, 1/7 of the four year olds and one of the eight five year olds used this strategy. This finding casts doubt on the assumption that if case markers do not assist in identifying semantic roles or syntactic functions, then word order information automatically steps in. Thus, word order and case marking may not provide the same information. Another finding of this study is that neither age nor severity of impairment is a good predictor for the performance of the impaired children. Some severely impaired children performed similarly to their normal peers.

### 12.8.3 Acquisition of particle verb constructions

P. Jordens (F.U. Amsterdam) continued his research on the acquisition of particle verb constructions in Dutch. Whereas some researchers use acquisitional facts in favor of an analysis which takes particle-verb combinations such as *opeten* ("up-eat", eat up) as lexical units, Jordens found evidence in child Dutch favoring an analysis which takes the particle as a predicate in its own right. First, as found in earlier studies, children use particles before they produce particle-verb constructions. For example, *papa goene aan* (daddy shoes on, Andrea 1;9) versus *deze jurk aandoen* (this dress onput, Andrea 1;11). Second, particles appear with modals as in *kannie nie ope* (can-he not open, Andrea 1;11). Like in the adult language, these particles function as secondary predicates. Third, the first particle verbs to be acquired are semantically transparent. Thus, *uitpakken* ("out-fetch", unwrap) is used while *inpakken* ("in-fetch", wrap) is not.





# Other Activities 1995

## Activities of the Technical Group

In 1995 there was a phase of consolidation, after the many changes started in previous years. VAX/VMS has been completely taken out of support and the shift to much better-supported UNIX systems using HP and SGI equipment has almost been finished. These changes created some trouble in that certain proprietary protocols (LAT, DECNET) were no longer supported. Various components therefore had to be replaced and other commands had to be learned by users. These changes created some practical problems, but we can finally say that in 1995 a situation has been established in which there are very smooth-running and stable UNIX, PC and Mac systems, high efficiency local and wide-area network components, and, most importantly, a high-level information network among users.

The field of information processing in computer networks is characterized by a continuous process of modification. Almost at every moment in time somewhere in the network something will change. One of the big challenges is to keep naive users well-informed, so that they can efficiently use the tools available. The TG is aware of this most important issue. We therefore always check very carefully whether changes are acceptable or necessary, and look for the most appropriate ways to inform users of changes. To complement this, the TG again spent some time running tutorials and also set up the new electronic TG-Guide (see below). Further, the newly-formed comprehension research group (Prof. Cutler) was integrated smoothly in various ways. The TG also did some work in the area of artificial neural networks (see below).

## Max Planck Electronic Information Desk (MEID)

One of the most important projects of the TG in 1995 was to establish an Institute-Wide-Web which is called MEID and which is intended to offer current and complete information about various services at the MPI. MEID is a comprehensive and

completely new electronic version of the TG-Guide which is accessible via the well-known WWW-browser technology. It contains information about all tools supported by the TG and about the services the TG is offering. Since the TG is aware of the fact that only up-to-date information is of value to the user, a formal update scheme has also been established. The documents are written in HTML, give many practical hints, and include many illuminating graphics.

MEID has a high degree of acceptance, as can be seen by the fact that there are about 300 requests to the available pages per day (!). This means that about 1 MB information is transferred to users per day. We are sure that MEID has helped a lot in establishing a high degree of informedness at the Institute, and we know that it has reduced the number of simple questions which are directed to the TG.

A new "graphics specialist guide" in MEID turned out to be very useful. The huge amount of different graphic formats and programs available made it almost impossible for the naive user to create documents efficiently. The graphics guide describes not only programs and formats, but also makes suggestions about how to navigate optimally through these programs, and how to create complex documents.

## Systems

The Institute bought additional high-speed servers from HP and added new HP and SGI workstations, all running the Xwaves/ESPS speech software and all equipped with high-quality audio hardware. In the area of desktop computing, new PCs based on the Pentium-Chip were bought, and, especially for multi-media applications, new Power-Macs have been purchased. The Institute also bought additional fast network printers and extended its facilities to color printing based on Postscript. The email system was changed in that the official address of members of the MPI now is: "firstname.lastname@mpi.nl". An alias file is used in parallel to handle some typical spelling variants. A central addressbook scheme was established which facilitates writing emails to individuals and groups of people. A unified font set was chosen and installed as default on all PC, Mac, UNIX and DB systems to allow for simple exchange of documents.

On the HP workstations, an MS Windows emulator called WABI was installed and tested. It allows the users to execute many programs running usually under MS Windows on PCs. In general we are satisfied with the functionality offered, but for certain operations a decrease in speed compared to a fast PC can be identified. Nevertheless, WABI allows those users who work at home on a PC and at the office on a UNIX workstation to exchange and to continue working on the same files, using the same software.

A so-called Archive Server concept was developed and installed. This consists of a hierarchical storage-management component with two layers: (1) fast disks to cache frequently-used files and (2) MOD libraries with more than 100 GB storage capacity. HSM software allows for automatic and user-transparent data transfer. This was necessary, since especially in the Computer-Assisted Video Analysis (CAVA) and the Spoken Childes (SC) projects (see below) we are confronted with huge amounts of data which have to be directly addressable and available with only short delays. The MOD library also solves the problem of archiving special data for longer periods, since for MOD a shelf time of 30 years is specified. Due to the increase of the amount of data stored, it was necessary to revise the backup solution. DLT-autochangers with a capacity of 40 GB (compressed) per cassette were installed to carry out network-wide backups at night, without operator intervention.

With respect to operating systems, the Institute does not see any reason to step away from UNIX as the basic server system. On desktop computers things will change due to the new operating systems from MS. We think it is likely that the desktop will be dominated more and more by operating systems from MS. However, the strategy here still is not clear. Windows 95 will probably only be installed where special application software requires this. In order not to create too many changes within a short period of time, we see Windows NT as the long-term successor to Windows 3.x.

With respect to databases, the Institute stepped over to ORACLE V7 and especially client-server tools. People working on a PC can now initiate database queries from their desk using convenient procedures. The library database is available now under

BISLOK V2.1, which now also runs on HP workstations. With the help of terminal emulation, PC users can also use OPAC.

In the Speech Lab, a completely revised and enhanced version of the Splice program was added which now preserves sub-labels when splicing and offers an improved zero-crossing search function. In addition, some old SGI computers were replaced by faster new ones.

### **New building**

Various plans for building up technical facilities in the new building and the intermediate container building have been finished. Most important here is that the Institute will have to start moving in 1996 to new high-speed network technology. The current flat Ethernet-infrastructure is becoming an increasing bottleneck, that is, increasingly slow access to the servers can prevent users from working efficiently. Additionally the CAVA and SC projects are asking for isochronous and high-volume data delivery from the servers via the network to the client stations. Although the Institute's primary technical choice would be ATM, with its possibility to associate fixed bandwidths to connections, it has been decided, for practical reasons, to start first with Fast-Ethernet switching components and partly dedicated lines.

### **Experimental labs**

Further functionality was added to the home-made NESU (Nijmegen Experiment Set Up V 2.0) software (video-timing support, PC speaker usage for rapid prototyping, and on-line feedback on reaction time conditions), and a new NESU Box was integrated. Compared to the PC Box, the NESU Box has more possibilities for running multiple subject experiments, for connecting microphones in voice key experiments (onset and offset pulses by hardware), for generating and reading pulses, and for controlling other unknown devices via TTL input/output bits. Both boxes are connected via printer ports to a PC or laptop and are therefore portable. For in-house experiments, a third Timer Server was built and tested. NESU is now also used by various external sites world-wide, and it is certainly one of the most advanced, flexible, and robust experimental packages in psychology. Future development was intensively discussed and it was

decided to test Windows NT with respect to its real time capabilities. If satisfying results are obtained, NESU will be ported to the Windows NT platform and a new Smalltalk dialect. This will guarantee further enhancements and continuity for NESU-driven experiments in the future.

The completely redesigned Child Lab now also operates under NESU. With the gesture lab as the only exception, all experiments within the Institute now run under NESU. In the Child Lab, some special electronics were added to control various devices for attracting infants' attention. Using NESU for almost all internal experimental purposes gives the Institute a high degree of flexibility.

In the Gesture Lab a better synchronization between the qualitative video recordings and the quantitative data streams generated by an ultra-sonic device was achieved. Speech and quantitative gesture data can be analyzed by using the standard speech lab software package.

## Corpora

In cooperation with scientists, a project was started which has the goal of converting all ESF files into the Chat format used in the CHILDES initiative. Scripts were developed which facilitate the conversion. The Spoken CHILDES software also took on its final shape: it is now possible for users working on a transcript with the CHILDES editor (CED) to address directly the corresponding speech segment, display it, and listen to it. The Spoken CHILDES environment further allows the user to use the speech lab software (Xwaves/ESPS) to extract parametric representations such as pitch contours and spectral envelope estimations. The environment is also suitable for transcription purposes, since time references can be transferred from the speech lab environment to the transcript by simply pressing a button. Of course, digitized speech allows the user to go backwards and forwards easily when transcribing. Currently, speech of many selectively-chosen ESF audio cassettes is being digitized such that scientists will soon have access to a large spoken corpus. The intention is to port this Spoken CHILDES environment to PC in 1996. However, it is not yet clear which operating system platform and which speech analysis package will be used.

## **Computer-assisted video analysis**

This work was one of the major investments of the TG in 1995 and this will continue in 1996. The principal system design was described in the 1994 Annual Report. In 1995, the Transcription Editor (TED) was revised, new features were added to facilitate its usage, and it was ported to MS Windows and Smalltalk. The Media Tagger (MT) user interface was improved and new functions were added such as time-code support, time-dependency relation between tiers, and import of existing text transcripts. Also a new Mac equipped with special digitizing interfaces was installed, tested, and fine-tuned. This Mac is able to digitize video (to Motion – Joint Photographer's Expert Group, MJPEG, standard), audio, and time-code information simultaneously in real-time and it allows substantial amounts of video to be digitized in batch mode. MJPEG with full resolution means a data rate of about 2 MB/s. This turns out to be too much to be able to decompress in real-time by existing software. Therefore, we decided to convert the MJPEG format to Cinepak format by software which takes about 40 to 70 times real-time, depending on the CPU used. The Cinepak full resolution video comes up to 500kB/s, which can be decompressed by standard software on all Macs which are powerful enough. The display of video scenes can therefore be done on all Macs, including PowerBooks, without the need to add special expensive decompression hardware.

The database has been designed and an analysis was done into how to build a query interface such that relatively complex queries can be composed in a user-friendly way. The implementation of the query interface and the converters to import the codes from TED and MT to the database will be finished in 1996. Further TED- and MT-capable hardware set-ups were installed.

## **Eye tracking**

The eye movement set-up was optimized to allow the user to run experiments efficiently. The flexible text editor was extended to allow pagewise operation, so that appropriate display formats can be automatically generated. It also now works on various text tags defined by the user. An ASCII import/export feature will be finished in early 1996. In addition, the experiment program was expanded to give more flexibility to the user. The pro-

grams were modified such that object-based analysis with software from U. Aachen can be done.

### **Audio/video/field equipment**

New field equipment was bought, mainly for the Cognitive Anthropology Research Group. However, in contrast to the last few years, no special new technology was introduced. With respect to audio- and video-walkmans, and audio- and video-recorders, a satisfying level of sophistication and miniaturization was achieved. The Hi8 camcorder and various types of small high-quality DAT recorders (down to SCOOPMAN with 3x2.1cm mini-cassettes) are the standard recording equipment. Field experience has shown that Toshiba and HP notebooks are reliable. Therefore, new color notebooks from Toshiba and HP-Omnibooks were bought, the latter especially for trips where weight and battery run-time has to be optimized. The solar panels which are very convenient for field research were completely revised. High-quality wire-less microphones for flexible and easy recordings in the field were bought and have turned out to be very useful. Due to heavy load and difficult environmental conditions, field equipment very soon gets into a bad state and has to be replaced. If equipment is used which is not in good condition, the risk of malfunctions in the field is too high. This is true even though the TG carries out intensive checks on all components.

The video installations in the Institute were expanded and partly replaced. It turns out that the heavy usage of the analysis recorder/players which were bought three or four years ago has led to an increasing error rate. Given high time-pressure, downtimes of the analysis equipment can hardly be accepted. To give the user more flexibility and an improved user interface for video editing purposes, a "Fast Video Machine" was bought. This machine is PC-based and is built up on PC-extension slots. For fast disk access these boards have a separate and fast disk channel. The boards perform a real-time compression and decompression (to MJPEG standard) with variable reductions. In doing so the amount of disk space needed can be minimized. The boards have a great deal of built-in electronics and software for editing, mixing, and special effects. We assume that users will make heavy

use of this device in 1996, since its handling is much more convenient compared to the existing electronic-editing suite. A second observation lab with multiple cameras and a simple split-screen unit was installed to enable multi-speaker recordings.

### **Animation**

The TG helped in making computer-based animations which are used in experiments. Here the question was whether it would be sufficient to make simple 2D cartoons or to attempt to make 3D animations. The requirements of the scientists with respect to quality and flexibility meant that only 3D animation tools would be acceptable. The TG compared a couple of 3D animation software packages with respect to their capability to generate objects and movies. Finally 3D Studio was chosen, since it has many up-to-date features, runs on PC, and there are many add-ons (ready-made objects, movies, procedures) for this package. The general idea was to have some basic objects and movies generated by a professional company and then modify these in house. The generation of the first animations demonstrated that a well-trained person was needed, since creating movies with human characters requires a great deal of understanding about human movements.

### **Artificial neural networks**

Together with D. van Leeuwen and T. Westerveld (both U. Twente) and in co-operation with H. Bourlard (U. Mons, ICSI Berkeley), architectures for building special speech recognition devices were investigated. Such devices will facilitate psycholinguistic research in many respects in the future. Artificial Neural Networks (ANNs) were found to be powerful building blocks of such speech recognition devices. In earlier research at the MPI (see Annual Report 1991), and at other speech recognition departments (e.g., R. Watrous, U. Rochester; T. Robinson, U. Cambridge), Recurrent Neural Networks (RNNs) have been successfully applied in the recognition of phonemes. Success in similar tasks was achieved with the help of Time-Delay Neural Networks (TDNNs) by A. Waibel (CMU). Bourlard showed comparable performance for RNNs, TDNNs, and Multi-Layer Perceptrons (MLPs) using left and right context in automatic speech



recognition. In contrast to TDNNs and MLPs, RNNs use flexible window lengths, which are defined by the strengths of the recurrent connections. These can be interpreted as decision boundaries in the time domain such that they also represent variations in time.

One critical aspect of RNNs, however, is their capacity to deal with long pattern sequences such as those of spoken words. Architectural variants to increase the memory capacity of RNNs were investigated. Of course, the most crucial factor was found to be the number of explicit copies of preceding time steps stored during learning. If this number covers the whole sequence to be trained and if there are enough hidden neurons (these determine the number of weights as free parameters) the complex information about word patterns and their variations can be stored. However, long-range dependencies are difficult to train for statistical reasons and the amount of memory and the training time increases with these parameters. Another variant which was tested was the use of recurrent links with multiple delays. Here again the number of explicit copies determined the capacity. For synthetic sequences it turned out that these nets needed extreme training times and that their convergence behavior was bad. The best solution in terms of performance and training behavior is a mixture of TDNN and RNN methods. Ten feature vectors were used as one input vector per step. With five to ten of such time steps a whole word pattern can be covered. No overlap is needed, since the RNN is able to extract the information belonging to the corresponding transitions.

Two architectures were finally chosen: (1), a monolithic RNN or MLP (using context) which is trained to extract phoneme knowledge and subsequent Hidden Markov Model layers describing words in terms of their phonemes and their embedding in a "syntax layer"; and (2), a number of RNN modules where each module stores the patterning belonging to a word plus a subsequent "syntax layer". The first variant was successfully applied by Bourlard, Robinson and their co-workers for continuous speech recognition. The second version has the theoretical advantage that the whole patterning of a word including the specific variations in terms of place of articulation and timing is stored in one module. In 1996, these architectures will be fully imple-

mented using a Dutch spoken language corpus and compared with respect to their recognition performance and their computational needs.

Related work on neural networks has been the further development of the RAW-model of speech recognition (see Annual Report 1994). First, D. van Kuijk (U. Nijmegen) and P. Wittenburg have adapted the mathematics of the model so that it yields optimal results given its current restrictions. Secondly, a number of simulations concerning the behavior of the model over time were conducted. The simulations investigated the effects of Uniqueness Point, word frequency, and the cohort size of the words in RAW's lexicon on the recognition times of words. The effects were shown to be in the same direction as the effects found in experiments on spoken-word recognition in humans. For instance, words with a small word-initial cohort are recognized faster both by humans and by the RAW-model. Thirdly, Wittenburg designed an algorithm which makes it possible to automatically add new words to the lexicon and to train the existing words in RAW's lexicon with multiple tokens of that word, so that the model can handle more variability in the speech signal and have an incrementally-increasing lexicon. To yield discriminative representations the algorithm has to be partly supervised.

## **CELEX: The Center for Lexical Information**

CELEX, the Dutch Center for Lexical Information, supports linguistic research and language-and-speech-oriented technological projects by providing lexical databases for Dutch, English and German, the hardware and software to access these data, and the expertise to support the data and facilities. CELEX is a resource open to academic institutions in the Netherlands and abroad. The databases can be accessed interactively through the Dutch academic research network SURFnet, or queried in a stand-alone set-up on CD-ROM.

A five-year grant (running until 1998) from the Dutch Ministry of Science, Culture and Education enables CELEX to continue to support the academic world. The day-to-day administration of CELEX has been formally entrusted to the Max Planck Institute, which acts as one of four Dutch-based organizations supervising

and assisting CELEX. In 1995, R. Piepenbrock continued his function as CELEX project manager.

In early 1995, version 2.5 of the German database was released for interactive access through the FLEX user-interface. It features about 1000 new lemmas, improved morphological decomposition and more extensive verb argument structures. Tying in with this update, the CELEX German Linguistic Guide was published as part of the CELEX User Guide. More general documentation was provided by creating a public World Wide Web information site on the University of Nijmegen campus server at <http://www.kun.nl/celex/>.

On the CELEX host computer, an automatic system-accounting program was installed to monitor usage and thus improve system performance and disk space management. In order to reflect changes in the German data, Piepenbrock prepared a second release of the CELEX CD-ROM, which was again brought out by the US-based Linguistic Data Consortium in December. This release also provided an opportunity to include additional lexica, to streamline AWK-scripts and to flesh out the documentation. The current CD, which replaces the previous version, is available from the LDC for US \$150.

## Nijmegen Lectures

The 1994 Nijmegen Lectures were postponed and then given in June 1995 by Lila Gleitman (U. Pennsylvania). The unifying theme of the lectures was "Some lexical structures and their acquisition". In this series, Gleitman discussed two different but related topics. The first one concerned the role which syntax plays in vocabulary acquisition. Gleitman claimed that children use the syntactic frames that words appear in to make predictions about the meaning of these words. The second topic questioned the lexical encoding of symmetry within the same framework.

The series was divided into two morning public lectures, titled "A picture is worth a thousand words, but that's the problem: Structural supports for lexical learning" and "'Similar' and similar concepts". Additionally, there were two afternoon seminars arranged around the topics "Biological bases of language learning: Deprivation paradigms" and "How language might affect category formation".

The lectures were organized with the Interfaculty Research Unit for Language and Speech (IWTS) of the University of Nijmegen. Members of the organizing committee were K. Drozd, H. Hendriks, I. Lasser (MPI), E. v. Hest and R. Schreuder (IWTS), with assistance from S. Aal.

The 1995 Nijmegen Lectures were given in December by Alan Prince and Jane Grimshaw (both Rutgers U., New Brunswick, USA). The theme of the series was "Optimality Theory". The lectures provided an overview of the leading ideas of Optimality Theory, with attention to theoretical architecture, characteristic patterns of analysis, and specific results obtained with respect to a range of basic empirical issues.

The series was divided into three morning public lectures "Introduction to Optimality Theory", "Optimality Theory and prosodic structure" (both given by Prince), and "Fundamentals of Optimality theoretic syntax" (Grimshaw). Additionally, there were three afternoon seminars with discussants (more informal and attended by a more specialist audience): "Characteristic interactions in constraint hierarchies; Issues of learning and parsing" (Prince) with H. van der Hulst (U. Leiden) as discussant, "Faithfulness, parallelism, and forms of identity" (Prince) with R. Kager (U. Utrecht) as discussant, and "Universal Grammar and Optimality theoretic syntax" (Grimshaw) with A. Neeleman and P. Ackema (both U. Utrecht) as discussants.

The lectures were again organized in collaboration with the IWTS. The series was organized by C. Gussenhoven, H. Jacobs (both U. Nijmegen), J. McQueen, and A. Roelofs (both MPI), with assistance from S. Aal.

## **The F.C. Donders Lectures on Cognitive Neuroscience**

This lecture series is organized by C. Brown and P. Hagoort, in collaboration with the Nijmegen Institute for Cognition and Information (NICI). In its third year, the series continued to be an important meeting point for the cognitive neuroscience community. Speakers in the 1995 series were: D. Caplan (Massachusetts General Hospital, Boston), M. Merzenich (U. California, San Francisco), S. Rose (Open U., Milton Keynes), M. Gazzaniga (U.

California, Davis), and A. Berthoz (Collège de France, CNRS, Paris).

## Awards

W. Klein was one of the twelve scientists who received the Leibnitz Prize in 1995 from the Deutsche Forschungsgemeinschaft for outstanding scientific achievement.

S. Allen received the 1995 Book Award from the Society for the Study of Indigenous Languages of the Americas, for her doctoral dissertation entitled "Acquisition of some mechanisms of transitivity alternation in arctic Quebec Inuktitut".

## Internal lectures and colloquia

Colloquia organized by the Institute's Colloquium Committee (P. Hagoort and A. Roelofs) included lectures by G. Waters (McGill U., Montreal), N. Martin (Temple U., Philadelphia), R. Shiffrin (Indiana U.), A. Nobre (U. Oxford), P. Zwitserlood (U. Münster), C. Price (Hammersmith Hospital, London), S. Weinert (U. Bielefeld), M. Crago (McGill U., Montreal), and L. Frazier (U. Massachusetts, Amherst). Many informal lectures were also given by long-term and occasional visitors to the Institute.

## Teaching

The staff of the Institute, the Cognitive Anthropology Research Group, and the Research Group on Structural Grammar (marked by an \*) taught courses at the following institutions:

Baayen (U. Nijmegen); \*Bierwisch (Humboldt U., Berlin); \*Blutner (Humboldt U., Berlin); Cutler (U. Helsinki); \*Dölling (Humboldt U., Berlin); Donselaar v. (U. Utrecht); Hagoort (U. Leiden); Indefrey (Heinrich-Heine-U., Düsseldorf); \*Jäger (Humboldt U., Berlin); Klein (U. Heidelberg; U. VIII, Paris); McQueen (Center for Language Studies, Tilburg/Nijmegen); Meyer (U. Nijmegen); Roelofs (Center for Language Studies, Tilburg/Nijmegen); Senft (U. Cologne); \*Strigin (Humboldt U., Berlin; U. Trondheim; U. Tübingen); Vonk (Iasi, Romani, Second Euro-Romanian Summer School on Natural Language Processing; U. Nijmegen); Wassenaar (U. Nijmegen); \*Wilder (Humboldt U.,

Berlin; Olomouc, Czech Republic, Central European Summer School in Generative Grammar).

## Colloquia Presented

The following members of the Institute, the Cognitive Anthropology Research Group, the Research Group on Structural Grammar (marked by an \*), and visitors (during their time at the Institute) presented colloquia at various institutions:

Allen (Free U. Amsterdam; U. Arizona; U. Stuttgart); Baayen (Humboldt U., Berlin; AT&T Bell Laboratories, Murray Hill; Haskins Laboratories, New Haven; U. Trier; U. Potsdam; U. Nijmegen); Baumann (U. Amsterdam); \*Bierwisch (U. Bonn; U. Jena; U. Mannheim); \*Blutner (U. Bielefeld); Bowerman (U. Essex); Brown, C. (U. Glasgow); Comrie (Scuola Normal Superiore, Pisa; U. Konstanz; U. Mainz); Crago (U. London; U. Lund; U. Linköping); Cutler (U. Amsterdam; U. Barcelona; U. Edinburgh; U. Helsinki; U. Potsdam; U. Groningen); Danziger (CNRS, Paris; U. Sorbonne); Donselaar v. (OTS, Utrecht; U. Nijmegen); Evans (U. Bielefeld; Instituut voor Algemene Taalwetenschap, Amsterdam; U. Cologne); Frazier (U. Freiburg; U. Konstanz; U. Nijmegen; U. Edinburgh); \*Gärtner (U. Potsdam; U. Lund; U. Jena; Free U. Berlin); Grabe (U. Saarbrücken); Hagoort (U. California, Davis; U. California, San Diego); Heesch (U. Cologne); Hendriks (U. Oslo); Indefrey (Heinrich-Heine-U., Düsseldorf; U. Cologne); \*Jäger (U. Leipzig); Keating (U. Nijmegen); Keurs ter (U. Nijmegen); Kita (U. Tokyo; U. Nagoya); Levelt (U. Bielefeld; MIT; U. Pennsylvania); Levinson (Heinrich-Heine-U., Düsseldorf; U. Tübingen); Meyer (U. Bielefeld); Nüse (U. Münster); Pederson (J. Nehru U., New Dehli; U. Saarbrücken); Roelofs (U. Exeter; U. Potsdam); Schmitt (U. Münster); Seuren (U. Edinburgh; U. Groningen); Slobin (U. California, Berkeley; U. California, Santa Cruz); Stolz (U. Osnabrück; U. Bielefeld); \*Strigin (U. Tübingen); Turenhout van (U. California, Davis); \*Wilder (Institut für Germanistik, Jena; U. Potsdam); Wilkins (U. Sydney; Institute for Aboriginal Development, Alice Springs; U. Heidelberg); Wittenburg (U. Cantabria, Santander; U. Nijmegen).

## Workshops and Summer Schools Organized

Together with L. Boves (U. Nijmegen), P. Wittenburg organized a workshop entitled "Methods and Models of Spoken Word Recognition", January 26-27, 1995. The workshop was held at the MPI and brought together specialists from the fields of Automatic Speech Recognition and Psycholinguistics. Presentations about the views from psycholinguists how humans solve this task and the methods used by speech engineers were given by J. McQueen (MPI), D. van Kuyk (MPI), L. Pols (U. Amsterdam), L. Boves (U. Nijmegen), U. Frauenfelder (U. Geneva), R. Moore (Speech Research DRA Malvern, UK), D. Norris (MRC APU, Cambridge), A. Cutler (MPI), and M. Ostendorf (Boston U.).

In the Research Group on Structural Grammar, M. Bierwisch, H. Gärtner and C. Wilder organized two workshops: "The Role of Economy Principles in Linguistic Theory", February 9-11, exploring alternative ways to pursue the notion of economy, which plays a central role in the "Minimalist Program of Linguistic Theory"; and "How to Constrain the Arguments of the Verb", July 28, which was concerned with the question of how the number of argument positions of lexical entries might be restricted, thereby concentrating on a specific issue concerning the economy of lexical information.

M. Baumann and U. Kleinhenz (FAS, Berlin) organized a workshop on "Suprasegmentale Phonologie: Modelle und Prozesse" ('Suprasegmental phonology: Models and processes') at the 17th Annual Meeting of the *Deutsche Gesellschaft für Sprachwissenschaft* (German Linguistic Society), held at the University of Göttingen, on March, 1-3, 1995.

H. Baayen and R. Schreuder (U. Nijmegen) organized a three-day workshop on morphology at the MPI (June 12-14), with papers presented by, M. Aronoff (SUNY, Stony Brook), H. Bennis (U. Leiden), G. Booij (V.U. Amsterdam), H. Clahsen (U. Essex), M. Gassar (Indiana U.), T. Hokkanen (U. Joensuu), A. Lahiri (U. Konstanz), A. Laudanna (Istituto di Psicologia del CNR, Rome), G. Libben (U. Alberta), R. Lieber (U. New Hampshire), W.

Marslen-Wilson (Birkbeck College, U. London), J. Niemi (U. Joensuu), A. Roelofs (MPI) and D. Wunderlich (U. Düsseldorf).

D. Slobin (U. California, Berkeley) organized and directed a three-week international workshop on crosslinguistic narrative development, supported by the National Science Foundation, at the Linguistic Institute of the Linguistic Society of America, University of New Mexico, Albuquerque, New Mexico, July 10-28, 1995.

During his visit to the Institute in July, D.R. Ladd (U. Edinburgh), in cooperation with C. Gussenhoven (U. Nijmegen), organized a one-day workshop on prosody at the MPI, attended by approximately 25 people including numerous members of the comprehension group. Papers were presented by C. Gussenhoven, D.R. Ladd, T. Rietveld (U. Nijmegen), and E. Grabe (MPI).

\*C. Wilder, in cooperation with D. Büring (U. Cologne), M. Den Dikken (U. Amsterdam), A. Candinaletti (U. Venice), D. Cavar (U. Potsdam), T. Hall (U. Berlin), P. Ludlow (U. New York), L. Repetti (U. New York), M. Schoorlemmer (U. Utrecht), L. Veselovska (U. Olomouc), and J.-W. Zwart (U. Groningen), organized and ran the "2nd Central European Summer School in Generative Grammar", held in Olomouc, Czech Republic, from 31st July to 18th August 1995. Eighty students attended the school, two-thirds from former Eastern Block states.

M. Bowerman and S. Levinson, working together with D. Slobin (U. California, Berkeley) organized a conference on Language Acquisition and Conceptual Development. The conference was held at the Max Planck Institute on November 13-17. Presentations were given by H. Behrens (U. California, Berkeley), P. Bloom (U. Arizona), M. Bowerman (MPI), M. Braine (New York U.), P. Brown (MPI), S. Carey (MIT), S. Choi (San Diego State U.), E. Clark (Stanford U.), L. de León (Reed College), W. Deutsch (U. Braunschweig), K. Drozd (MPI), S. Gaskins (U. Pennsylvania), D. Gentner (Northwestern), A. Gopnik (U. California, Berkeley), J. Langer (U. California, Berkeley), S. Levinson (MPI), D. Slobin (U. California, Berkeley), L. Smith (U. Indiana),



L. Spelke (Cornell U.), M. Tomasello (Emory U.). The papers will be published by Cambridge University press as an edited volume entitled "Language acquisition and conceptual development".

C. Brown and P. Hagoort, together with M. Rugg (U. St. Andrews), organized a 2-day workshop in November in San Diego on "ERPs in neuropsychology: Problems and potentials", hosted by M. Kutas (U. California, San Diego). A total of 35 scientists were invited to attend, all with relevant experience in ERP research with patient populations. Presentations were given by C. Brown (MPI), E. Courchesne (U. California, San Diego), P. Hagoort (MPI), E. Halgren (U. California, Los Angeles), B. Knight (U. California, Davis), T. Münte (U. Hannover), K. Nobre (U. Oxford), and M. Rugg (U. St. Andrews), with G. Berlucchi (U. Verona) acting as discussant.

A one-day workshop on gestures in relation to concurrent speech was organized by S. Kita on December 7, 1995. The participants were: S. Levinson (MPI), S. Kita (MPI), E. Keating (MPI), J.-P. de Ruitter (MPI), D. Wilkins (MPI), S. Duncan (MPI/U. Chicago), A. Kendon (U. Pennsylvania), and C. Müller (F.U. Berlin).

## **Presentations at Conferences, Congresses, and Workshops**

Allen, S. "Acquisition of causatives in Inuktitut". 27th Stanford Child Language Research Forum. Stanford, April.

Allen, S. "Crosslinguistic perspectives on the acquisition of noun incorporation". Canadian Linguistics Association. Montreal, June.

Allen, S. "Learning noun incorporation in Inuktitut". Society for the Study of the Indigenous Languages of the Americas. Albuquerque, New Mexico, July.

Allen, S. "Null subjects and null objects in early Inuktitut". Workshop on Functional Constraints on Ellipsis in First Language Acquisition. Albuquerque, New Mexico, July.

Baayen, R. H. "The randomness assumption in word frequency statistics." Joint Conference of the Association for Computers

- and the Humanities and the Association for Literary and Linguistic Computing. Santa Barbara, July.
- Baayen, R. H. "Een semantisch principe voor de keuze tussen 'hebben' en 'zijn' (A semantic principle for the choice between 'have' and 'be')". Annual Dutch-Flemish morphology meeting. Leuven, September.
- Baayen, R. H. "Chronicling 'The Times': Lexical innovations in an English newspaper". Workshop on terminology, information retrieval, and linguistics. Consiglio Nazionale delle Ricerche, Rome, October.
- Baumann, M. "Investigating the production of syllabic structure in connected speech". Second Holland Institute of Linguistics Phonology Conference. Amsterdam, January.
- Baumann, M. "Die Rolle der Silbe bei der Produktion klitisierter Formen". 17. Jahrestagung der deutschen Gesellschaft für Sprachwissenschaft. Göttingen, March.
- Baumann, M. "The production of syllables in connected speech". Conference on Interfaces in Phonology. Berlin, March.
- Baumann, M. "Die Rolle der Silbe in der Satzproduktion: Experimente zur Auslautverhärtung". 37. Tagung experimentell arbeitender Psychologen und Psychologinnen. Bochum, April.
- Baumann, M. "The production of syllables in cliticized forms". 31st. Annual Regional Meeting of the Chicago Linguistic Society, Parasession on Clitics. Chicago, April.
- Behnke, K. and Wittenburg, P. "Language acquisition and the necessity of a new neural network approach". 3rd Symposium on Neural Networks, Nijmegen, September.
- Benedet, M.J., Christiansen, J.A., and Goodglass, H. "Production and comprehension of possessive constructions by Spanish-speaking Broca's aphasics". Academy of Aphasia Annual Meeting, San Diego, November.
- Bertram, R. and Vonk, W. "Temporele connectieven en prominentie". 18e Minisymposium over Lezen. Nijmegen, April.
- \*Bierwisch, M. "Siebzehn Jahre jung - Eine Fallstudie in semantischer Beschränktheit". 17. Jahrestagung der deutschen Gesellschaft für Sprachwissenschaft. Göttingen, March.

- \*Bierwisch, M. "Fritz Hintze und der Strukturalismus". Internationales Colloquium in memoriam Prof. Dr. Fritz Hintze. Berlin, April.
- \*Bierwisch, M. "Die Zweiteilung des Lexikons. Comments on E. Zimmermann". Workshop on Context Dependence in the Analysis of Linguistic Meaning. Bad Teinach, Germany, May.
- \*Bierwisch, M. "Underspecification in Semantic Form". Conference on Lexical Structures. Wuppertal, August.
- \*Bierwisch, M. "Modularität von semantischem und konzeptuellem Wissen". Symposium 'Konzeptuelles und semantisches Wissen in der Sprachproduktion'. Heidelberg, November.
- \*Blutner, R. "Normality in update semantics". Semantics and Linguistic Theory - SALT 5. Austin, February.
- \*Blutner, R. "Systematische Polysemie und das Restriktionsproblem der Variantenbildung". 17. Jahrestagung der deutschen Gesellschaft für Sprachwissenschaft. Göttingen, March.
- Bowerman, M. "How children learn to talk about space: A crosslinguistic perspective. 13. Hamburger Kognitions-kolloquium: Sprachentwicklung und Sprachentwicklungsstörungen". Hamburg, February.
- Bowerman, M. "Predicate semantics and lexico-syntactic development: A crosslinguistic perspective". Seventh Annual Symposium of Network Eerste Taalverwerving. Utrecht, February.
- Bowerman, M., de León, L., and Choi, S. "Verbs, particles, and spatial semantics: Learning to talk about spatial actions in typologically different languages". 27th Child Language Research Forum. Stanford, April.
- Bowerman, M. "Leaving things out\_\_ and putting them in\_\_: Optional Ground nominals in the acquisition of English." Workshop on First Language Acquisition: Functional Constraints on Ellipsis. Albuquerque, New Mexico, July.
- Brinkmann, U. "Discovering nonalternating verbs: News from the locative alternation". 3rd Groningen Assembly on Language Acquisition Conference. Groningen, September.
- Brinkmann, U. "Zählbarkeit und Syntaxerwerb: Warum beschmieren leichter als bewerfen ist". 14. Arbeitstagung für Entwicklungspsychologie. Leipzig, September.

- Brinkmann, U. "The locative alternation: Accounting for its acquisition without reference to innate linking rules". 20th Boston University Conference on Language Development. Boston, November.
- Brown, C., Hagoort, P., Vonk, W., and Hoeks, J. "On-line sentence processing: Parsing preferences revealed by brain responses". 8th CUNY Conference on Sentence Processing. Tucson, March.
- Brown, C. "Taal en/in de hersenen". Meeting of the Governing Board of the Netherlands Organization for Scientific Research. The Hague, April.
- Brown, C. "Etwa 40,000 Gründe sich zu wundern: Neurophysiologie des Sprachverstehens." 46th Annual Meeting of the Max Planck Society. Potsdam, June.
- Brown, C., and Hagoort, P. "The tissue lost, the language gone by: What is left to electrify? I" Workshop on ERPs in Neuropsychology. San Diego, November.
- Brown, C. "On the neurobiology of language processing: Implications for the human language processor." Conference on Architectures and Mechanisms for Language Processing. Edinburgh, December.
- Brugman, H. and Kita, S. "Media Tagger: all digital gesture coding development at the MPI for Psycholinguistics". Conference on Gestures compared crosslinguistically. Albuquerque, New Mexico, July.
- Chen, H.-C. and Cutler, A. "Auditory priming in lexical decision: Modality effects". 7th International Conference on Cognitive Processing of Chinese and other Asian Languages. Hong Kong, December.
- Choi, S., and Bowerman, M. "A crosslinguistic study of spatial semantic development in English and Korean". Society for Research in Child Development Biennial Meeting. Indianapolis, March.
- Christiansen, J.A. "Getting to the point: Relevance in story production and comprehension by aphasic patients". Academy of Aphasia Annual Meeting. San Diego, November.
- Comrie, B. "To the investigators of Himalayan languages". Himalayan Languages Symposium. Leiden, June.

- Coolen, R. "De gevoeligheid van jonge kinderen voor fonotactische en metrische informatie in het spraaksignaal". 7th Symposium of the Network First Language Acquisition. Utrecht, February.
- Coolen, R. "Word segmentation strategies in the infant". 18th Meeting of the European Neuroscience Association. Amsterdam, September.
- Crago, M. "Evaluating language development at the end of the twentieth century: A cultural framework". Workshop on Definitions of Normality. University of Linköping, October.
- Crago, M. "Languages and cultures in contact: Evaluative educational evidence from Canada". Swedish Board of Education. Stockholm, November.
- Cutler, A. "Universal and language-specific in the development of speech". Symposium on Uniqueness and Universality in a Biological World. UNESCO, Paris, January.
- Cutler, A. "Problems with the processing of lexical prosody". Deutsche Gesellschaft für Sprachwissenschaft, Göttingen, March.
- Cutler, A. "Recognising words in continuous speech: Is there a significant false alarm rate?" II Simposium de Psicolinguística. Tarragona, April.
- Cutler, A. "Processing evidence, variability and linguistic explanation". International Workshop on Language Variation and Linguistic Theory. Nijmegen, September.
- Cutler, A. "Symposium: Development of language". Annual Meeting of the European Neuroscience Association. Amsterdam, September.
- Cutler, A. "The syllable's role in the segmentation of stress languages". Workshop on Cognitive Models of Speech Processing. Sperlonga, Italy, September.
- Cutler, A. and Gelder, B. de. "Bilingual data in a universal model". Workshop on Bilingualism. Groesbeek, October.
- Danziger, E. "Cross-cultural studies in language and thought: Is there a metalanguage?" 4th Biennial Meeting of the Society for Psychological Anthropology. San Juan, Puerto Rico, October.
- \*Dölling, J. "Systematische Bedeutungsvariationen: Sortenanpassung vs. abduktive Interpretation". 17. Jahrestagung der

- Deutschen Gesellschaft für Sprachwissenschaft. Göttingen, March.
- \*Dölling, J. "Metonymien und andere systematische Variationen der Bedeutung". SFB 360 'Situierete Künstliche Kommunikatoren'. Bielefeld, May.
- \*Dölling, J. "Semantische Form und Parameterfixierung durch Abduktion". SFB 360 'Situierete Künstliche Kommunikatoren'. Bielefeld, October.
- Donselaar, W. van. "Listeners' use of the 'information-accentuation' interdependence in processing implicit and explicit references". Eurospeech '95. Madrid, September.
- Drozd, K.F. "On children's motivations for symmetrical misinterpretations of quantified sentences". 20th Annual Boston University Conference on Language Development. Boston, November.
- Duncan, S. "Rhythm and human language". The 11th Annual Meeting of the Language Origins Society. Pecs, Hungary, July.
- Duncan, S. "Motion events and growth points, cross-linguistically". Conference on Gesture Compared Cross-linguistically. Albuquerque, New Mexico, July.
- Duncan, S. "Differences between Mandarin and English speakers in the cognitive processes underlying speech production: gestural indices". The 7th Annual Conference on The Cognitive Processing of Chinese and other Asian Languages. Hong Kong, December.
- Evans, N. "Insubordination and its uses". First Conference of the Association for Linguistic Typology. Vitoria Gasteiz, Spain, September.
- \*Gärtner, H.-M. "Are There V2 Relative Clauses in German". 11th Comparative Germanic Syntax Workshop. Rutgers, NJ, November.
- \*Gärtner, H.-M. "Are There Ve Relative Clauses in German". Workshop on Syntax and Semantics of Partial WH-Movement. Tübingen, December.
- Grabe, E., Warren, P. and Nolan, F. "Prosodic disambiguation of coordination structures". 8th CUNY Conference on Sentence Processing. Tucson, March.

- Hagoort, P. "Lexical and parsing strategies in language processing and their implications for brain imaging research." Workshop on Cognition and Brain Imaging: The Technical Challenges. Jülich, April.
- Hagoort, P. "Over taal gesproken." Lustrumcongres Federatie van Nederlandse Audiologische Centra. Doorwerth, June.
- Hagoort, P., and Brown, C. "Electrophysiological insights into language and speech processing." XIIIth International Congress of Phonetic Sciences. Stockholm, August.
- Hagoort, P., and Brown, C. "Investigating language comprehension with event-related potentials." 18th Annual Meeting of the European Neuroscience Association. Amsterdam, September.
- Hagoort, P., "The neurophysiology of sentence processing." Freiburg Workshop on Human Sentence Processing. Freiburg, October.
- Hagoort, P., and Brown, C. "The tissue lost, the language gone by: What is left to electrify? II" Workshop on ERPs in Neuropsychology. San Diego, November.
- Hagoort, P., Brown, C., and Swaab, T. "Semantic deficits in right hemisphere patients." 33rd Annual Meeting of the Academy of Aphasia. San Diego, December.
- Hendriks, H., and Hickmann, M. "Référence spatiale et cohésion du discours: acquisition de la langue par l'enfant et par l'adulte". Réseau Européen des Laboratoires sur l'Acquisition des Langues. Barcelona, March.
- Hendriks, H., Hickmann, M., and Liang, J. "Motion and location in children's narrative discourse: A comparison of Mandarin Chinese, English and French". Joint meeting of the Fourth International Conference on Chinese Linguistics and the Seventh North American Conference on Chinese Linguistics. Madison, Wisconsin, June.
- Hendriks, H. "Spatial reference in narrative discourse: a comparison of child first language and adult second language acquisition". EUROSILA 5 conference. Dublin, September.
- Indefrey, P., Hagoort, P., Brown, C., Law, I., Herzog, H., Steinmetz, H., and Seitz, R.J. "The reading of words and legal non-words: A [15O]-Butanol PET study." First International

- Conference on Functional Mapping of the Human Brain. Paris, June.
- Indefrey, P. "A European activation study of verbal fluency: Results from a multi-centre PET experiment." *Brain* 95, 17th International Symposium of the International Society of Cerebral Blood Flow and Metabolism. Cologne, July.
- Indefrey, P. "Analyzing a European PET activation study: Lessons from a multi-centre experiment." *Brain* 95 Satellite Symposium on Quantification of PET. Oxford, July.
- \*Jäger, G. "Topic, scrambling, and Aktionsart". 17. Jahrestagung der deutschen Gesellschaft für Sprachwissenschaft. Göttingen, March.
- Jordens, P. "The acquisition of extraction in L2 Dutch". LARS Symposium: Second Language Acquisition and Cognitive Science. Utrecht, May.
- Keating, E. "Spatial conceptions of hierarchy in Pohnpei". Conference for spatial information theory. Semmering, Austria, September.
- Keating, E. "The social valuing of space: Linking status, space and cognition". Meeting of the Anthro societies of Germany, Austria, and Switzerland. Vienna, September.
- Keating, E. "Positioned knowledge: Constructing asymmetrical epistemologies". American Anthropological Association, Annual Meeting. Washington, D.C., November.
- Keurs, M. ter, Brown, C., Hagoort, P., Praamstra, P., and Stegeman, D. "ERP characteristics of function and content words in Broca's aphasics with agrammatic comprehension." 33rd Annual Meeting of the Academy of Aphasia. San Diego, December.
- Kita, S. "The interface of language and visuo-spatial perception as probed by spontaneous gestures". *Time, Space, and Movement '95: The 5th International Workshop*. Chateau de Bonas, France, June.
- Kita, S. "Linguistic effects on spatial thinking as manifested in spontaneous gestures". *Workshop on Gestures compared crosslinguistically*. Albuquerque, New Mexico, July.
- Kita, S. "Two dimensional semantics for Japanese giongo/gitai-go (sound/manner mimetics)". *Workshop on Gestures compared crosslinguistically*. Albuquerque, New Mexico, July.



- Klein, W. "Focus particles in learner varieties". Conférence de la Société Acquisition et Interaction en Langue Etrangère. Paris, January.
- Krämer, I. "Aspect and objects in child Dutch". 3rd Groningen Assembly on Language Acquisition. Groningen, September.
- Krämer, I., Brinkmann, U. and Drozd, K. "Physical individuation as a prerequisite for children's symmetrical interpretations". 20th Boston University Conference on Language Development. Boston, November.
- Krämer, I. "Objects and Events in child language: when are objects obligatory?". 6de Association Néerlandaise de Linguistique Appliquée Juniorendag. Amsterdam, December.
- Kubozono, H. "The phonetic basis of phonological foot: Evidence from Japanese". 13th International Congress of Phonetic Sciences. Stockholm, August.
- Kuijpers, C. T. L. "Production-perception relationship in the voicing contrast for medial stops in children and adults". 13th International Congress of Phonetic Sciences. Stockholm, August.
- Kuijpers, C. T. L. "Assimilation of voice in speech development". 13th International Congress of Phonetic Sciences. Stockholm, August.
- Lasser, I. "Verb Placement in German: A comparison between adult and child language". Fall 1995 Linguistics Program Conference. New York, October.
- Leeuwen, D. van, Wittenburg, P., and Poel, M. "Appropriate context association and learning parameters for word spotting with partially recurrent neural networks". 3rd Symposium on Neural Networks, Nijmegen, September.
- Levelt, W.J.M. "A theory of lexical access in speech production". The XVth Scandinavian Conference of Linguistics. Oslo, January.
- Levelt, W.J.M. "Where do spoken words come from?". Cognitive Neuroscience Second Annual Meeting. San Francisco, March.
- Levelt, W.J.M. "Speaking: From intentions to spoken words". Heisenberg Lecture. Munich, March.
- Levelt, W.J.M. "Where do spoken words come from?" Table Ronde Fyssen "Topics in language development". Paris, April.

- Levelt, W.J.M. "Frequency effects in the production of words". II Simposium de Psicolinguistica. Tarragona, April.
- Levelt, W.J.M. "Speaking: A natural skill and its acquisition". 6th European Conference for Research on Learning and Instruction. Nijmegen, August.
- Levelt, W.J.M. "Spreekende hersenen". Publieksdag Hersenonderzoek. Amsterdam, September.
- Levelt, W.J.M. "Speaking: A biological skill and its acquisition". Festvortrag Opening Max Planck Institute for Cognitive Neuroscience. Leipzig, September.
- Levelt, W.J.M. "Spreekend een mens. Naar een psychologisch model van het spreekproces". Koninklijke Academie voor Wetenschappen, Letteren en Schone Kunsten van België. Brussels, October.
- Low, E. and Grabe, E. "Prosodic patterns in Singapore English". 13th International Congress of Phonetic Sciences. Stockholm, August.
- McQueen, J.M. and Norris, D. "Continuous speech recognition: The use of metrical, syllabic and phonotactic information in a competition model". Workshop on the Processing Consequences of Contrasting Language Phonologies. Trieste, April.
- McQueen, J.M., and Cox, E. "The use of phonotactic constraints in the segmentation of Dutch". Eurospeech '95. Madrid, September.
- Mehler, J., and Cutler, A. "Processing consequences of contrasting language phonologies". Workshop at the Scuola Internazionale Superiore di Studi Avanzati, Trieste, April.
- Meyer, A.S., Fechter, M., and Wissink, M. "Was tun die Wörter miteinander im Satz? Sie stehen sich (oft) im Wege". 37. Tagung experimentell arbeitender Psychologen. Bochum, April.
- Meyer, A.S. "Advance planning in phrase and sentence production". Workshop on Cognitive Models of Speech Processing. Sperlonga, September.
- Meyer, A.S. "Does 'nap' prime 'pen'? On the ordering of sounds in speech production". 8th Meeting of the European Society for Cognitive Psychology. Rome, September.

- Meyer, A.S. "Een modulair model van taalproductie". 17de Congres Vlaamse Vereniging voor Logopedisten. Antwerpen, October.
- Meyer, A.S. "Een modulair model van taalproductie". Jaarcongres Nederlandse Vereniging voor Logopedie en Foniatrie. Ede, November.
- Meyer, A.S. "Conceptual determinants of advance planning in phrase production". Congres Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.
- Naidoo, S., Goodglass, H., Alexander, M.P., and Christiansen, J.A. "An investigation of the syntactic abilities of patients with lesions to the dominant lenticulostriate areas". Academy of Aphasia Annual Meeting. San Diego, November.
- Nüse, R. "Polysemieauflösung bei Präpositionen". 37. Tagung experimentell arbeitender Psychologen. Bochum, April
- Noordman, L G. M. and Vonk, W. "The role of conjunctions in text understanding". 8th Meeting of the European Society for Cognitive Psychology. Rome, September.
- Noordman, L. G. M., Vonk, W. and Cozijn, R. "On the different functions of *because* in constructing a representation of the text". Workshop on Discourse Markers and the Representation of Text. Egmond aan Zee, January.
- Pederson, E. "Local space in Tamil language and thought". 8th International Conference on Tamil Studies. Thanjavore, India, January.
- Pederson, E. "Defeasibility in event realization". International Cognitive Linguistics Association Conference. Albuquerque, New Mexico, July.
- Roelofs, A. "Lexical access in speech production: A psycholinguistic perspective on the lexicon". 17. Jahrestagung der Deutsche Gesellschaft für Sprachwissenschaft. Göttingen, March.
- Roelofs, A. "Computational models of lemma retrieval and word-form encoding". European Summer School on Aspects of speech production. Birmingham, July.
- Roelofs, A. "Time course of morphophonological planning in the production of speech: Model and data". Workshop on Cognitive models of speech processing. Sperlonga, Italy, September.

- Roelofs, A. "Role of linear order, length, frequency, and repetition in planning morphophonological forms in speech production". 8th Meeting of the European Society for Cognitive Psychology. Rome, September.
- Roelofs, A. "The WEAVER model of word-form encoding in speech production". Winter School of the graduate program Cognition, Brain and Neural Nets. Bochum, December.
- De Ruiter, J.P.A. "Classifying gestures by function and content". Gesture Conference. Albuquerque, New Mexico, July.
- De Ruiter, J.P.A. "Why do people gesture at the telephone?". Opening of academic year of C.L.S. Nijmegen, October.
- Schmitt, B. "Ellipsen in der Sprachproduktion". 37. Tagung experimentell arbeitender Psychologen. Bochum, April.
- Schmitt, B. "Aktivierung beim Sprechen - Was passiert, wenn während des Nennens eines Bildes auf ein gehörtes Wort reagiert werden muß?". Neuronale-Netzwerke-Workshop. Frankfurt, October.
- Schultze-Berndt, E. "Verbs of motion in Jaminjung". Top End Linguistics Circle Meeting. Darwin, Australia, July.
- Senft, G. "On language and culture of the Trobriand islanders - an introduction". Seminar on the Anthropology of the Pacific. Nijmegen, March.
- Senft, G. "Kilivila motion verbs". 2nd International Conference on Oceanic Linguistics. Suva, Fiji, July.
- Senft, G. "Language, cognition and spatial conceptualization in various cultures". Tagung der deutschsprachigen Ethnologen und Ethnologinnen. Wien, September.
- Senft, G. "Noble Savages and the islands of love: Trobriand islanders in popular publications". Annual Conference of the Belgian Linguistic Association on Political Linguistics. Antwerp, December.
- Slobin, D. I. "New perspectives on the development of morphology". Linguistic Institute of the Linguistic Society of America. Albuquerque, New Mexico, June.
- Slobin, D. I. "Some consequences of linguistic typology for narrative style". International Conference on Functional Approaches to Grammar. Albuquerque, New Mexico, July.
- Slobin, D. I. "Special issues in the acquisition of Spanish: Contributions to theory". First International Meeting on the Acqui-

- sition of the Languages of the State. Santiago de Compostela, Spain, September.
- \*Steinbach, M. and R. Vogel "Zur Basisposition freier und selegierter Dative im Deutschen". GGS-Tagung. Jena, May.
- \*Steinbach, M. and R. Vogel "On the Base Position of Datives in German". Workshop on Optionality. Utrecht, September.
- Stolz, C., and Stolz, T. "Transpazifische Entlehnungsisoglossen. Hispanismen in Funktionswortinventaren beiderseits der Datumsgrenze". 10. Essener Kolloquium zum Sprachwandel "Areale, Kontakte, Dialekte. Sprache und ihre Dynamik in mehrsprachigen Situationen". Essen, June.
- \*Strigin, A. "Abductive inference during update: the German preposition 'mit'". Conference on Semantics and Linguistic Theory, SALT V. Austin, February.
- \*Strigin, A. "Abduktion und die lexikalische Bedeutung: die Interpretation der Präposition 'mit'". 17. Jahrestagung der deutschen Gesellschaft für Sprachwissenschaft. Göttingen, March.
- Swaab, T., Brown, C., and Hagoort, P. "Delayed integration of lexical ambiguities in Broca's aphasics: Evidence from event-related potentials". Cognitive Neuroscience Society. San Francisco, March.
- Swaab, T., Brown, C., and Hagoort, P. "Delayed integration of lexical ambiguities in Broca's aphasics: Evidence from event-related potentials". 33rd Annual Meeting of the Academy of Aphasia. San Diego, December.
- Turenhout, M. van, Hagoort, P., and Levelt, W. "Brain potentials as an index of semantic and phonological activation in speech production". Cognitive Neuroscience Society. San Francisco, March.
- Vonk, W. "On the discourse structuring function of referring expressions". Workshop on Discourse Markers and the Representation of Text. Egmond aan Zee, January.
- Vonk, W. and Hustinx, L. G. M. "Demonstratieve NP anaphora in text". 18e Minisymposium over Lezen Nijmegen, April.
- Vonk, W. "Discourse functions of NP-anaphora: demonstratives". Workshop on Local and Global Phenomena in Discourse. Darmstadt, December.

- \*Wilder, C. "Rightward movement as leftward deletion". Congress on Linguistics at the End of the XXth Century. Moscow, January.
- \*Wilder, C. "Extrapolation and leftward deletion". Research Group on Grammatical Models. Tilburg, February.
- \*Wilder, C. "V2-Effekte: Wortstellung und Ellipse". IDS-Jahrestagung 'Deutsch-Typologisch'. Mannheim, March.
- \*Wilder, C. "Antecedent-Containment and Ellipsis". Workshop on Germanic Syntax. Berlin, July.
- \*Wilder, C., and Cavar, D. "Auxiliaries and Ellipsis". 1st Conference on the Formal Description of Slavic Languages. Leipzig, November.
- Wilkins, D. "What's the point? : The significance of gestures of orientation in Arrernte". Meeting of the Central Australian Linguistic Circle. Alice Springs, July.
- Wilkins, D., and Evans, N. "The knowing ear: from perception to cognition in Australian Languages". Institut für Sprachwissenschaft, Universität zu Köln, November.
- Wittek, A. "Misdeeds and reversals: The acquisition of complex verbs in German". 3rd Groningen Assembly on Language Acquisition. Groningen, September.
- Wittek, A. "Misdeeds and reversals: The acquisition of complex verbs in German." 6de Association Néerlandaise de Linguistique Appliquée Juniorendag. Amsterdam, December.
- Wittenburg, P., Kuijk, D. van, and Behnke, K. "Automatic speech recognition systems and models of human word recognition: A comparative study". 3rd Symposium on Neural Networks. Nijmegen, September.
- Wittenburg, P. "Multimediale Lösungen in der Psycholinguistik". 12. DV-Treffen in der MPG, GWDG Göttingen, November.
- Wittenburg, P., and Broeder, D. "Die Explosion der Datenmengen in der Wissenschaft und ihre Behandlung unter der Berücksichtigung der Forderung nach isochroner Präsentation". GI-Fachtagung DV-Versorgungssysteme. Göttingen, November.
- Wittenburg, P., and Plessner, T. "WWW-Server/Browser als Informationsdrehscheibe im lokalen Netzwerk". GI-Fachtagung DV-Versorgungssysteme. Göttingen, November.

- Wittenburg, P., Brugman, H., and Broeder, D. "De impact van digitale media op de opbouw en analyse van corpora". Studiedag Stichting Tekstkorpora en Databestanden in de Humaniora. Nijmegen, December.
- \*Zimmermann, I. "'Sich vertun' auf Deutsch und auf Russisch. Ein Sprachenvergleich zur Arbeitsteilung von Morphologie und Syntax". Konferenz 'Slawische und deutsche Sprachwelt. Typologische Spezifika der slawischen Sprachen im Vergleich mit dem Deutschen'. Berlin, March.
- \*Zimmermann, I. "Possessivadjektive im Russischen: Ihre Morphologie, Syntax und Semantik". Konferenz 'Zur Struktur von nominalen w-Phrasen und zum Status von D-Elementen'. Tübingen, April.
- \*Zimmermann, I., and Schick, I. "Das possessive Klitikum des Bulgarischen". 1. Europäische Konferenz 'Formale Beschreibung slavischer Sprachen'. Leipzig, November.
- Zwitserslood P, Bolwiender A., and Drews E. "Die lexikalische Aktivierung morphologisch komplexer Verben". 37. Tagung experimentell arbeitender Psychologen. Bochum, April.





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