Max-Planck-Institut für Psycholinguistik

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Preface

The year of 1997 saw significant changes to the Institute. In September, we were able to move back into a splendid reconstructed and enlarged building (see end papers) by the architects Prins and Kentie. Scientific work during 1997 was a bit constrained by temporary quarters, and then by the need to set up new labs, and some experimental work had to be deferred. On the whole, though, the transfer was remarkably smooth, thanks to the heroic efforts of, in particular, the then managing Director Pirn Levelt, the Head of our Administration Rolf Koenig (whose achivements were specially recognized by the President of the Society), and the Head of the Technical Group Peter Wittenburg and their staff.

At the end of the year, the Cognitive Anthropology Research Group's six and a half year term ran out, and thus this booklet contains the last report from that Group. Work of a very similar nature will however continue in a new Department 'Language and Cognition', beginning in January 1998, which with its program of field research now institutionalizes the long standing interests of the Institute in how the human language capacity copes with the huge variety of natural languages.

More in the way of continuity than change, the Neurocognition project received a further 5 year grant to continue the work on the neurocognitive basis of language processing. Wolfgang Klein's Leibniz Prize has allowed the continued expansion of work in language acquisition, especially on the acquisition of scope. Also in the Acquisition Department, Melissa Bowerman's special contributions and international standing were recognized by a professorial level appointment.

As in previous years, the printed Report is organized in terms of the major Projects, which in many cases cross-cut Departments (Language Production, Comprehension, Acquisition, Cognitive Anthropology). One new project reports here for the first time, namely Communication under Impairment. And, as in the 1996 Report, to keep this Report within bounds despite increasing activities, each researcher has been given only a few hundred words to report the year's successes. However, further information is now available under the Web Pages of the Institute: http://www.mpi.nl, and the pages of individual researchers.

Stephen C. Levinson

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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 1997 addressed the acquisition of native phonology, the role of phonological structure in the processing of segmental structure, the use of phonological information in segmenting continuous speech into words and in recognizing written and spoken words, and continuation of the group's series of cross-linguistic studies of prosodic structure and its role in processing.

1.1 Development of phonological structure perception

The development work on this project in 1997 consisted of three sub-projects which are now almost or fully completed: the student project of Van Wijk (1.1.1), Van de Weijer's Ph.D. project (1.1.2); and Behnke's Ph.D. project (1.1.3) which has now resulted in a dissertation.

1.1.1 Infants' word recognition in fluent speech

The final-year student project by Van Wijk (U. Nijmegen), supervised by Kuijpers, investigated early word recognition abilities, and the segmentation of words from a continuous speech context, in 18-month-old Dutch children, using the preferential looking paradigm. In this experimental paradigm, children are presented

with two objects while hearing a target word. Only one of the objects corresponds to the target word; the dependent variable is how long the child looks at the correct object. The target word had a trochaic (e.g., *appet)* or iambic (e.g., *banaan)* stress pattern, and was embedded in a short sentence. The weak syllable contained a reduced vowel or a full vowel. The words were either pronounced correctly (baseline *Waar is de appel nouT),* mispronounced in the stressed syllable *(Waaris de ieppel nouT),* or mispronounced in the unstressed syllable *(Waar is de appiel nou?).* Results showed the recognition of words to be impaired, as compared with the correct-pronunciation baseline, when the stressed syllable was mispronounced but not when the unstressed syllable was mispronounced. Vowel quality of the unstressed syllable had no significant effect, nor did position of the stressed syllable. These results suggest that Dutch children pay more attention to stressed syllables in processing fluent speech.

1.1.2 Speech input to a prelinguistic infant

Van de Weijer completed compilation of the corpus of linguistic input to a prelinguistic infant (see Annual Report 1995, 1996). The corpus consists of the language that the infant heard during 18 days, selected from the period that the infant was between six and nine months old. The corpus exists as labeled sound files containing utterances spoken to the infant or to other addressees near the infant. Further, that part of the input consisting of language addressed directly to the infant, to other children or to adults has been fully transcribed.

Analysis of the transcriptions revealed differences in vocabulary size and mean length of utterance across the three speech types, with infant-directed speech having the smallest vocabulary and the shortest utterances. A phonological analysis suggested that word boundaries may be more clearly present in the infant-directed speech: this speech type namely displayed a restricted set of word

onsets and offsets, and a more evenly distributed stress pattern. Analysis of features of the suprasegmental structure of the input showed that the infant-directed speech was produced at a slower speech rate, with more diversity in pitch, and with relatively simple intonation contours.

In all, the linguistic input to this infant consisted only to a relatively small extent of language addressed directly to the infant. However, the infant-directed speech did display a number of characteristics which could well have a facilitative effect on the early vocabulary building which starts late in the first year of life.

1.1.3 Modeling the development of a phonetic repertoire

Behnke's dissertation project, now complete, investigated the development of the system of phonetic categorization in infants, based on a theoretical model according to which infants' capabilities in discriminating non-native phonetic contrasts decrease as phonetic categories, in the form of memory representations of the distributional properties of the language, develop. His project investigated whether the developmental process could be described by a self-organizing neural network model (see Annual Report 1996). The neural network was constructed and tested with isolated spoken CVCV sequences (in which both consonant and vowel remained constant); the consonants used were */b/,* /d/, /l/, /m/, and /p/, and the vowels were the seven long vowels of Dutch. The input was the sampled speech data transformed into an Acoustical Band Spectrum (ABS) representation and filtered by different energy filters.

The simulation results confirmed the applicability of the neural network; the system was able to acquire stable representations for the vowel categories. However, this result was only achieved if the input was previously filtered by an energy filter whose permeability increases during the simulation process. Moreover, the simulation

results indicated that for a (short) period during language development no distinction can be made between vowels which have a strong overlap within the acoustic space.

1.2 The role of phonological structure in segmental processing

Investigations of regressive voice assimilation in Dutch (Annual Report, 1996) were followed up in 1997 with a comparison of the comparative strength of perceptual effects at different types of word boundary (1.2.1). These studies, and the further studies of assimilatory phenomena in Japanese reported in 1995 and 1996, have shown clearly that violation of obligatory phonological rules adversely affects phonemic processing. This finding forms the basis for a new Ph.D. project by Weber which will investigate the effects of violation of native-language phonological rules on the perception of foreign-language input. Further comparative studies of Spanish and Dutch followed up the previous work on the effects of phonemic repertoire size on phonemic processing (1.2.2).

1.2.1 Voice assimilation in Dutch

Kuijpers and Van Donselaar contrasted voice assimilation across morpheme boundaries and word boundaries. Voice assimilation frequently occurs in obstruent clusters with a second voiced stop, thereby violating the obligatory final devoicing rule. For instance, the word *kaas* before *boer* is often realized as *kaazboer* instead of *kaasboer.* Voice assimilation in Dutch is less common across word boundaries than across morpheme boundaries. In a phoneme-monitoring task realizations of compound words like *kaazboer* and *kaasboer,* and phrases like *kaaz bakt* and *kaas bakt* were compared. Voice assimilation did not facilitate recognition of the subsequent consonant within the same compound word: listeners detected */b/* equally fast in *kaazboer* as in *kaasboer.* However,

detection of */b/* was significantly slower in *kaaz bakt,* than in *kaas bakt.* Phoneme recognition is clearly affected if the obligatory phonological rule of word-final devoicing is violated.

1.2.2 The size of the phonemic inventory

Dutch and Spanish differ in how predictable the stress pattern is as a function of the segmental content: it is correlated with syllable weight (and hence largely predictable) in Dutch but not in Spanish. Pallier (CNRS Paris) and Sebastian (U. Barcelona), with Cutler, investigated the abilities of Dutch and Spanish speakers to process segmental information separately from stress information. It was predicted that the Spanish speakers would have more difficulty focusing on segmental structure and ignoring stress pattern than the Dutch listeners, because stress information in Spanish cannot be derived from the segments as it largely can in Dutch. The task was a speeded classification of CVCV syllables, with blocks of trials in which the stress pattern could vary versus blocks in which it was fixed. The results showed interference due to stress variability in both languages, suggesting that segmental information cannot be processed independently. Nevertheless, the effect was larger for Spanish than for Dutch listeners, suggesting that the degree of interference from stress variation may be partially mitigated by the predictability of stress placement in the language.

1.3 Phonological structure and the segmentation of continuous speech

In collaboration with the Spoken Word Recognition project, and following earlier work described in the Annual Reports of 1995 and 1996, further investigations were undertaken of the language-specificity of the possible-word constraint (PWC), across three languages (1.3.1), and of speech segmentation in Finnish (1.3.2).

1.3.1 The Possible Word Constraint and language-specific word structure

The PWC inhibits activation of word candidates if accepting them would leave a residue of the speech signal which could not possibly be a word. Thus *apple* is inhibited in *fapple* compared with *vuffapple;* neither *f* nor *vuff* is actually a word of English, but *vuff* could be a word whereas *f* could not. In collaboration with Cutler and McQueen, Pallier studied the PWC in the segmentation of spoken French. Native speakers of French performed a word spotting task in which the potential target words (e.g. *lire)* could appear in one of three preceding contexts: 1) [C] context (e.g., *flire)* 2) [CVC] context (e.g., *caflire)* 3) [CVCC] context (e.g., *camllire).* Only in condition (2) was the chunk of phonemes before the target word a permissible word; in condition (3), phonotactics forced the last [C] of the context to group with the target word. The prediction of the Possible Word Constraint hypothesis was verified: subjects had significantly faster detection times in condition (2) (detection of *lire* in *caflire)* than in the two other conditions *(flire* and *camflire),* which yielded similar reaction times.

Although / could not be a word in any of the languages we have tested, there are sequences which could be a word in some languages but not in others. In the Bantu language Sesotho, for instance, word forms are minimally bisyllabic. Thus the monosyllable *ro* could be a word of English, French or Japanese, but it could not be a word of Sesotho. Cutler and McQueen collaborated with Demuth (Brown University) in a series of word-spotting experiments in which native Sesotho speakers responded to target words such as *alafa* ('to prescribe'). These words could appear in one of three preceding contexts: (1) [C] context (e.g., *halafa)* (2) [CV] context (e.g., *roalafa)* (3) [CVCV] context (e.g., *hapoalafa).* All three contextual residues are nonwords in Sesotho, but only in (3) could the residue be a possible word of Sesotho. The results showed that detection times were significantly slower in condition (1) than in (2)

or (3), which did not differ, suggesting that the PWC is not sensitive to language-specific vocabulary constraints.

This suggestion was put to further test in English by McQueen and Cutler together with Norris, Butterfield and Kearns (MRC APU, Cambridge). Open (CV) syllables can be words in English only if the vowel is tense. Native English speakers performed a word-spotting task in which the potential target words (e.g., *canal)* could appear in one of three preceding contexts: (1) [C] context (e.g., *scanal)* (2) [Cvlax] context (e.g. *vEcanal,* where *E* is the lax vowel of *bet)* (3) [Cvtense] context (e.g., *voocanal,* with the tense vowel of *boot).* All three contextual residues are nonwords in English, but only in (3) could the residue be a possible word of English. Detection times were once again significantly slower in condition (1) than in (2) or (3), which did not differ, giving further support to the conclusion that the PWC is not sensitive to language-specific vocabulary constraints.

1.3.2 Finnish vowel harmony and speech segmentation

Suomi (U. Oulu) continued collaborating with Cutler and McQueen on the use of vowel disharmony as a segmentation cue. Previous work (see Annual Report 1995) showed that Finnish listeners find it easier to spot words (e.g., *hymy,* 'smile') in disharmonious sequences *(puhymy)* than in harmonious sequences *(pyhymy).* In 1996 a further project was begun, asking whether Finnish listeners also use disharmonies in segmenting foreign-language input. In word-spotting experiments conducted with English materials in 1997, Finnish listeners spotted *charge,* for example, no faster in *daepcharge* (where the English vowels correspond to what in Finnish would be a disharmonious sequence) than in *darpcharge* (a putatively harmonious sequence). Finnish listeners appear able to switch off what would be an inappropriate harmony-based segmentation procedure when they are listening to a foreign language. Dutch listeners, who would not be expected to show a

harmony effect, also spotted words in the two conditions equally easily. Note that speakers of both languages were able to perform non-native word-spotting with a high degree of accuracy.

1.4 Phonological structure in word recognition

As in previous Annual Reports, the work described under this heading overlaps considerably with work on the Spoken Word Recognition project and with other sub-projects reported here; for instance, much of what is reported in section 1.5 below also concerns the recognition of words. Under this heading are reported studies of phonological effects in Chinese-character reading (1.4.1) and of phonological priming in Cantonese (1.4.2). The Ph.D. work of Haveman on the processing of open- and closed-class words, reported under this heading in the past few Annual Reports, was presented during 1997 as a dissertation.

1.4.1 Phonological structure in visual processing of Chinese characters in Chinese and in Japanese

Flores d'Arcais, with Saito (Nagoya U.), Hatano and Tokimoto (Keio U.) continued three separate investigations on reading of Kanji characters. The first, on radical migration in the recognition of Kanji, focussed on the influence of the differences in ease of processing of the left and of the right radical of complex characters. The right radical is more likely to undergo perceptual migration, and seems to contribute more strongly to character recognition. This difference, interpreted earlier in terms of differential ease of access of the two radicals due to some superiority of the phonological information offered by the right radical, may in fact reflect statistical differences in processing. There is a differential distribution of the number and of the frequency of radicals in the two positions: the right radical is statistically more informative and clearly more useful for character identification. Recent experimental work on recognition of Kanji

characters in a radical-migration experiment has confirmed the importance of the distributional factor in character recognition.

The second investigation involves the interference effect of 'kun' and 'on' readings, that is, the Japanese and Chinese pronunciations, for Japanese characters. Pairs of characters were selected with identical kun and on pronunciation, different on and identical kun, or different kun and identical on pronunciation. When readers are asked to judge whether two characters are pronounced identically in a given reading, an alternative pronunciation available in the irrelevant reading interferes (Annual Report 1996). Further experiments in 1997 confirmed the previous findings with improved materials in which character frequency was controlled, and characters which could provoke problems in selection between two pronunciations were eliminated.

The third investigation concerns the choice of orthography for neologistic place names (Annual Report 1996). In earlier experiments, effects were observed of analogy to existing words. Further experiments in 1997 led to the added observation that there are also effects of prosodic structure, for example, a clear preference for solutions involving at least one bimoraic element. That is, a trimoraic nonword will be written most often as a 2-1 mora grouping, next often as 1-2, and least often as 1-1-1.

1.4.2 Repetition priming in Cantonese

Chen (Chinese U. Hong Kong) and Cutler undertook two lexical decision experiments following earlier work described in the 1995 Annual Report. Recognition of spoken Cantonese words was investigated via 'repetition priming': the effect whereby lexical decisions to spoken words are faster if a word is presented for a second time. In these experiments phonological similarity to a preceding word was manipulated, with either zero or four intervening items between the two words. Identical primes and those with

phonological similarity in second syllables produced both short-term and long-term facilitatory priming effects, while those with phonological similarity in first syllables led to short-term inhibitory effects. Differences between stimuli in tonal and segmental structure had similar effects in general.

1.5 Prosody in comprehension

As described above, much of the work done on prosodic structure within this project - sections 1.5.3-5 - addresses issues in word recognition; it is reported under the heading 'prosody' because it contributes to a long-term line of research on various prosodic issues. Also part of this line of research was the recently completed dissertation project of Grabe (1.5.1), and cooperation in the establishment of a standard transcription system for the intonation of Dutch (1.5.2).

1.5.1 Comparative intonational phonology: English and German

Grabe's dissertation, now completed, concerns the comparative intonational phonology of English and German. Previous studies contrasting English and German intonation had disagreed on whether the languages were intonationally very similar or quite different. Grabe's investigation revealed that the two languages share a common inventory of phonological representations, but differ in the way these representations are realized phonetically. Evidence was provided from (a) a cross-linguistically comparable corpus of speech, and (b) production studies investigating hypotheses generated by the corpus. The data showed that in identical contexts, English and German speakers produce highly similar intonation patterns which can be represented as having the same underlying tonal structure. This finding explains why some researchers have asserted the absence of differences between the

intonation of German and English. However, the analysis also showed that the languages differ in the way underlying categories are realized in fundamental frequency (FO). English and German differ systematically in FO peak alignment, the realization of FO patterns when little sonorant material is available, and the implementation of FO downtrends. These findings explain why other researchers have claimed there to be cross-linguistic differences.

1.5.2 A standard for the transcription of Dutch intonation

Grabe, in collaboration with Gussenhoven and other intonation researchers at the University of Nijmegen, developed a standard transcription system for Dutch intonation *(DtoBI:* Dutch Tones and Break Indices). The *DtoBI* project was modeled on *ToBI,* a similar enterprise for Standard American, British and Australian English. ToBI suffers from a number of practical and theoretical shortcomings, and a substantial number of these have been remedied in DtoBI. A grant has recently been awarded allowing extensive testing of DtoBI and publication of the system on the World Wide Web.

1.5.3 Processing of pitch accent in Japanese

Via a gating experiment, Cutler and Otake (Dokkyo U.) addressed the question of how early in the process of recognizing spoken Japanese words pitch-accent information may be exploited. 24 pairs of Japanese words such as *nimotsu/nimono,* beginning with the same bimoraic CVCV sequence but with the accent pattern of this initial CVCV being HL in one word and LH in the other, were presented, in increasingly large fragments, to 36 native speakers of Tokyo Japanese. After presentation of each fragment, which was incremented in each case by one phoneme transition from the previous fragment, listeners recorded a guess regarding the word's identity and a confidence rating for that guess. The results showed that the accent patterns of the word guesses corresponded to the

accent patterns of the actually spoken words with a probability significantly above chance from the second fragment onwards - i.e., from the middle of the vowel in the first mora of the word. Furthermore, although all guessed words for the initial fragments of the words were wrong guesses, listeners recorded significantly greater confidence in guesses which had the same initial accent pattern as the actually spoken word than in guesses with a different accent pattern. This demonstrates that Japanese listeners can exploit pitch-accent information effectively at an early stage in the presentation of a word, and use it to constrain selection of lexical candidates.

In a further experiment, the role of pitch-accent information in activation of candidate words was addressed using the repetition priming paradigm. If pitch-accent information did not fully constrain lexical activation, then presentation of a word like *ame* HL ('rain') might momentarily activate both that word's lexical representation and the representation of its minimal accent pair *ame* LH ('candy'). The experiment showed however that repetition priming only occurred when the word itself had been presented earlier, not when an accent-pair had been presented: *ame* LH was primed by *ame* LH but not by *ame* HL. This suggests that pitch-accent information plays a role in lexical activation.

1.5.4 Lexical stress in Dutch

In a series of cross-modal priming experiments Van Donselaar and Cutler investigated whether lexical stress is used during pre-lexical activation. They used 20 pairs of Dutch words such as *octopus/oktober,* with two initial syllables which were segmentally identical but different in stress; both begin *okto-* (N.B. in neither case is there vowel reduction, in Dutch), but *octopus* is stressed on the first syllable, *Oktober* on the second. Exploiting the known effect that visual lexical decisions are made more rapidly if subjects have just heard the word, or part of it, Van Donselaar and Cutler compared

the lexical decision response times of 56 native speakers of Dutch to the target words (e.g., *Oktober),* presented visually immediately following spoken presentation of a neutral sentence ending with a two-syllable word fragment. This partial word had (a) a correctly-stressed beginning (e.g., *okTO-),* (b) an incorrectly-stressed beginning (e.g., *Okto-),* or (c) a control beginning (e.g., *eufo-).* Responses were significantly faster (than the control condition) only after correctly-stressed primes; that is, *Okto-* primed *Octopus* but not *okTOber, okTO-* primed *okTOber* but not *Octopus.* A replication of the experiment with one-syllable word fragments (e.g., *OK-)* showed a very similar effect; again responses were faster after correctly-stressed primes. These results with identity-priming strengthen the conclusion indicated by the associate-priming results reported in the Annual Report 1996: Dutch listeners can exploit stress information effectively at a relatively early stage in the spoken presentation of a word.

In another cross-modal priming experiment, the contribution of segmental versus suprasegmental information to word recognition was contrasted. Van Donselaar and Cutler compared the lexical decision response times of 56 native speakers of Dutch to the target words such as *abstraktie,* presented visually immediately following the spoken presentation of a two-syllable word fragment. This word fragment had (a) a correctly-stressed beginning (e.g., *abSTRAK),* (b) an incorrectly-stressed beginning (e.g. *ABstrak),* (c) an incorrect segmental beginning (e.g., *ibSTRAK)* or (d) a control beginning (e.g. *Domo).* 16 stimulus sets of bisyllabic fragments were used. Results showed that the priming effect of word onsets with incorrectly stressed beginnings did not significantly differ from onsets with correctly stressed beginnings. However, word onsets with incorrect segmental information caused a delay in reaction times compared to the correctly stressed onsets. This suggests that stress information can be used during lexical activation in Dutch, but does not contribute as much to the activation and selection of candidates as segmental information.

Further, a repetition priming experiment was carried out with minimal pairs in Dutch, analogous to the experiment reported above for Japanese. Repetition priming occurred for words like *VOORnaam* ('first name') from an earlier occurrence of the same word, but not from an earlier occurrence of a minimal stress pair (here, *voorNAAM,* 'respectable'). In fact, responses were slowed by earlier occurrence of the stress pair. This again suggests that stress information plays a role in the early stages of spoken-word recognition in Dutch, but may not constrain processing as tightly as segmental information does.

Finally, a stress classification experiment was conducted which was also based on a study previously conducted in Japanese. As described in the Annual Report 1996, Japanese listeners can assign a single syllable extracted from a word with high accuracy to its source when they are given a choice of two words which differ in the accent value assigned to the syllable in question (e.g., *me* from *ame* HL or *ame* LH). 24 Dutch listeners performed a similar classification task on all the individual syllables edited out of the minimal pairs used in the repetition priming study. The overall correct classification rate was very high, with stressed syllables (89.5% correct) being classified significantly more successfully than unstressed syllables (76.5%), but initial and final syllables being classified equally accurately.

1.5.5 Lexical stress in Spanish

Cutler, Sebastian and Soto (U. Barcelona) conducted a cross-modal identity-priming experiment in Spanish analogous to the Dutch *octopus/oktober* experiment described in 1.5.4. As in Dutch, responses were significantly faster (than the control) only after correctly-stressed primes; so *ARti-* primed *ARtico* but not *arTIculo,* whereas *arTI-* primed *arTIculo* but not *ARtico.* Responses were, once again, inhibited after incorrectly stressed primes. Lexical stress

seems to play a similar role in word recognition in Spanish and Dutch.

2. Spoken Word Recognition

This project examines how listeners recognize words in spoken language. As in last year's report, research is again divided into three major topics: the segmentation of continuous speech into words; the information-processing architecture of the word-recognition system; and the processing and representation of morphologically complex words.

2.1 Segmentation of continuous speech

In the last three Annual Reports, it has been argued that segmentation is based on competition between candidate words, as instantiated in the Shortlist model. Cutler, McQueen, and Norris and Butterfield (both MRC Applied Psychology Unit) have also argued that this competition process is modulated by a universal segmentation procedure: the Possible Word Constraint (PWC). The PWC acts on cues to likely word boundaries, and penalizes candidate words misaligned with those boundaries. A word is penalized if the stretch of speech between the edge of that word and the boundary is not a possible word. Computational work reported last year showed that Shortlist with the PWC could simulate a large body of experimental data. This year, simulations testing the model against a sample of continuous input (1034 words) have shown that the PWC improves recognition performance. Although the PWC acted to improve word recognition for all cues to likely word boundaries marked in the input, metrical cues (the marking of strong syllable onsets) provided the greatest benefits. Experimental research in 1997 on this topic has asked, cross-linguistically, what should constitute a possible word. This research has been done with

the Phonological Structure in Comprehension project and is described in Chapter 1 (1.3.1).

A related question is this: what cues should the PWC use as signals to likely word boundaries? One line of investigation has asked whether the sequential likelihoods of segments can be used to assist segmentation (2.1.1). Related work on the use of vowel disharmonies as segmentation cues in Finnish is reported in Chapter 1 (1.3.2). Lexical statistics on problems for segmentation caused by the embedding of words in other words have also been computed (2.1.2).

2.1.1 Transitional probability in segmentation

Van der Lugt continued his Ph.D. research on the segmentation of speech using transitional probabilities between segments. Following up on previous word-spotting experiments (see Annual Report 1996), a second set of experiments was run. Target words were again paired with nonsense context syllables. But instead of there being a range of transitional probabilities in the context syllables, two strictly bimodal sets of transitions were used: low versus high probability CV onsets followed target words (e.g., *boom,* 'tree', in *boom-douf* versus *boom-dif);* and low versus high probability VC rhymes preceded target words (e.g., *veer,* 'feather', in *buul-veer* versus *beel-veer).* The results suggest that people do not use these types of sequential probabilities in the segmentation of spoken language.

2.1.2 Lexical embedding

Baayen, McQueen and Cutler continued their analyses of the MARSEC corpus (see Annual Reports 1994, 1995). One specific analysis examined a problem caused by the embedding of words in other words for segmentation models which recognize words sequentially. In such models, initially-embedded words (like *are* in

argue) could be falsely recognized, which in turn would result in an incorrect new lexical access attempt at the offset of the embedded word. Such models could recover from such errors if the cohort of words starting at this point was zero (e.g., there are no words beginning with the syllable [gju]). The results, however, showed that 68.7% of the word tokens in MARSEC with initially-embedded words had non-zero cohorts beginning immediately after that embedding (e.g., after *are* in *artery,* there are words beginning [ta]). Sequential models would thus be unable to recover easily on the majority of occasions such errors occurred.

2.2 The architecture of the word-recognition system

A central goal of this project is the development and testing of Shortlist. One central assumption of the model is that it is autonomous: information flows only bottom-up from prelexical to lexical levels of processing, and not top-down. One way of testing this claim has been to examine the way in which listeners use their lexical knowledge in making decisions about speech sounds. This research has led to the development of the Merge model (2.2.1).

Another important issue concerning the flow of information from prelexical to lexical levels is the goodness of match required between the speech signal and stored knowledge about the phonological forms of words. Experiments are examining how good this match has to be for lexical access to occur (2.2.2). At the lexical level, the core assumption of Shortlist is that there is competition between candidate words. The effects of lexical competition have been tested using cross-modal priming (2.2.3) and phonological priming (2.2.4).

2.2.1 The Merge model

Results from several recent experiments have challenged all previous models of phonetic decision-making. For example, various demonstrations of lexical effects in phonetic decisions to nonwords (including the experiment using nonwords cross-spliced with words reported in section 2.2.2 of last year's Annual Report) show that the assumption that decisions about segments in nonwords are always made without lexical involvement (as in the autonomous Race model, Cutler & Norris, 1979) is no longer tenable. Given the lack of any acceptable model of phonetic decision-making, and specifically given the absence of an account which preserved the assumption that the recognition system is autonomous, McQueen, Norris and Cutler have developed a new model of phonetic decision-making.

The Merge model is autonomous, but, in contrast to Race, it correctly predicts lexical involvement in phonetic decisions to segments in both words and nonwords. This is because phonetic decisions are based on the merging of prelexical and lexical information. Merge is instantiated as a connectionist network, and simulations have shown that Merge can account for a wide range of data. This is only possible because of lexical competition in the model. Merge is an account of phonetic decision-making that uses the same spoken-word-recognition system as that described by Shortlist.

McQueen and Pitt (Ohio State U.) have collected more data showing that while transitional probabilities between speech sounds can modulate perceptual compensation for coarticulation, lexical knowledge does not (see Annual Report 1996). These results suggest that knowledge of transitional probabilities is stored prelexically and that the lexicon cannot influence prelexical processing. The Merge model is consistent with these results. As a further test of Merge, McQueen has recently been examining the time-course of lexical involvement in phonetic categorization.

2.2.2 Mismatch in lexical access

Van der Lugt has been examining how tolerant the spoken word recognition system is of mismatching information. McQueen, Norris and Cutler *(JEP.LMC,* 1994) found that it is harder to spot a word like *mess* in *demess,* which is the beginning of *domestic,* than in *nemess* which is not the beginning of an English word. This competition effect was utilized in a Dutch word-spotting experiment with the following three conditions: a word onset condition (e.g., *choLES[terol\);* a minimal mismatch condition where the initial phoneme only differed in place of articulation (e.g., *foLES),* and a maximal mismatch condition where the initial phoneme differed in place, manner and voice (e.g., *boLES).* The critical case was the minimal mismatch condition: would it pattern with the word onset condition, or with the maximal mismatch condition, or would it be an intermediate case? The results showed that subjects spotted *les* ('lesson') equally fast in *foles* and *boles,* but were significantly slower to spot it in *choles.* This experiment is being followed up by identity-priming and further word-spotting experiments.

2.2.3 Cross-modal priming

Norris, McQueen, Cutler and Butterfield have been exploring the time-course of lexical competition. Subjects heard spoken words, some of which contained embedded words (e.g., *trombone),* and were then required to make lexical decisions to items appearing on a screen 0 msec, or 500 msec, after the acoustic offsets of the spoken words. Responses to associates of the embedded words (e.g., *dog)* were faster after the words containing those embeddings than after control words, but only with the 0 msec, delay. These results suggest that lexical competition is powerful, and acts rapidly to suppress the activation of embedded words.

2.2.4 Phonological priming

McQueen and Slowiaczek (U. Albany) have continued their collaboration comparing the inhibitory and facilitatory components of phonological priming. Robust facilitation was observed with items which rhymed (e.g., faster responses to the target *mound* after listeners had just heard the prime *bound* than after *bolt).* This facilitation occurred when prime and target rhymed, but not when they shared non-rhyming final segments. Facilitation was found both with shadowing and with lexical decision, was equivalent for words and nonwords, and did not depend on the nature of other materials in the experiment. In contrast, inhibitory priming with items sharing initial information (e.g., slower responses to *mound* after *mount)* varied between tasks, depended on the lexical status of the materials, and was absent if there were also rhyming materials in the experiment. It appears that inhibitory priming is due to lexical competition, as predicted by Shortlist, while rhyme facilitation may be due to task-specific processes.

2.3 Morphological processing

In recent work, Baayen, Schreuder (U. Nijmegen), and Lieber (U. New Hampshire) have reported that a type count of the number of derived words and compounds in which a given monomorphemic noun appears as a morphological constituent, its *morphological family size,* is an independent factor affecting lexical decision latencies (Schreuder and Baayen, *JML,* 1997; Baayen, Lieber and Schreuder, *Linguistics,* 1997). The effect of family size seems to be a late effect that arises due to the spreading of semantic activation from the meaning of the monomorphemic noun to the meanings of the complex words in its morphological family in the central lexicon.

Together with Schreuder and Bertram (U. Turku), Baayen has extended his investigation of the effect of family size from

monomorphemic nouns to derived words, focusing on the effect of family size of the base word on the processing of the derived word. Words with five Dutch affixes were studied experimentally using visual lexical decision. In addition to Base Family Size, two other variables were investigated, the frequency of the base word (Base Frequency), and the frequency of the complex word itself (Surface Frequency). Each of these three factors was studied separately using a factorial design, with only complex words with one specific affix as target words in any experiment. The main pattern of results was as follows. For the inflectional suffix -te, which realizes singular past tense on verbs, no effect of Surface Frequency was obtained, but solid effects of Base Frequency and Base Family size were found. These verb inflections are clearly processed on the basis of morphological parsing. Once the base word has been accessed, semantic activation spreads from the verb to its morphological family just as for monomorphemic nouns.

The inflectional suffix *-te* has an unproductive derivational homonym, historically the same suffix as *-th* in English (e.g., as in *warmth).* For derived words in *-te,* no effect of Base Frequency or Base Family Size was observed. Only Surface Frequency emerged as a reliable factor. Clearly, these unproductive formations are processed just like monomorphemic words. Their morphological structure does not play a role in visual word recognition.

The unproductive derivational suffix - *te* has a productive synonym, *-heid.* For *-heid,* reliable effects of Base Frequency and Surface Frequency were observed, but no effect of Base Family Size. This suggests that for words in *-heid,* parsing is carried out in parallel with full-form based retrieval. The absence of an effect of Base Family Size suggests that the specific meanings of derived words block activation from spreading to the more general meaning of their base words and from there into the morphological family.

The suffix *-er* attaches to adjectives to form comparatives *(bigger),* and to verbs to create subject nouns *(walker).* Both suffixes are productive. Nevertheless, no effect of Base Frequency was observed, neither for the subject nouns nor for the (completely regular) comparatives. This suggests that affixal homonymy of productive suffixes may lead to massive storage. No clear effect of Base Family Size was found for the subject nouns. However, the effect of Base Family Size was highly significant for the comparatives, which may indicate that the meanings of inflected complex words are too similar to the meanings of their base words to block activation from spreading into the morphological family.

3. Lexical Access in Speech Production

What is stored in a speaker's mental lexicon, and how is lexical knowledge accessed when words and sentences are produced? The members of the Lexical Access Group continued their theoretical and empirical work on issues of lexical representation and retrieval. Over the years, a comprehensive model of lexical access had been developed, which has now been described in a discussion paper soon to appear in Behavioral and Brain Sciences (Levelt, Roelofs & Meyer, accepted). Roelofs has computationally implemented large parts of the theory in WEAVER++. This computational model is also described in the BBS paper and in more detail in Roelofs *{Cognition,* 1997).

As in the preceding year, much of the empirical work of the group was directed at morphological and phonological encoding in speech production. Important issues concern the roles of different sublexical units in speech planning, the temporal order of their retrieval, and the properties of the frames to which they are associated.

Finally, considerable effort has been directed at the development of a new research paradigm to study the conceptual and linguistic planning processes carried out during speech production. Inspired by the successful application of eye tracking in studies of visual and auditory language comprehension, especially by the 'Visual World' project directed by Mike Tanenhaus *(Science,* 1995), the group set out to test whether the eye movements speakers make when they describe pictures are systematically related to their conceptual and/or linguistic planning processes. This turned out to be the case, and we are now ready to use eye monitoring to study the timing of

visual/conceptual and linguistic planning processes during speech production.

3.1 Testing and extending WEAVER

3.1.1 Segments versus features

Models of language production differ in the roles they assign to phonological segments and features in planning utterances. Featural models hold that segments are involved in terms of their features only. In contrast, segmental models, such as WEAVER, hold that, in addition to features, there are segmental planning units. Roelofs tested these views in a series of implicit-priming experiments. In such experiments, participants first learn a small set of prompt-response word pairs. On each of the following test trials, they see one of the prompts and produce the corresponding response word as quickly as possible. Production latencies are measured. In the segment-homogeneous sets of Roelofs' experiments, the responses shared the initial segment (e.g., boaf, *bird, boy).* By contrast, in the feature-homogeneous sets, the initial segments shared most, but not all features (e.g., *paint, bird, boy,* where /p/ is voiceless and /b/ is voiced). In heterogeneous sets, the responses differed on more than one feature. A preparation effect (i.e., faster reactions in homogeneous than heterogeneous sets) was only obtained for the segment-homo-geneous, but not for the feature-homogeneous sets. This suggests that segments are independent planning units and argues against featural, and for segmental models like WEAVER. Computer simulations showed that WEAVER accounts for the findings.

3.1.2 WEAVER with two languages

WEAVER was originally designed to capture word-form encoding in a single language. However, the model could readily be adapted to

account for bilingual production. A core feature of the bilingual version of WEAVER developed and tested by Roelofs is that the model's suspend-resume mechanism is used for incremental production in the first and second language: When given partial information (e.g., information about the first two or three segments of a word), computations are completed as far as possible, after which they are put on hold, and the resulting partial representation is buffered. As soon as further information is provided, processing is resumed and the representation is completed. This mechanism explains why in implicit-priming experiments monolingual speakers can prepare for word-initial segments without knowing the remainder of the word, but cannot prepare for non-initial segments without also knowing the preceding segments. In implicit-priming experiments with Dutch-English bilinguals, Roelofs obtained exactly the same patterns of results for speakers using their second language: Preparation was only possible for word-initial, but not for word-final segments. This supports the assumption that the suspend-resume mechanism operates in the same way in first and second language production.

Following a general principle of economy, the monolingual version of WEAVER stores segment types rather than tokens. This principle was extended across languages, such that segments occurring in both languages (such as /s/ and /t/ in Dutch and English) have a single representation in memory. This predicts that participants in a bilingual implicit-priming experiment, in which words of both languages appear together within a test set, should be able to plan segments that are common to both languages. They should, for example, be able to prepare /st/ when the set comprises English *steam* and *stone* and Dutch *stoel* ('chair'). By contrast, if the segments are not shared between languages, such a variable-language set would be segment-heterogeneous, and preparation should therefore be impossible. The results showed that participants could plan word-initial segments common to both languages in variable-language sets, suggesting that there is a single memory

representation for segments occurring in both languages. This variable-language preparation required advance knowledge of complete segments; knowledge about features alone yielded no facilitation.

Thus, utterances in the first and second language are phonologically planned in a rightward incremental fashion, with segments rather than features being the critical planning units. The representations of segments common to the languages are shared. Computer simulations showed that the bilingual version of WEAVER accounts for the findings.

3.1.3 Implicit priming of picture naming

An important practical advantage of the implicit-priming paradigm compared to paradigms relying on picture naming is that the responses need not be names of depictable entities. A possible objection against the paradigm is that retrieving the sound of a word using paired-associates may be different from retrieval in normal speech production, where words are generated for concepts to be expressed. Roelofs showed, however, that preparation effects exactly like those found in standard implicit-priming experiments are obtained when pictures are used instead of written prompts and the responses are the names of the pictures.

3.2 The role of the syllable in speech production

3.2.1 Segment versus syllable priming

Schiller completed his dissertation on 'The Role of the Syllable in Speech Production' (Schiller, 1997). The dissertation includes a lexico-statistical study of the Dutch syllable inventory (Schiller et al., *J. Quantitative Linguistics,* 1996) and a study showing that Dutch speakers can refer to syllable structure in a metalinguistic task

(Schiller et al., *Language and Speech,* 1997; see also Annual Report 1996).

To investigate the role of syllables during early stages of phonological encoding Schiller carried out a series of masked priming experiments. The task was either word or picture naming. In four experiments the targets were bisyllabic Dutch nouns that either had clear syllable boundaries and began with a CV syllable (e.g., *ke.tel,* 'kettle') or a CVC syllable (e.g., *kak.tus,* 'cactus'), or had an ambiguous syllable boundary and began with a CV[C] syllable (e.g., *ke[tt]ing,* 'chain'). In the syllable match condition, targets were preceded by syllable primes that were identical to their first syllable (e.g., ke### - KETEL). In the syllable mismatch condition, the syllable prime was one segment shorter or longer than the target word's first syllable (e.g., ket## - KETEL). Relative to a neutral condition (e.g., %&$## - KETEL), the related primes facilitated target naming. Importantly, the size of the priming effect increased with the length of the prime, regardless of whether prime and target matched or mismatched in syllable structure.

In a fifth experiment, using a word-naming task, the targets were the infinitive or past tense forms of Dutch verbs (e.g., *hui.len,* 'to cry', or *huil.de,* 'cried'), which differ in the syllabification of the segments constituting the stem. As in the preceding experiments, the size of the phonological priming effect increased with the number of primed segments, and there was, again, no evidence for syllable priming. Thus, huil##, for instance, was a more efficient prime than hui### for both *huilen* and *huilde.* These results suggest that, at least in Dutch, syllables do not play a functional role in the relatively early stage of phonological encoding tapped in masked priming experiments. This conclusion is compatible with WEAVER, according to which the segments' syllable positions are determined in a late stage of phonological encoding.

3.2.2 Development of the syllable inventory

The absence of syllable priming effects in the masked priming experiments (and in some of our earlier research, see Annual Report 1996) does not mean that syllable units play no role at all during language production. Most likely, they do, but only at a late stage of utterance planning. C. Levelt, Schiller and W. Levelt worked out the development of primary stressed syllable types in child language. Developmental data came from twelve children acquiring Dutch, ranging in age from 1;0 - 1;11 years at the outset of the data-collecting period. Approximately 20.000 spontaneous utterances constituted the input to a syllabification algorithm developed by Schiller (Schiller et al., *J. Quantitative Linguistics,* 1996). The resulting syllable structures were submitted to a Guttman scale to determine whether there was a shared underlying developmental order of syllable types. This turned out to be the case, with two variants. The structures CV, CVC, V, and VC were acquired in this order by ail children. One group of children subsequently acquired CCV, CCVC, CVCC, and VCC, while another group acquired the same structures in a slightly different order: CVCC, CCV, VCC, and CCVC. The final acquisition for both groups was CCVCC. These orders could be analyzed in terms of a developing Optimality Theoretic grammar (Prince & Smolensky, 1991). In such a grammar, structural constraints (constraints demanding unmarked structure) are initially, ranked above faithfulness constraints (constraints demanding correspondence between input and output forms of the grammar). Unmarked output structures, such as CV syllables, will result. By subsequent rerankings of constraints in the grammar, whereby faithfulness will outrank more and more structural constraints, more marked structures are able to form the output of the grammar.

Van de Weijer (see Section 1.1.2) provided data on the relative frequencies of different syllable types in child-directed speech. It turned out that the developmental order closely matched this

frequency distribution. Our preferred explanation of this fact is that the observed developmental order and the frequencies observed in caretakers' speech are due to a common factor, namely the constraint ordering of the language.

3.3 The production of Rössel labial consonants

During the past year, Walsh Dickey, with field collaboration from Levinson, has set up a large-scale phonetic research project on Rössel, a language isolate spoken in Papua New Guinea. The focus of the work is on the production of the vast range of multiply articulated consonants found in this language. Rössel has 94 phonemes, some of them apparently unique in the world (e.g., a palatalized, post-nasalized alveolar-labial double stop [TpnnV]). The project has so far included acoustic analyses and transcription, analysis of labial articulations using aligned video and DAT tape recordings, and an oral/nasal airflow study.

The major findings of this study so far have focused on the labial articulations and the doubly articulated stops. Labiality is found in Rössel as a primary place of articulation for stops, as labialization (which can be coupled with palatalization), and as a point of articulation for double stops (both labio-velar and labio-coronal). Labio-coronal double stops are not known to occur in any other language. Using aligned video and acoustic data, Walsh Dickey measured the timing and type of lip movements which correspond to various labial consonantal types. One major result is that the labial constrictions found in plain stops (e.g. [p]) are quite distinct from labial constrictions seen in double stops (e.g.'[tp]). Both the degree of closure and the degree of lip rounding are stronger in the simple stops than in the double stops.

The second set of findings concerns the range of closure and lip rounding which is distinctive in Rössel consonants. Rather than a

'rounded - unrounded' distinction, Rössel contrasts three levels of rounding. In the stricture domain, Walsh Dickey discovered a third level of closure, beyond simple closure and approximation. It was found that pressure closure, in which the lips continue to press together even after closure is achieved, is distinctive in certain consonant classes.

3.4 Production of morphologically complex forms

3.4.1 Production ot inflected verbs

Janssen continued his work on verbal inflections. In earlier implicit-priming experiments (see Annual Report 1996) he had found weaker preparation effects when the responses within a set were either inflected verbs or nouns (as in *raadde,* 'guessed', *rafel,* 'loose end', *radar,* 'radar') than when they were all nouns *(rage,* 'craze', *ratel,* 'rattle', *raming,* 'estimate'). Several new experiments were carried out in order to further investigate this syntactic class effect and to control for possible confounds. An important new finding was that the preparation effect was only reduced when the verb form occurring along with the nouns was a *regular* past tense form, as in above example, but not when it was a *strong* past tense form, as in *kreeg* ('got' - strong past tense of *krijgen), kruin* ('crown'), *krent* ('currant'). In the latter case the preparation effect was identical to that obtained in a set including only nouns. These results can be explained by reference to the words' inflectional frames. The inflectional frame is the interface between morphological and phonological encoding. It is a set of slots, one for the word stem and one for each possible inflectional affix. Dutch nouns and strong verb forms have the same frame consisting of one slot for the stem and one for an affix specifying number, whereas the frames for regular verbs include an additional slot for an affix specifying tense. Apparently, the full preparation effect is only obtained when all words in a set have the same inflectional frame, probably because

only then can speakers prepare on the morphological and the phonological level. Otherwise, only phonological preparation is possible.

3.4.2 Accessing compounds

In the theory, lexicalized compounds, such as *blackboard,* are represented as single lemmas with multiple morphemes (<black> and <board>) at the word form level. From earlier work (Jescheniak & Levelt, *JEP.LMC,* 1994) we know that the word frequency effect in word production arises at the level of word form access. This raises the question whether there are independent frequency effects for the two morphemes in accessing compounds. Levelt addressed this issue in an experiment in which first and second morpheme frequency of compounds were independently varied, while compound frequency was constant. Hence, subjects produced four types of compounds with the following morpheme frequency patterns: HH, HL, LH, and LL. The experiment used the technique reported in Levelt and Wheeldon *(Cognition,* 1994): Subjects first learned to associate visual probes (like ####) with the target words. In the test phase of the experiment, they produced the compound targets in response to the corresponding visual probes. Naming latencies were measured. The data showed no effect of morpheme-1 frequency, but a highly significant effect of morpheme-2 frequency. Our present interpretation of this result is as follows: Each morpheme is indeed independently but incrementally accessed, and the speed of access is morpheme-frequency dependent. Independence of access means that the initiation of accessing the second morpheme ignores the completion of phonologically encoding the first morpheme. Since the speaker will initiate the response only after both morphemes have become phonologically encoded, only the morpheme-2 frequency effect will show up in the response latencies.

3.5 Lexical access in phrase and sentence production

3.5.1 Coordination of retrieval processes for several words of a phrase

How do speakers coordinate the lexical access processes for several words of an utterance with each other and with the articulation of the utterance? Lexical access to a single word is a sequential process proceeding from a word meaning to its syntactic specification (the lemma) and from there to its form (e.g., Levelt et al., *Psych. Rev.,* 1991). In earlier research, we had used the picture-word interference paradigm to determine which lemmas and wordforms speakers retrieve before initiating an utterance (Meyer, *ML,* 1996; Meyer, *LCP,* 1997). However, with experimental paradigms that, like the picture-word interference paradigm, use utterance onset latency as the main dependent variable one can only study the processes occurring *before* utterance onset, but not those carried out during the articulation of the utterance.

To overcome this limitation, Wissink, in her dissertation project, examines word and pause durations in addition to utterance onset latencies. The leading question is whether the lexical retrieval processes for the words of an utterance are completely independent of each other, or whether the access to one word can be helped or hindered by properties of other words in the utterance. In Wissink's experiments, speakers named object pairs in noun phrase conjunctions, such as de *beer en het been* ('the bear and the leg'). The names of the two objects were either semantically or phonologically related or unrelated. Semantic relatedness did not greatly help or hinder access to the individual words. Phonological relatedness reduced the utterance initiation times, showing that the form of the second noun must already be activated to some extent before utterance onset. Interestingly, the utterance durations were longer in the phonologically related than in the unrelated condition, due to lengthening of the final word. One account of this effect is

that in the related condition, the second noun reactivates the form of the first noun, which facilitates the selection of the segments shared by both words, but strongly interferes with the selection of the segments only included in the second noun.

3.5.2 A computational model of lexical access in phrases

De Ruiter, Schriefers (U. Nijmegen), and Steigerwald (FU Berlin) investigated the temporal coordination of lexical retrieval processes in the production of noun phrases. Native speakers of German described colored line drawings of common objects in noun phrases such as *der rote Tisch* ('the red table') or *roter Tisch* ("red table'). Immediately before the presentation of a complete line drawing, the participants received advance information about the color or the object class of the upcoming object. The pattern of reaction time benefits from advance information was compared to the predictions derived from Kempen and Huijbers' *(Cognition,* 1983) theory of the temporal coordination of lexical retrieval processes. There were important deviations from the 'verbal' predictions of the theory and from the predictions of an implementation of the theory as a stochastic reaction time model. A modified version of the model yielded a better fit with the experimental data, mainly due to the new assumption that articulation can be initiated as soon as all syntactic and phonological information about the first word of the utterance is available.

3.5.3 Developing a new research tool: Registration of eye movements during speech production

Members of the Lexical Access Group have recently started to monitor the eye movements speakers make when they name two or more objects shown together. The primary goal of the first experiments using this new technique was to determine whether the pattern and timing of the speakers' eye movements reflected on their conceptual and/or linguistic planning processes.

Based on results of studies of object and scene perception, speakers were expected to fixate each of the objects to be named in the order of mention. In experiments carried out by Meyer, Sleiderink and Levelt, in which speakers named pairs of objects in noun phrase conjunctions (e.g., *cup and pen),* and in experiments by Sleiderink, in which the speakers named four objects per trial, this prediction was born out. The speakers fixated each object they mentioned, and on more than 98% of the trials the order of looking at the objects was the same as the order of mention.

How long would the speakers look at the objects? One hypothesis is that this depends exclusively on the speed of the processes leading to the identification of the objects because these are the only processes that depend directly on visual information. Alternatively, the decision to move the eyes from one object to the next may be taken after lexical access to the first object name has been completed, or even after the articulation of the object name has been initiated. To discriminate between these hypotheses, Meyer et al. orthogonally varied the ease of identifying the objects and of retrieving their names. Ease of identification was manipulated by presenting the object pairs as normal line drawings, or in a partial version in which 50 percent of their contours were deleted, and ease of name retrieval was varied by presenting object pairs with high vs. low frequency names, which were matched for ease of identification.

As expected, speakers named normal line drawings faster than contour-deleted ones, and they named objects with high frequency names faster than object pairs with low frequency names. These effects were additive, as predicted by a serial stage model of lexical access. Importantly, exactly the same pattern of results was found for the viewing: Speakers looked longer at objects with partial than with complete contours, and at objects with low frequency than with high frequency names. The timing of the speakers' eye movements

evidently depended not only on how difficult the objects were to identify, but also on how difficult it was to retrieve their names.

This conclusion was supported by the results of picture-word interference experiments carried out by Meyer. Again, participants named object pairs, but now they also heard distractor words at picture onset, which could either be phonologically related or unrelated to the name of the first object to be mentioned. The speech onset latencies and the viewing times for the left object were shorter after phonologically related than after unrelated distractors.

To sum up, these results suggest that the time speakers spend looking at an object appears to correspond closely to the time needed for visual and conceptual processing and name retrieval. The new paradigm can now be used to determine when different parts of a picture are processed, how conceptual and linguistic planning are coordinated with the speech output, and how the order and time spent processing each object are related to the speaker's lexical and syntactic choices.

3.6 Disfluencies

Most models of language production treat disfluencies as mistakes. H. Clark and his colleagues have used spontaneous speech to argue quite the opposite. In their view, many disfluencies are really techniques by which speakers signal their listeners about momentary problems in speaking. In one study *{Cognition,* 1997), Fox Tree (U. California) and Clark showed that speakers sometimes pronounce *the* as 'thiy' (rhyming with *see)* when it should be 'thuh' (rhyming with the second syllable of *sofa),* as in 'when you come to look at thiy (pause) thuh literature'. Speakers use 'thiy, it was argued, to signal that they are suspending their speech immediately after *the.* In another study (unpublished, 1997), Clark and Wasow (Stanford U.) showed that speakers often repeat words at the left

edge of major constituents, as in 'I uh I wouldn't be surprised at that'. They produce the first token, it was argued, to signal early commitment to the constituent, and the second token, to restore continuity to the constituent. In another study, Clark and Fox Tree showed that English speakers use *uh* and *urn* to signal minor vs. major delays in resuming speaking. These findings suggest that speakers are truly artful in their use of these techniques.

4. Argument Structure

Members of the Argument Structure Project explore both general questions about the possible universality and innateness of argument structure and more specific questions about the structure and acquisition of argument structure patterns in particular languages. The work of the group in 1997 can be summarized under the following four topics:

a. Predicate semantics: the semantic structure of predicates in crosslinguistic perspective and in language acquisition;

b. Linking: the relationship between predicate semantics and the assignment of arguments to syntactic positions;

c. Argument realization: factors influencing how arguments are realized in adult and child speech (e.g., as lexical, pronominal, or null elements); the syntactic treatment of 'external possessors' in various languages and in acquisition;

d. The acquisition of causative constructions.

A theme that continues to pull together much of the work is the relevance of the group's findings for hypotheses about how children figure out the meaning of verbs and how they project syntactic frames for verbs whose meanings they know (see Annual Report 1996). A second and related continuing theme concerns the limits of crosslinguistic variation, which capitalizes on the wide range of languages studied by group members. New directions over the past year include the growing interest of group members in the potential of a Construction Grammar approach to the structure and

acquisition of argument structure (cf. Goldberg, 1995), and a convergence of research on 'external possessor' constructions - structures in which a semantic relationship between a possessor and a possessed item is expressed by coding the possessor as a core argument of the verb and in a constituent separate from the one that contains the possessed item.

4.1 Predicate Semantics

Bohnemeyer extended his analysis of the argument and event structure of Yucatec Mayan 'inactive' motion verbs. These verbs are difficult to accomodate within existing approaches to the semantics (e.g., Jackendoff) and acquisition of motion verbs (Landau & Gleitman, Pinker). Inactive motion verbs are used to express change of location. However, some of them, in particular the translational equivalents of *enter* and *exit,* display apparent underspecification in two respects. First, they do not assert whether it is the figure or the ground that moves; for example, a sentence roughly equivalent to 'the cart, it has *exited* from the box' *(hook* 'exit') can be said of a situation in which either a (toy) car has left a box or a box has been removed from a car. Second, the theme of these verbs can be either the figure or the ground; for example, a sentence roughly equivalent to 'the box, it has *exited* with respect to the cart' can describe the same two situations as the previous sentence.

Bohnemeyer investigated the event structure properties of the entire set of inactive motion verbs. He found that these verbs are incompatible with egressive aspectual verbs implying interruption unless they are understood as referring to multiple instances of a motion event, and, when marked with progressive aspect, they yield mostly pre-state interpretations. These behaviors show that the verbs are strictly punctual: they do not lexicalize the continuous locomotion of the figure with respect to the ground, but instead a binary (i.e., nongradual) change in the spatial configuration formed

by figure and ground. Accordingly, locomotion from source to goal cannot be expressed with these verbs in a single clause. This punctual event structure makes the underspecification phenomena observed for some of the inactive motion verbs more understandable: the same punctual change of configuration comes about regardless of whether it is the figure or the ground that moves, and it can be asserted of either the figure or the ground.

Danziger investigated the semantics and acquisition of the Mopan Maya verb *tal* 'coming'. Her study shows that Mopan adults believe that this verb encodes movement uniquely toward the speaker's own location. In observed usage, however, Mopan adults require only that the goal of motion for *tal* be potentially a speech participant, much like English *come.* As observed in a cross-sectional study, Mopan children's acquisition of *tal* proceeds by a process of refinement towards, rather than extension away from, the adult ideal. For young Mopan children (age 5-7), the goal of motion for this verb can be any kind of object, even an inanimate one. This usage is ungrammatical for adults. However, by about 8 years of age, children drop this unconventional usage and begin to restrict their use of of *tal* to Motion-toward-Speaker. The acquisition of this kind of linguistically-expressed 'point of view' constitutes a critical step in child development under social interactionist accounts such as those of Vygotsky and Mead. It is only after this point in language acquisition that children might be able to use language to see themselves 'through the eyes of the Other'.

For an additional study of predicate semantics with ties to the Argument Structure Project, see Wittek's work on how German-speaking children learn the meanings of state-change verbs, summarized in Chapter 5 of this volume.

4.2 Linking

Essegbey investigated the puzzle posed by double object constructions (DOCs) in Ewe. Both sentences below translate as 'Kofi gave money to Ami':

(1) Kofi naga Ami
Kofi give money Ami
(2) Kofi na Ami ga
Kofi give Ami money

In (1), the direct object (DO) of the verb is the theme, *ga* 'money', while in (2) it is the recipient, *Ami.* Sentence (1) seems to contradict the universalist assumption that DOCs in languages that do not possess case or applicatives (including Ewe) should have the recipient in DO position (cf. Givön, 1984). One explanation offered for why the recipient argument plays the role of DO in double object constructions is that, in these constructions, it is the recipient that is construed as the 'affected' argument (e.g., Pinker 1989).

If it is correct that DO status is accorded to the argument with higher affectedness, then we would predict that in the DOC in (1) it is the theme *ga* 'money' which is construed as 'affected', and that the construction concerns a change of location rather than a change of possession. This is confirmed by the fact that Ewe speakers prefer sentences like (1) as descriptions of transfer events in which the recipient refuses the object offered. Further confirmation comes from a set of verbs known as 'inherent complement verbs' (ICVs) (see Annual Report 1996: 42). When these verbs occur in a DOC, they allow only the theme in DO position, as in example (3).

(3) Kofi tu asi gli-a
Kofi ICV hand wall-DEF
'Kofi pushed against the wall'

Here, Kofi's hands undergo a change of location but the wall does not undergo any change of location or state. Data from Ewe, therefore, are consistent with the claim that the DO encodes the argument which is taken to be affected, in terms of either change of location or change of possession.

As part of her Ph.D. research, Schultze-Berndt explored the representation of complex predicates in Jaminjung, a Non-Pama-Nyungan language of Australia, in the framework of Construction Grammar. This approach is preferable to a lexical approach for several reasons. First, Jaminjung verbs form a closed class and are semantically generic. Sometimes they are interpretated 'lexically' and sometimes 'grammatically', depending largely on the construction they occur in. A Construction Grammar analysis can also accomodate 'mismatches' of case-frame and verbal cross-reference marking (e.g., the cross-referencing of an allative-marked undergoer or an ablative-marked actor) by treating the two as distinct but overlapping constructions. Most importantly, a Construction Grammar approach is suited to representing patterns of argument sharing within Jaminjung complex predicates. Complex predicates consist of a closed-class verb combined with one or two coverbs from an open class. Coverbs never enter into syntactic argument constructions without a generic verb, but can be shown to contribute to the overall argument structure of the complex predicates they occur in (see Annual Report 1996: 41). Since coverbs are not themselves arguments of generic verbs, the only remaining possibility is that they are predicates whose semantic participant structure is merged with that of the generic verb. Those participants of both coverbs and generic verbs which are expressed as syntactic core arguments across constructions can be considered the participants relevant to linking. The sets of core ('profiled') participants shared between coverb and generic verb can then be shown to either fully overlap, or to be in a relationship of inclusion. This is true even when a generic verb combines with more than one coverb. In terms of Construction Grammar, Jaminjung

complex predicates are integrated into an argument structure construction by linking the semantic arguments of one or more component predicates with the syntactic arguments provided by the construction.

Within her Ph.D. research on Saliba, an Oceanic language of Papua New Guinea, Keusen worked on the argument structure of 'give' verbs. In Saliba, two defective paradigms of 'giving' expressions complement each other and form a suppletive paradigm. The two paradigms are distinguished by choice of verb stem, which depends on the grammatical person of the recipient. 'Giving' events which involve a first or second person recipient are expressed by the stem *hai* 'take' plus a directional suffix 'hither' or 'thither'. 'Giving' towards a third person recipient is expressed by the stem *mosei* 'give'. The two constructions differ in argument structure in two respects:

(1) they encode different participants with their object suffix,
(2) one construction is transitive while the other is ditransitive.

The stem *hai* encodes the theme with its object suffix. The recipient of the 'giving' event is typically expressed indirectly by means of the directional marker. If the recipient is expressed overtly in the clause, it is marked by a postposition as a peripheral participant. Since the construction involves two core arguments (agent and theme), it is transitive. The stem *mosei,* in contrast, encodes the recipient with its object suffix and the theme as a secondary object (a bare noun not marked by a postposition). Both the recipient and the theme are expressed as core arguments, so the construction with *mosei* is ditransitive. The two different patterns in argument structure raise questions for both semantic and syntactic 'bootstrapping' proposals about language acquisition. Assuming that a single basic meaning 'give' underlies both constructions (an assumption that needs further examination), how can the child project two expressions with distinct argument structures? Conversely, how can the child infer a unitary meaning of 'giving' from two syntactically distinct constructions?

4.3 Argument Realization

4.3.1 Argument realization in early language development

Allen continued her investigation of the link between argument realization and discourse features in child and caregiver speech. Children at the early stages of language learning (under age 4;0) tend to omit core arguments in their speech regardless of whether the target language permits this (e.g., Inuktitut, Japanese, Korean, Mauritian Creole) or not (e.g., English, French, German). Further, they omit subjects much more often than objects. Current widely-accepted explanations for argument omission invoke both grammatical knowledge and performance factors. In previous work, Allen showed that argument omission in child Inuktitut (Eskimo-Aleut) is sensitive to discourse phenomena. In particular, it follows the pattern of Preferred Argument Structure, which predicts that clauses will contain maximally one new argument and one lexical argument, each of which will tend to appear in S(ubject) or O(bject) rather than A(gent) position (see Annual Report 1996: 45).

This year, Allen extended her work to include the effects of various other discourse features on argument realization, and especially on the omission and asymmetry patterns just described. The discourse features she analyzed include given/new mention, presence/ absence in physical context, contrastiveness, competition in context, competition in discourse, query of referent, speech act participant status, and animacy. Many of these have been shown to affect argument realization in adult narratives across typologically varied languages. Using videotaped spontaneous speech data from both English- and Inuktitut-speaking children (age 1;10-3;6) and caregivers, Allen analyzed the relationship between the pragmatic prominence of each discourse feature and the omission or realization of each argument. Each data set shows the expected omission and asymmetry patterns, and the patterns can be explained by the distribution of the discourse features analyzed. For

instance, an argument is more likely not to be omitted and to appear in O (vs. S and A) or S (vs. A) position if its referent is pragmatically prominent. Although much more argument omission occurs in Inuktitut than in English, the same general patterns of linking between argument realization, syntactic position and discourse features hold for both. These results match well with earlier similar research involving Korean child and caregiver data (Clancy, 1996, *Japanese/Korean Linguistics* 6). The findings overall indicate that the patterns of argument omission and asymmetry could well be explained by the distribution of discourse features.

P. Brown investigated how children acquiring Tzeltal Mayan discover the argument structure of verbs, given the massive ellipsis of NPs in adult speech in Tzeltal (See Annual Report 1995: 52-4). Her analysis is based on a detailed examination of the first 500 multi-morpheme combinations in spontaneous speech samples from two children (ages 1;3-2;3 and 1;5-2;5, Mean Length of Utterance (MLU) up to 1.77 morphemes). Tzeltal appears to be a 'verb-friendly' language for learners. New verb types soon outnumber new noun types at the one- to two-word stage and utterances with verbs outnumber utterances with nouns. There is no evidence of a noun explosion before verbs become dominant. This pattern is at odds with acquisition patterns in Indo-European languages, but in line with the picture emerging for Korean (Choi 1996,1997).

Three different characteristics of the Tzeltal children's early verbs were examined:

(1) the semantic generality or specificity of their first verbs,
(2) the nature of the first arguments represented in their speech, and
(3) the acquisition of explicit argument marking with ergative and absolutive cross-referencing affixes, and with independent pronouns or demonstratives, on both verbs and nouns.

The third characteristic was of interest because in Tzeltal both verbs and nouns are marked with the same sets of cross-referencing

affixes. Ergative prefixes mark A(gent) on transitive verbs and possessor on nouns, while absolutive suffixes mark the O(bject) of transitive verbs and the S(ubject) of intransitive verbs and of any other one-argument predicates, including nouns and adjectives.

With respect to (1), the Tzeltal children's data challenge Ninio's (1996) proposal that children initially rely on semantically general 'pathbreaking' verbs (like 'do', 'make', 'give', and 'get') to break into argument structure. For transitive and 'positional' verbs (see Annual Report 1992: 55, 112), the Tzeltal children's few general (or 'light') verbs do not appear to lead the way either in early word combinations as a whole or in specific constructions. Rather, it is semantically 'heavy' verbs, in particular, verbs for eating different kinds of things, that play a dominant role in early transitive combinations. The children's early intransitive verbs are indeed light (for example, 'exist', 'go', 'come'). However, these verbs are among the five most frequent verbs in the adult language and would be expected to be learned early on frequency grounds alone.

With respect to (2), the children usually did not mark arguments overtly at all during this period. Fewer than half the arguments of each type (O, A, S) were lexical, pronominal, or inflectionally cross-referenced on the verb (Cross-referencing affixes are obligatory for adults, although lexical or pronominal representation are not.). When cross-referencing affixes appear, they most often represent the A argument. This is due largely to the early emergence of the set of ergative prefixes for vowel-initial roots (members of the set for consonant-initial roots are phonologically minimal and still mostly missing). Among lexically represented arguments, O outnumbers A, as predicted by the Preferred Argument Structure (PAS) constraint that overt arguments appear predominantly in positions which encode new information (O, S, but not A) (see Annual Report 1996: 45).

With respect to (3), the Tzeltal children at first represent the arguments of nouns and verbs in the same way. They apply the unconventional strategies of marking actors (for verbs) and possessors (for nouns) with independent pronouns and of marking patients (for verbs) and focus (for nouns) with 'it-this'. By age 2;3-2;5 (MLU under 2.0), both children use some cross-referencing affixes productively with both nouns and verbs. The vowel-initial ergative prefixes and the absolutive suffixes mark not only A, S, and O arguments on verbs but also possessor arguments on nouns, although there are systematic omissions. By this age, the children are constructing novel utterances and beginning to differentiate verbs and nouns morphologically, applying aspectual markers to verbs and deictic particles to nouns. Brown proposes that the early learning of verbs in Tzeltal, and the early productivity of some cross-referencing of arguments on verbs, are promoted by two structural features of the language:

(1) the semantic specificity of Tzeltal transitive and positional verbs, and
(2) the shared system of person-marking on both nouns and verbs.

4.3.2 External possession

Bowerman and U. Brinkmann initiated a study of the structure and acquisition of External Possessor (EP) constructions in German, English, and Dutch. EP constructions raise problems for proposals that children draw on inborn knowledge of links between semantic and syntactic roles to predict syntactic frames for verbs whose meanings are already known (Pinker, 1989) or to home in on plausible meanings for new verbs (Syntactic Bootstrapping, Gleitman, 1990). These proposals assume that the syntax of sentences is projected from the lexical properties of their predicates, so they are challenged by EP constructions, in which the verb seems to take an 'extra argument' beyond the arguments normally associated with its meaning. According to an alternative account, argument structure patterns may be learned as 'constructions': form-

meaning correspondences that exist independently of particular verbs and whose 'form or meaning is not strictly predictable from the properties of their component parts or from other constructions' (cf. Goldberg, 1995 *Construction Grammar,* p. 4). The constructional approach seems particularly appealing for EP phenomena, given the difficulty of projecting a possessor argument from the verb's meaning. But Bowerman and Brinkmann suggest that languages differ in the degree to which EP sentences are idiosyncratic and need a special constructional account.

In German, EPs are very productive, with the referent of an 'extra' NP in the dative case being interpretable as the possessor of an entity specified by another NP, as in *Sie hat ihm den Arm gebrochen* 'she has him (DAT) the arm (ACC) broken' ('She broke his arm'). In English, EPs are restricted to certain fixed expressions (e.g., */ looked her in the eye,* and arguably the pattern exemplified by *He tapped/ cut/ hit me on the shoulder).* Dutch falls between these extremes. Bowerman and Brinkmann analyze these cross-linguistic differences in productivity as stemming from differences in the status of the dative not only as a morphological category (present in German, absent in English and Dutch) but also as a syntactic category (present in German and arguably in Dutch, absent in English). Under this analysis, superficially similar EP constructions have a different grammatical status in the three languages, and so pose different acquisition problems. Preliminary work suggests that German children acquire EP patterns as part of their more general mastery of the dative. Learners of English approach EP constructions piecemeal or as very small-scale 'constructions', and produce them almost exclusively with verbs with which they have heard them used. The lack of dative case marking in Dutch may initially lead Dutch learners to misanalyze the language as lacking a syntactic dative. Bowerman and Brinkmann predict that Dutch children's productivity with EP constructions will be minimal at first, but will rise sharply when they reanalyze the syntactic status of the dative. Work is in progress to test this prediction.

Zavala investigated two major sets of EP constructions in Oluta Popoluca (OP), a Mixe-Zoquean language of Mexico. EP constructions allow the semantic possessor of a NP to be coded as an argument directly dependent on the verb. One subset of EP constructions comprises two applicative constructions. A second subset involves noun incorporation. The strategy of noun incorporation is used when the possessed NP is a relational noun (i.e., body part, kinship term), and it allows for a possessed theme, locative or benefactive relational noun to be incorporated into an OP verbal complex. In this type of noun incorporation (Type II in Mithun's typology), the semantic possessor functions as core argument and the incorporated noun does not have any of the properties assigned to core arguments. Formal and semantic properties of OP N-V compounds support the claim that this type of incorporation is governed lexically rather than syntactically.

Previous studies of EP constructions in other Middle-American languages (Aissen, 1987, Marlett, 1986) have argued that applicative constructions which code the semantic possessor as a core argument are cases of syntactic Possessor Raising. This analysis is based on two assumptions:

(1) the argument introduced by the applicative does not have semantic relevance to the clause, and
(2) the possessed nominal becomes a 'chomeur' once the possessor has 'ascended' to a core argument position.

The Possessor Raising analysis does not hold for applicative constructions in OP, since the two assumptions are not met: the extra participant introduced by the applicative *does* have semantic relevance to the clause, and the possessed noun is not a chomeur. Zavala demonstrated that applicative constructions get the special External Possession semantic interpretation only when the possessor of an NP in argument position is coreferential with the extra argument introduced by the applicative.

Van Geenhoven's analysis of EPs in noun-incorporating constructions in West Greenlandic gave a formal semantic answer to the question of how exactly the external possessors are related to the verbal component in these constructions. Van Geenhoven distinguishes between two constructions which, so far, have been treated as equivalent. In one, an EP turns up as the non-head part of a nominal compound that is incorporated in a verb. In the other, an EP shows up in a so-called 'raising' construction. From a semantic perspective, the possessor is a full-fledged argument of the raising verb only if the verb bears object agreement. If it does not, because it is antipassivized, the EP is a predicative expression that is semantically incorporated by the raising verb (see Chapter 5, this volume).

4.4 Causatives

Allen continued her research on the acquisition of causatives in Inuktitut (Eskimo-Aleut), focusing on how the learning of causatives helps to reveal patterns in learning verb categories. How children learn the category 'verb' as a grammatical construct has been much investigated. Less attention has been paid to the acquisition of verb subcategories. Inuktitut has one class of verbs which permits only a morphological causative and a second class which permits either a morphological or lexical causative. Although the semantic basis for this distinction is not yet entirely clear, verbs permitting a lexical causative include verbs of change of state, grooming, putting, emission, appearance, and some verbs of motion, while those forbidding a lexical causative include verbs of change of possession and other verbs of motion. If both types of causative are permitted, the morphological causative is used for indirect or permissive causation while the lexical causative is used for direct causation.

Data from eight Inuktitut-speaking children aged 1;0 through 3;6 indicate that the verb class distinction is acquired in three stages.

During the first stage, the children use only lexical causatives and there is no evidence that they understand that these structures have a causative meaning component. During the second stage, they use the morphological causative indiscriminately across verb categories for a particular discourse purpose - to issue commands. In addition, they begin to show productivity in their use of lexical causatives: they produce some overgeneralizations and alternate between intransitive and lexical causative uses of the same verb root. By stage three, children have begun to distinguish the two verb classes in causative constructions. Across the three stages, children apparently learn to use linguistic indicators of causation first in a 'situation-based' way (i.e., for issuing commands) and later verb-by-verb, rather than employing a class-based approach to category formation.

Bowerman continued her work with W. Croft (U. Manchester) on the acquisition of causatives. Children learning English overgeneralize the zero-derivation causative alternation to many predicates that do not allow it (e.g., *go it over there* [=take, make go], *disappeared it* [=made disappear]. Bowerman and Croft are examining Bowerman's longitudinal corpora of errors and related forms produced by two children over a period of 10 years for clues to what causes the errors and why they eventually fade out. Surprisingly, several plausible existing hypotheses about why errors subside are not supported. Counter to hypotheses that appeal to verb class membership (e.g., Pinker, 1989), errors do not drop out more quickly for predicates belonging to semantic classes whose members do not alternate in adult speech (e.g., verbs of directed motion) than for those belonging to classes most of whose members do alternate (e.g., verbs of extrinsic change of physical state). Counter to pre-emption hypotheses (e.g., MacWhinney, 1987), errors do not decline more quickly for predicates that have suppletive lexical causative counterparts than for those that do not. In fact, the existence of a suppletive counterpart seems, if anything, to promote rather than suppress errors: it is as if the child knows

that there is a lexical causative associated with a predicate, but is often content to generate a default version of it rather than retrieve the needed form. Particularly subject to prolonged over-generalization are intransitive verbs with two or more suppletive counterparts (e.g., causativized *go* vs. *take, send, put...).* Using the intransitive as a causative may relieve the child of having to choose among competing transitive forms whose semantic nuances are still poorly understood.

5. The Acquisition of Scope Relations

The general aim of the project is to analyze, for a selected group of scope-bearing elements and for a selected group of languages,

(a) what the scope properties of these elements are in the adult language, and

(b) how children acquire them.

The focus is on acquisition, but purely structural aspects will be addressed too. Scope properties, and their acquisition in particular, are not well-researched. There are exceptions, especially for existential and universal quantification and negation. Most of this work, however, does not focus on scope properties as indicated by position, intonation, etc. but on the lexical meaning of the scope-bearing elements. There is also massive cross-linguistic variation of scope properties, and, for many languages, the issue has hardly ever been addressed. In the first phase, four types of scope-bearing elements are investigated - NP quantifiers, focus particles (including negation operators), temporal adverbials and their interaction with other types of temporal marking such as tense and aspect marking, and finiteness, whose semantic contribution to a sentence may be represented by an abstract operator with scope properties that marks assertion or other illocutionary roles.

5.1 NP quantifiers

Drozd continued his research on children's understanding of universal quantification. Drozd and others have shown that children consistently deny that a universally quantified sentence like (1) correctly describes a picture of 3 boys each of whom is riding his own elephant (distributive context) or a picture of 3 boys all riding a

single elephant (collective context) if one or more unridden elephants also appear in the picture (see Annual Report 1995:153-154 for a more detailed description). Drozd calls the child's denial a reflection of the Exhaustive Pairing Strategy (EPS) and the task used to elicit the EPS the EPS task.

(1) Iedere jongen rijdt op een olifant
('Every boy is riding an elephant').

Pragmatic accounts suggest that children turn to the EPS because the discourse contexts typically presented to children on the EPS task either do not satisfy the presuppositional requirements for the appropriate use of universally quantified NPs or, more generally, fail to observe the felicity requirements for truth-value judgements. From this perspective children are seen as being less experienced discourse participants than adults, and are sometimes unable to proceed with a quantificational interpretation of a sentence if it is pragmatically inappropriate or unsupported in context. Under these conditions, children may use contextual and pragmatic clues (e.g., extra elephants) to determine which domain of individuals the experimenter intends as the domain of quantification.

Drozd conducted an experiment with 78 Dutch children (39 4-year-olds, 39 5-year-olds) to investigate how varying the way the domain of quantification to be presupposed by a child is presented in discourse affects the child's interpretations of universally quantified sentences. The results suggest that clearly identifying the intended domain of quantification (e.g., the boys) for children before administering the EPS task significantly improves their performance on the task. However, this was only true for tasks using distributive contexts. Children's interpretations of universally quantified sentences may be sensitive to collective vs. distributive contexts because they impose (slightly) different presuppositional or felicity conditions on the use of universal quantification than adult speakers. Children may find a particular use of *iedere,* a distributive

universal quantifier, felicitous only when it is matched with a context in which the domain of quantification is also distributed, e.g., in a 1-1 fashion, and infelicitous when that domain is presented as an undistributed collection.

Krämer continued her research on the acquisition of the interpretation of indefinite object NPs. Dutch syntax indicates whether or not indefinite object NPs like those in (2,3) are discourse or non discourse-bound.

(2a) De jongen heeft geen vis gevangen
The boy has no (not a) fish caught.
The boy didn't catch a fish'
(no particular fish is referred to)

(2b) De jongen heeft een vis niet gevangen.
The boy has a fish not caught.
The boy didn't catch a fish.'
(a particular fish is referred to)

(3a) Wil je twee keer een potje omdraaien?
Want you two times a jar turn?
'Would you turn a jar twice?'
(no particular jar is referred to)

(3b) Wil je een potje twee keer omdraaien?'
Want you a jar two times turn
'Would you turn a jar twice?'
(a particular jar is referred to)

The unscrambled indefinite NPs in (2a,3a) are interpreted as predicates of variables which are introduced by the verbs in these examples (Van Geenhoven, 1996). Hence, they are in the scope of the negation and *twee keer* operators in the examples and interpreted as non-discourse-bound. In contrast, the scrambled

indefinite NPs in (2b,3b) each have a free variable which is interpreted as discourse-bound. Thus, the interpretations of these NPs are independent of the interpretations of the operators in the sentences.

Krämer tested the hypothesis that acquisition proceeds from non-discourse bound to discourse-bound NP interpretations. Like adults, children (4;0-8;0) interpret the indefinite NP in (2a) as non-discourse-bound. However, unlike adults, 85% of the children interpreted the indefinite NP in (2b) as non-discourse bound. No progress toward the adult-like discourse-bound interpretation of (2b) was found, even in 7-year-olds. Krämer tested children's (4;0-7;0) understanding of (3a,b) using an Act-Out Task. Only 29% of the children responded like adults. These results show that children prefer a non-discourse bound interpretation of indefinite object NPs regardless of their syntactic position, supporting Kramer's hypothesis.

5.2 Focus particles

Drozd (in collaboration with E. van Loosbroek) (D&vL) continued his research on children's understanding of the scopal properties of the Dutch focus particle *alleen* ('only'). In previous research, (see Annual Report 1996: 56-57), D&vL showed that children (4;0-7;0) asked to judge sentences like (4) and (5) on a picture verification task surprisingly adopted either a subject-focus interpretation or, less often, an object-focus interpretation for BOTH kinds of sentences. Most children continued to adopt these interpretive strategies even when the intended focus was marked by intonational prominence.

(4) Alleen [het [meisje]focus]scope heeft een mand
'Only the girl has a basket'.

((Expected) Subject-focus Interpretation: The only person with a basket is the girl)

(5) Het meisje heeft alleen [een [mand]focus]scope
The girl has only a basket'.
((Expected) Object-focus Interpretation: The only thing the girl has is a basket)

D&vL hypothesized that children adopt these strategies because the appropriate 'set of alternatives', e.g., a set of things other than the basket which could be carried by the girl in (5), was not explicitly established in the discourse context. Results of an experiment designed to test this possibility revealed that children's behavior significantly improved when the appropriate set of alternatives was clearly established for the children in context. This result suggests that young children's interpretations of focus particle constructions are initially contextually- or pragmatically-oriented and generally insensitive to the structural and intonational clues adults typically use to determine the intended scope of the focus particle.

5.3 Temporality and temporal marking

Swift began research on the acquisition of scope and temporal marking in Inuktitut, an Eskimo language spoken in Arctic Quebec. Work on the acquisition of scope centered on word-internal phenomena. Inuktitut is a polysynthetic language, so much of its syntax is accomplished through word-internal morphology. One word composed of several morphemes in Inuktitut is typically used to express what would require a sentence of several words in a non-polysynthetic language.

Scope is crucial to the Inuktitut word-building process since word meaning depends on morpheme ordering. Each morpheme has in its potential domain of application all morphemes which precede it.

Accordingly, sentential modifiers such as tense markers, the negation operator *-nngit-,* and the focus particle *-mi-* 'again/also' occur towards the end of the word. Data from four Inuktitut-speaking children aged 2;0-3;6 (Allen, 1996) show surprisingly few errors in sentential modifier placement even when multiple modifiers occur within one word.

Further research concentrated on temporal marking. In Inuktitut, tense is not represented by an obligatory verbal inflection, as it is in Indo-European languages. Rather, the temporal interpretation of a verbal predicate in Inuktitut is determined by the lexical semantics of the verb in combination with the presence or absence of temporal marking by optional derivational affixes, subordinating verbal inflection, and/or lexical adverbials. Data from eight children aged 1;8-3;6 (Allen, 1996; Crago, 1988) reveal that derivational affixes which mark location in time are the most frequent form of temporal marking at this stage. These children have a preference for marking present and, somewhat surprisingly, future in early stages. Overt past marking is minimal for most children until almost 3;0, and no child used past markers before 2;0. This use of future marking before past is in contrast to the order of acquisition of temporal marking in other languages reported in the literature.

Wittek continued her dissertation project on the acquisition of the meaning of simplex and complex German change-of-state verbs. Wittek has been investigating the hypothesis that relevant aspects of verb meaning can actually be learned via adverbial modification in the linguistic input. It has been shown that in interpreting change-of-state verbs like *wake,* children neglect to enforce the requirement that an endstate has to come about (that the relevant experiencer must become 'awake'). One adverbial which has scope over the endstate of a change-of-state verb is *again* (or German *wieder)* in its 'restitutive' reading (see Annual Report 1996:52). Wittek hypothesized that if a child knows that *again* modifies an endstate and if the child hears restitutive *again* in a sentence like *The prince*

woke Sleeping Beauty again, she should be able to use the meaning of *again* to infer that a certain endstate has been restored (the change-of-state interpretation), i.e., that Sleeping Beauty is awake again, rather than that the prince is performing an action for a second time (the activity interpretation). This inference should lead the child to the notion that the verb *wake* has to encode an endstate.

Wittek tested this hypothesis in a comprehension study (48 German children, 4;0-6;9). Novel verbs were presented to the children in an ambiguous context consistent with either a change-of-state or an activity interpretation. The results indicate that children do indeed make use of the intended adverbial modification cue. When the test sentence introducing the novel verb contained the restitutive *wieder,* children opted significantly more often for a change-of-state interpretation of the verb than when *wieder* was not a part of the sentence. The same design was used to test whether the use of durational adverbials like *ganz lange* ('for a long time') in test sentences would lead children to infer activity interpretations of novel verbs. However, the children's responses on this condition did not differ from their responses *on* the condition where the test sentences contained no such adverbs.

5.4 Finiteness

Lasser's Ph.D. thesis addresses the puzzling fact that 2- and 3-year old children acquiring German and other languages productively use finite sentences with correct verb inflections and word order, but also frequently produce non-finite root clauses or 'Root Infinitives' (RIs). On the basis of a diary study and a corpus study with over 5000 root clauses from two German adult speakers, Lasser shows that adults produce RIs as well. Adult RIs occur with lower frequency, in different contexts, and in a much wider variety of interpretations, than child RIs. Lasser shows some grammatical constraints on adult RIs and concludes that RIs are a linguistic

phenomenon of adult language and in particular of the German target language.

A comparison of adult German and child German RIs in discourse revealed that child German RIs share important syntactic and semantic properties, such as word order and temporal interpretation, with adult German RIs. The deviance of infelicitous child German RIs is mainly due to their incompatibility with pragmatic constraints (e.g., that subjects, temporal interpretation, and illocutionary force be recoverable from the discourse context). If all pragmatic constraints had been respected, a high proportion of children's RIs would be well-formed adult utterances. In explaining the high proportions of RIs in child language, Lasser discusses in depth the fact that an intricate system of context-independent and context-dependent interpretive properties determines which particular morphological verb form is appropriate in finite sentences. For the learner, knowledge of verbal inflections and verb placement constraints is insufficient to ensure correct verb use. Rather, a learner also has to acquire a large number of subtle relationships and mappings between interpretive aspects of sentences and the their verbal morpho-syntax. Since these relationships differ even across typologically close languages, a considerable amount of learning is required before finiteness on verbs can be correctly marked. Lasser suggests that RIs are favored by learners whose abilities of marking finiteness are not yet complete. RIs are suitable default constructions because non-finite forms are the least specified with respect to finiteness and also with respect to other interpretative properties of the sentence.

6. Space

The Space Project investigates the nature of spatial parameters in natural languages and their relation to non-linguistic spatial cognition. In this summary of the 1997 research activities we continue our reports on the issue of 'frames of reference' in language and cognition. In addition to further observations on motion we also report on existential verbs in YélT dnye or Rössel, the language of Rössel Island (Papua New Guinea), on spatial properties of Arrernte sand drawing (Central Australia), on mirror-image rejection and literacy, on research started on directionality in sign and oral languages, and on the future of the cross-linguistic project on dimensional expressions.

6.1 Frames of reference

The Space Project has been conducting research on the interrelationship between language, cognition and the conceptualization of space. This research revealed that various languages utilize three Frames of Spatial Reference (FSR):

1. the absolute FSR,
2. the relative FSR, and
3. the intrinsic FSR.

Languages also seem to prefer using one particular FSR for particular spatial contexts. It was hypothesized that when speakers of a language preferentially use one FSR in a particular spatial domain, they rely on a comparable coding system for memorizing spatial configurations and making inferences with respect to these spatial configurations in non-verbal problem solving. Non-verbal

cognitive tasks were developed to test this hypothesis across various speech communities.

With the exception of Kilivila, initial research results verified the hypothesis. Correlations were found between verbal and non-verbal coding of spatial configurations (Annual Report 1993: 89-91, Table 4.5). However, these findings were, at the time, based on preliminary analyses of only some of the elicited verbal data. Is Kilivila an exception?

To find out what really happens in Kilivila, Senft has been carefully checking his corpus of rich empirical data on verbal spatial reference. He found that Kilivila speakers prefer the intrinsic FSR for describing the location of objects with respect to each other in a given spatial configuration - especially if these objects themselves have inherent intrinsic features. However, they prefer an absolute, ad-hoc, landmark FSR system for describing the spatial orientation of objects in a given spatial configuration. Kilivila also offers its speakers the option to use the relative-deictic system for referring to the location and orientation of objects in space, but this FSR is rather rarely used. Thus, Kilivila is a language which uses all three FSRs, but not freely. Its speakers show clear preferences for using certain frames of spatial reference in certain contexts for expressing certain functions.

This finding suggests that functional aspects of FSR usage have to be considered in the formulation of the basic hypothesis, which is reformulated as follows:

The relative, instrinsic, and absolute FSR can all be found and utilized for verbal spatial reference in a given language like Kilivila. More generally, languages prefer specific frames of reference in particular contexts that ask for specific spatial tasks and seek specific means and ends of spatial reference. Such tasks include the expression of location of objects (1) with respect to each other,

(2) with respect to their orientation in space, and (3) with respect to the relation these objects have to speaker and hearer within a particular space or spatial configuration. Specific means and tasks within the realm of spatial reference may evoke different preferred uses of frames of reference across languages.

Senft also reconsidered his 1993 predictions and results concerning the correlation between verbal and non-verbal coding of spatial configurations. Senft's close analysis of his data revealed a strong correlation between the results of the non-verbal experiments and the earlier results of the verbal codification of spatial configurations in Kilivila. A comparison of the results of the non-verbal experiments, which asked for memorizing the orientation of certain objects, and of the verbal codification tasks showed that the vast majority of the Kilivila consultants opted for absolute, ad-hoc, landmark FSR solutions in specific spatial configurations on both kinds of tasks. Thus, the Kilivila data confirm the hypothesis that verbal coding of spatial relations in a language indeed seems to influence the choice and the kind of conceptual parameters its speakers use to solve non-verbal spatial configuration problems.

Cablitz started her dissertation project on first language acquisition of spatial expressions in Marquesan, an Austronesian language spoken on the Marquesas Islands in French Polynesia. This year's research mainly focussed on spatial reference in adult language. Data were gathered using elicitation techniques developed within the Space Project. Speakers of Marquesan employ all three FSRs (absolute, relative, intrinsic) for describing small-scale spatial arrays (absolute spatial reference was also observed in pilot studies with non-verbal tasks carried out with Marquesan adults and 5-9 year old children (Annual report 1993). However, the absolute FSR is preferred. Marquesan has at least two kinds of absolute FSRs. One is a local landmark system with a SEA/INLAND-axis and an orthogonal undifferentiated ACROSS-axis. Another relative absolute FSR based on canonical orientation is one in which SEAWARDS is

equivalent to FRONT, and INLAND(WARDS) is equivalent to BACK. Reference to the ACROSS axis within a specific valley is expressed using LEFT HAND/RIGHT HAND expressions. In other contexts, LEFT HAND/RIGHT HAND expressions are used only in intrinsic FSRs. In the relative FSR, FRONT and BACK terms may refer either to the near or to the far side of an unfeatured Ground object. Choice of lexical item is determined by the Figure object and its inherent properties. If the Figure has an inherent FRONT/BACK-axis and faces away from the speaker/hearer, the lexical choice of FRONT for the far side and BACK for the near side in relation to the Ground is preferred. Initial research on the acquisition of spatial reference with children revealed that Marquesan children seem to master the absolute spatial reference system between the ages of 4 and 5. Controlled tasks are being created to conduct further research in this area.

6.2 Motion and existential verbs

Slobin continued his research on motion events (Annual Report 1995: 80-84). Schematically, there seem to be two basic types of lexicalization patterns in languages. Satellite-framed languages like English have a collection of verbs that indicate the fact of movement, and often manner of movement as well, but with no indication of direction, e.g., *go, walk, run, fly, crawl, limp, dash.* These verbs are associated with 'satellites' that indicate direction of movement, e.g., *in, out, across, through.* Such languages include all of Indo-European with the exception of Romance, Finno-Ugric, Chinese, Warlpiri, Ojibwa, and many others. Verb-framed languages like Spanish have a collection of verbs that indicate direction-of-movement only, like the Latinate verbs in English, e.g., *entrar* ('enter'), *salir* ('exit'), *subir* ('ascend'), *bajar* ('descend'). Information about manner is optional in such languages, and is provided in additional expressions, - e.g., *entrar corriendo* (enter running) [=run in]. Such languages include Romance, Semitic, Japanese, Korean,

Turkic, Tamil, Polynesian, most Bantu, most Mayan, and many others. There are two salient consequences of the typology. First, with regard to manner of motion, satellite-framed languages provide an open verb slot for manner, thus facilitating the use and elaboration of this domain. Second, with regard to path of motion, verb-framed languages tend to use a separate verb for each segment of an extended path, with consequences for the structure of narrative (cf. satellite-framed: 'she ran out of the house, across the field, and into the woods' versus verb-framed: 'she exited the house running, crossed the field, and entered the woods').

In earlier research, Slobin and Berman used a picture storybook to elicit standard narratives from subjects of ages 3-9 and adults (the 'frog story'). Systematic crosslinguistic patterns are now being checked in two other types of materials: novels and parent-child discourse. Slobin and his co-workers in several countries have been examining novels written in the satellite- and verb-framed languages and translations of novels between the two types of languages in an effort to determine whether the patterns are limited to the artificial task of telling a story in response to a series of pictures. A writer of creative fiction is free to make full and imaginative use of the language. Yet, the patterns found in the frog stories hold up in novels as well. Applying an elaborate coding system across languages, Slobin and co-workers found that writers using satellite-framed languages like English, German, and Russian devote much more attention to manner of movement than do writers using verb-framed languages like Spanish, Turkish, and Hebrew. They also found that novels written in the first type of language tend to provide readers with more elaborate descriptions of path of movement. By contrast, novels written in the second type seem to provide more information about physical settings and inner states that allow the reader to draw inferences about manner and path. In translating from a verb-framed to a satellite-framed language, manner-of-motion is often omitted and path-of-motion is often reduced. Translations from satellite-framed to verb-framed languages often

add information about manner-of-motion that was only implicit in the original. Slobin suggests that the link between typology and discourse must lie in different patterns of attention to dimensions of experience - at least for purposes of linguistic expression ('thinking for speaking/writing').

In the area of parent-child discourse, Slobin, in collaboration with Bowerman and Behrens at MPI and students at Berkeley, has been examining transcripts of discourse between caregivers and preschool-aged children in the computerized CHILDES data base. This research compares English, Dutch, and German, on the one hand, with Spanish, French, and Italian on the other - as well as fine-grained intra-typological comparisons. One finding is that the typological differences reflected in narrative discourse also affect everyday talk. For example, the English-speaking 2- and 3-year-olds have a large vocabulary of manner verbs, such as *run, hop, jump, skip, slide,* and *crawl,* whereas the Romance-speaking children have almost no verbs of this type. Children acquiring Germanic languages use elaborated path descriptions (e.g., *take the doll out over the top of the crib),* in comparison with the use of single path verbs in the Romance languages (equivalents of, e.g., *remove the doll).*

Slobin has also begun to explore cognitive effects of linguistic typology beyond 'thinking for speaking.' In research with A. Bocaz (Chile) and E. Sebastian (Spain) *on* Spanish, and with S. Özcaliskan (Berkeley) on Turkish, subjects are presented with narrative texts and asked for later recall and report of mental imagery. Preliminary results indicate that Spanish and Turkish speakers may pay much less attention to manner of motion than do English speakers, as suggested by the typology.

Levinson continued field research on Yell dnye or Rössel, the language of Rössel Island, Milne Bay, Papua New Guinea, with special reference to its spatial descriptions. Rössel is a language

isolate which has a number of features of special interest (see report by Walsh Dickey). The motion verbs have unusual semantic content, e.g., conflating 'go up' with 'enter", not distinguishing lexically between 'come' and 'go', etc. There is a very rich set of postpositions describing spatial relations, with much finer distinctions than e.g. English *on* or *in.* But here we report on another feature of special interest, existential verbs, which have a kind of classificatory function.

Rössel has three existential verbs, which have suppletive roots according to the following paradigm (after Henderson; 'proximal tense' here denotes those three of the six tenses closest to coding time):

		'sit'	'stand'	'hang'
Indicative & Proximal Tense	SG/DUAL	*too*	*kwo*	*t:a*
	PLURAL	*pyede*	*wee*	*t:a*
Non-Indicative or Non-Proximal	PLURAL	*ya*	*kwo*	*t:a*

These verbs have non-existential uses as shown by the English glosses given above. Locative expressions normally require one of these verbs, for example one says in effect 'the cup stands on the table', 'the mango sits in the bowl', 'the shoe hangs on the foot', etc. The question we now address is how does one choose the relevant existential verb, 'sit', 'stand' or 'hang'? The answer is complex. All familiar nouns have a default assignment by convention. This becomes clear in two ways. First, abstract or non-concrete nouns

require a specific existential, e.g., one says 'A smell is standing here', 'Mist is sitting on the mountain', 'Sickness is hanging in that village'. Secondly, in negative existentials, there is usually only one correct usage, e.g., 'There is no smoke hanging there', There is no money sitting in my house', 'He has no eyes standing' (i.e., he is blind). Despite this default assignment by apparently arbitrary convention, in many sentences one can nevertheless use another existential, in which case the literal meaning of the main verb use becomes prominent. For example, by default people 'sit' (e.g., one says 'There are three people sitting in the house' regardless of their actual stance). But if one wishes to emphasize that they are standing one uses the 'stand' verb. Less obviously, there are other contrasts made possible by selection of a verb other than the default. For example, yams 'sit' by default, so one says 'There are no yams sitting' (e.g., in my house), but if one wants to say that the yam harvest failed, one would say There are no yams hanging'. Similarly a sentence glossed as There is no school standing there' would mean the indicated village has no school, but There is no school sitting there' would mean the school is on holiday.

The account so far is, however, oversimplified in one crucial respect - the notion of a default assignment by arbitrary linguistic convention. When subjects are presented with novel physical objects, they can agree on the correct default assignment, based on its canonical disposition. This shows that there is underlying conceptual content anchoring the system in the case of physical objects. Thus the implicit classification that the system imposes on nouns may be somewhat like gender systems: motivated in part, arbitrary elsewhere.

6.3 The spatial properties of Arrernte sand drawing

As in other communities inhabiting the desert regions of Central Australia, traditional Arrernte narratives to young children were

typically accompanied by drawings in the sand. Wilkins has investigated the spatial properties of sand drawing (i.e., how sand drawing is used as an iconic system for representing events as they unfold in space). His description is a synthesis of his own fieldwork observations together with those of other researchers working in Central Australia (especially Munn). There are more than a dozen spatial properties that one needs to be familiar with in order to interpret an Arrernte 'narrative in sand', six of these properties are listed below:

a) Only visible features of a scene are drawn; there are no marks of the invisible.
b) Things that move necessarily leave a trail of tracks. In the course of narration, when motion along the ground is predicated of an entity, its path will be marked in the sand.
c) The longer a mobile entity is statically located in one place, the deeper its 'track' (i.e., it is not simply a 2-D medium, it has 3-D properties).
d) Objects and events as if they had been seen from above (i.e., sand drawings present an aerial view of events).
e) Entities or events in a story representation should be oriented as they would have been in the real world. That is, things are represented in their absolute (geo-centric) spatial orientation.
f) Narrative episodes that unfold in a single place-time location are drawn continuously into a single drawing space. Total erasure of the space signals a change of place-time location and a new focal episode.

6.4 Mirror-image rejection and literacy

Members of the Cognitive Anthropology Research Group have replicated the finding that literates generally reject mirror-images whereas many non-literates accept them across a sample of 10 language communities of mixed literacy (data contributed by P.

Brown, Danziger, Hill, Inoue, Keating, Levinson, Levy, Pederson, Stolz, and Senft). This research has shown that literacy has a decisive influence on the part-whole judgement task (see Annual Report 1996: 62) that was employed. Particularly striking in the data, however, are high levels of mirror-image acceptance reported from the Tamil (Dravidian) community. In the Tamil sample, there is no correlation between literacy and mirror image acceptance or rejection. Some literates as well as some non-literates accept mirror-images. Pederson and Danziger hypothesize that the difference between the Tamil and the other samples may derive from the actual nature of the scripts involved. Both Tamil and Roman scripts are written from left to right, and both consist of graphemes for which the mirror-images would be incorrect representations. However, only the Roman script has graphemes for which the mirror image is actually another distinct grapheme (i.e., 'b' vs. 'd' and 'p' vs. 'q'). The systematic discrimination between graphemes which differ essentially only in terms of mirror-image inversion may be one of the critical experiences of literacy which motivates mirror-image rejection in non-reading tasks. Pederson has undertaken further data collection to explore this possibility.

6.5 Directionality in sign and oral languages

Brito started research on directionality in sign and oral languages. This research deals with orientation, speed, source, and goal of motion events, spatial axes, figure and ground problems, metaphoric use of space, and - following Talmy - fictive and factive motion events. Brito is also investigating the structure of sign languages that are 'pragmatically bound', i.e., constrained by interactional-contextual factors. Like many other oral languages, the Amazonian language Marubo encodes in its pronominal forms spatial pragmatic features like +/-visibility of the referent. In sign languages (like the Brazilian LIBRAS and LSUK sign languages Brito studies) this feature is fundamental because sign space is

used to talk about space. Direction or orientation of the sign movement takes specific shapes depending on the location or size of the referents. Thus, to refer to a difference in size between two referents the source and the goal of the sign movement occur in different planes. Only a pragmatic approach can account for such kinds of problems, which are present in most sign languages.

6.6 Dimensionais

Stolz has been working on a proposal for a volume on the typology of dimensional expressions as output of the dimension sub-project (see Annual Report 1996: 68-71). The volume is to contain specific descriptions of reference to spatial dimensions in individual languages, plus one cognitively-oriented and one ethnographically-oriented theoretical chapter.

7. Gesture

The Gesture Project continued to focus on cross-cultural comparisons of gestural representations of spatial notions. The Gesture Project expanded its comparative investigations of sign language and gesture (cf. Wilkins' report on Arrernte sign language in Annual Report 1994:91). Comparisons of gesture and sign language, two representational systems in the same visuo-kinesic modality, sharpen our understanding of what is special about gesture and what is special about language. Such comparisons have become more important in the light of findings that the linguistic structuring of spatial information in Turkish, Japanese, and English coincides with the gestural representation of space in these languages. This year, the Gesture Project also investigated how gestural representations of space are extended to more abstract domains such as time in Yucatec and Mopan. During her visit, Alibali continued her research on the effect of visual contact between the speaker and the listener on gesture frequency.

De Ruiter completed his Ph.D. dissertation, entitled 'Gesture and Speech Production'. The dissertation consists of three parts. In the first part, Levelt's 'Blueprint of the Speaker'' speech production model is extended to incorporate the production of gesture. The second part is a detailed experimental study of the temporal synchronization of pointing gestures and concurrent speech. De Ruiter shows that pointing gestures are closely synchronized with speech, even in the case of speech hesitations and interruptions. The third part addresses the issue of the potential facilitatory function gesture has on speech production. Evidence is found that gesturing aids the retrieval of visual imagery during speech production.

7.1. Gestures and sign language

7.1.1 Sign language phonology and gesture

Kita, in collaboration with Van Gijn and Van der Hülst (Leiden U.), compared the form characteristics of spontaneous gestures produced by Dutch speakers and signs in the Sign Language of the Netherlands. This study compared the formal features of the spontaneous gestures and signs produced in the narration of an animated cartoon. The Gesture Phone coding system was developed to phonetically transcribe the data.

The first set of findings showed that two-handed gestures and signs in the narratives violate the 'Symmetry Condition' to the same degree. The Symmetry Condition states that when two hands move without touching each other, the movement and configurational features of the sign must be the same or symmetrical for the two hands. Two-handed signs in which each hand produces separate morphemes violated the Symmetry Condition especially frequently. It was concluded that the Symmetry Condition originated from the characteristics of the articulators and was now a linguistic rule in signing which applies to monomorphemic, but not bimorphemic, bimanual movement.

However, two differences between the signs and gestures were found. In the signs, the hand often touched the body. In the gestures, the hand never touched the body. Secondly, the hand shapes in the gestures tended to be more 'sloppy' (i.e., fingers are neither fully extended nor fully curled into the palm) than the hand shapes in the signs. These differences can be attributed to signs being part of a system of oppositions among discrete categories, a characteristic of language. The body contact and non-sloppy hand shapes in signs are used for making clear distinctions among discrete place-of-articulation features and discrete hand shape features, respectively.

7.1.2 Sign language linguistics

Slobin continued his research with Hoiting (Royal Institute for the Deaf, Haren) on issues in sign language linguistics. Slobin and Hoiting examined several instances of borrowing of grammatical elements from Dutch into the Sign Language of the Netherlands. The results indicate that a borrowed element from a spoken language can be assimilated into the grammatical structure of a signed language.

7.2 Cross cultural comparison of iconic and metaphoric gestures

7.2.1 Yucatec and Mopan

Kita, Danziger, and Stolz (Bielefeld U.) compared the use of the lateral axis (i.e., the axis that is parallel to the shoulder line) in the gestural representations of Yucatec Mayans and Mopan Mayans. This study was motivated by previous findings that Yucatecs treated the two poles of the lateral axis represented by mirror images as distinct while Mopans treated the two poles as non-contrastive. These findings suggest that the two cultures differ in how the lateral axis is used in both linguistic and non-linguistic spatial representations (Annual Report 1994:71; Annual Report 1996: 62).

Kita, Danziger, and Stolz also investigated the hypothesis that the gestural representations of various notions in the two cultures also follow the same pattern. They conducted a study consisting of two analyses of gestures produced during the telling of traditional mythical stories by Yucatecs and Mopans. The first, quantitative analysis of the gestural representations of spatial events and spatial relationships in the two cultures revealed that Yucatecs produce more laterally asymmetrical gestures during the description of spatial notions than Mopans. The second, qualitative analysis of the

use of spatial gestures to represent more abstract notions like time found that Yucatecs use the lateral axis asymmetrically and Mopans use the lateral axis symmetrically in gesturally representing events such as sighting, the flow of time, and development of plot (e.g., the plot develops right to left in Yucatec, but it flows away from the body along the front-back axis in Mopan). These results show that the treatment of the lateral axis in the gestures and non-linguistic pattern matching of a culture aligns with the treatment of the lateral axis in the language of that culture. For Mopans, the two poles of the lateral axis are not distinctive in either gesture or language use. For Yucatecs, the two poles are distinctive in both gesture and language use.

7.2.2 **Turkish, Japanese, and English**

Ozyürek and Kita investigated the linguistic effects of the shapes of iconic gestures in narrative discourse. In earlier research, Kita compared English and Japanese narrations of two scenes of the same stimulus cartoon (Annual Report 1995: 116). Kita found that the shapes of iconic gestures produced during scene descriptions and the linguistic means for describing these scenes were related in both the English and the Japanese narrations. However, the gestures produced during English narrations differed from those produced during Japanese narrations. These differences in gestures across narrations could have been due to cultural rather linguistic differences. To investigate this possibility, Ozyürek collected similar data in Turkey with Turkish speakers. Turkish is similar to Japanese in terms of the linguistic encoding of the two scenes. Yet the cultural context in Turkey is very different from the cultural context in Japan. Kita and Ozyürek hypothesized that if the use of iconic gestures is related to language, then the use of iconic gestures in Turkish scene narrations should be similar to Japanese scene narrations, despite cultural differences, but different from those produced in English scene narrations.

Özyürek and Kita analyzed Turkish and Japanese narrations of two cartoon scenes and compared the results with English results from Kita's previous research. The first scene represented a cat and a bird sitting on window sills of different buildings which were separated by a street. The cat swung across the street on a rope to catch the bird. Turkish, like Japanese, does not provide any lexical item expressing an agentive change-of-location with an arc trajectory. However, English encodes this notion lexically in the intransitive verb *swing.* The results showed that Turkish speakers, like Japanese speakers, produced non-arc gestures to represent the cat's motion. This result positively correlates with the absence of a lexical term expressing agentive change-of-location with arc trajectory in the Turkish lexicon. No English speakers produced non-arc gestures. This result supports Özyürek and Kita's hypothesis.

The second scene represented a cat, who had swallowed a bowling ball, rolling down the hill. The English description of the cat's motion requires one verb with a satellite *rolls down.* In contrast, Turkish, like Japanese, requires two verbs: *yuvarlanarak iniyor* ('rolling descends') or *yuvarlanarak gidiyor* ('rolling goes'). An analysis of the narrations of this scene revealed that Turkish and Japanese speakers were more likely to produce (a) more pure rotation gestures (representing manner only) and (b) more pure trajectory gestures (representing path only) than English speakers. This suggests that the linguistic encoding of manner and path information has an effect on how manner and path information are represented in gestures.

7.3 Visual contact and gesture frequency

During her visit, Alibali continued her investigations on how visual contact between speaker and listener influences gesture and speech. Alibali found that representational gestures are suppressed when visibility is blocked, but beat gestures are unaffected.

8. Sentence and Discourse Integration

In comprehension, lexical, syntactic, semantic, and pragmatic information as well as world knowledge contribute to the construction of the representation of sentences and discourse. This project investigates the time course of the integration of these sources of information. It is assumed that information from different sources is not equally available at each moment during the comprehension process and that, depending on the available information, different kinds of integration take place.

A number of issues related to different levels of linguistic information have been studied during 1997. The use of syntactic and semantic information has been studied in long distance dependencies. A start has been made in investigating whether semantic information can impede an alleged syntactic preference. Aspects of short-term memory in the integration process were investigated in a study on double-embedded verb clusters. The contribution of the reader's knowledge in integration was the main focus in a study that aimed to develop a model of text comprehension and inferencing.

8.1 Semantic and syntactic integration processes during comprehension

8.1.1 Semantically biasing information.during the syntactic analysis of long-distance dependencies

As part of the collaboration between the Neurocognition of Language Processing Project and the Sentence and Discourse Integration Project, C. Brown, Hagoort, and Vonk continued the

series of studies on the processing of long-distance dependencies. In these studies, we recorded, in separate experiments with the same materials, moving-window reading times, eye movements, and ERPs while participants read subject-relative (SR) and object-relative (OR) sentences. The major focus of the research was on the possible impact of semantic information during the analysis of SR and OR sentences. We presented SR and OR sentences in which the main verb of the relative clause was either semantically neutral, or was biased towards an SR or an OR reading. For example, in English gloss preserving the word order of the original Dutch stimuli:

(1) *Neutral*
In the middle of the ocean received the captain, who the sailors seen has/have, a bottle of rum.

(2) *SR-bias*
In the middle of the ocean received the captain, who the sailors sacked has/have, a bottle of rum.

(3) *OR-bias*
In the middle of the ocean received the captain, who the sailors obeyed has/have, a bottle of rum.

Most parsing models predict that in semantically neutral contexts SR readings are preferred over OR readings. Different predictions are made for contexts where semantic information biases for either an SR or an OR reading. Proponents of models that assign a primary role to syntactic analyses claim that even in the presence of contrary semantic information, an SR analysis is initially assigned (e.g., Clifton & Frazier, 1989). Proponents of models that assign a primary role to lexically based analyses claim that semantic information can override default syntactic preferences (e.g., MacDonald, Pearlmutter & Seidenberg, 1994).

In semantically neutral contexts, we found a default SR parsing preference. This showed up in reading times for the disambiguating auxiliary in the moving window study, in the first gaze duration to the auxiliary in the eye-movement study, and in the Syntactic Positive Shift (SPS) to the auxiliary for the OR sentence. In SR-biasing contexts, reading time effects were again observed at the auxiliary and an SPS effect was obtained at the auxiliary for the OR sentences. These effects were much larger than in the neutral contexts, indicating that the semantic information affected the ongoing parse. In OR-biasing contexts, the effects disappeared: Reading times did not differ at the auxiliary, and the previously observed SPS for the auxiliary in the OR sentences was no longer present. This provides further evidence regarding the interplay between meaning and structure during parsing, and suggests that in the case of multiple possible parses, a preferred syntactic assignment can be overruled by semantic information.

Although the SR preference appeared at the auxiliary, no clear effect was seen at the main verb itself in the biased conditions. To investigate whether the SR reading is established before the auxiliary is encountered, Vonk and P. Mak (U. Nijmegen) included an extra (neutral) main verb between the first main verb and the auxiliary in the relative clause. In an experiment with comprehension questions that directly probed who did what to whom, reading times for the second main verb were slower in the OR-bias sentences than in the SR-bias sentences. This shows that the preferred syntactic structure is assigned at least before the auxiliary has been encountered.

8.1.2 Semantically biasing information before the syntactic analysis of long-distance dependencies

If semantic information bearing on a possible interpretation of a relative clause becomes available before a syntactic analysis can begin, will an SR preference show up at all? This was investigated

by Mak, Vonk, and Schriefers (NICI, U. Nijmegen) for SR and OR sentences in which the animacy of the head noun was varied. In a corpus study it was found that relative clauses following inanimate heads are frequently of the OR type, whereas relative clauses following animate heads are not. Preliminary analyses of moving window data from the experiment show that in sentences with an inanimate head, there is no SR parse preference throughout the sentence.

8.2 Integrating doubly-embedded verb clusters

In collaboration with Vonk, M. Dickey (U. Massachusetts, Amherst) carried out a self-paced reading study examining the processing of verb-cluster sentences in Dutch. In a previous off-line rating task, Bach, C. Brown and Marslen-Wilson found that doubly-embedded verb cluster sentences in Dutch and German were rated as significantly more difficult than their singly-embedded or unembedded counterparts. This jump in difficulty for doubly-embedded verb cluster sentences is parallel to the jump in difficulty associated with doubly center-embedded sentences in English. The current study was conducted in order to find the point at which this jump in difficulty occurs on-line. Subjects were presented with verb cluster sentences which appeared in either a doubly-embedded or one of two singly-embedded versions. The singly-embedded versions contained either four NPs and a ditransitive verb or three NPs and an adverb (see (1)-(3)).

(1) doubly-embedded
De lerares heeft Piet een klasgenoot het probleem taten helpen oplossen op het bord in de klas.
'The teacher made Piet help a classmate solve the problem on the board in the class.'

(2) singly-embedded, three NPs
Piet heeft gisteren een klasgenoot het probleem helpen oplossen op het bord in de Mas
'Yesterday, Piet helped a classmate solve the problem on the board in the class.'

(3) singly-embedded, four NPs
De lerares heeft Piet een klasgenoot het probleem laten uitleggen op het bord in de klas.
The teacher made Piet explain the problem to a classmate on the board in the class.'

Results indicate that the jump in difficulty for the doubly-embedded sentences comes at the final verb in the cluster ('oplossen' in (1)). This is after the point at which subjects receive evidence that they are reading a sentence which might exceed the parser's short-term memory capacity. These results therefore argue against theories of processing complexity which claim that processing breaks down at the moment at which the parser's memory capacity is overrun. Instead, they argue in favor of theories which claim that processing breakdown occurs after the parser's memory limit is overrun, when the parser tries to integrate material which it has earlier thrown out of memory with the verbs of the cluster (e.g., Lewis, 1996; Dickey, 1996; Gibson, 1997).

8.3 Inference processes and discourse integration

Previous research has pointed out that on-line inferences during reading do not only depend on the text, but also on the reader's knowledge. Following up work with M. Weeber (U. Nijmegen), Vonk, together with E. Roskam (NICI, U. Nijmegen) and L. Noordman (U. Tilburg), is working on a simulation model of text comprehension that incorporates knowledge representation and that aims to account for inference processes. Text understanding in the model is

described at the level of propositions and sentences. Therefore, the model concerns only higher processes in reading. In the model, three kinds of propositions are distinguished: text propositions, knowledge propositions, and inference propositions. Reading is considered the activation of propositions. Text propositions have an initial activation. A proposition spreads its activation to related propositions, in proportion to its own activation and in proportion to the strength of the links with other propositions. This is reflected in the connectivity matrix of the propositions. This spreading activation process is an iterative process that converges to a stable state of activation that reflects the cognitive representation of the text.

One issue which was investigated concerns the mathematical basis of this type of model. It has been proven mathematically that the iterative process converges to a specific vector that corresponds to a submatrix of the connectivity matrix of the propositions. What has not yet been determined is the exact nature of the mathematical relationship between the final activation vector and the connectivity matrix. Once this relation is known, it will be possible to specify how the connectivity matrix for the interpretation of a particular sentence has to be constructed. Some preliminary simulation studies with ambiguous sentences were conducted.

The second topic that was investigated deals with the incremental processing of consecutive sentences, and in particular with backgrounding and reinstatement. These processes can be described in terms of activation. Information in a sentence is backgrounded (i.e., decreases in activation) the longer the time interval between that sentence and the current input is. If, however, this backgrounded information is referred to by the current sentence, it is reinstated, i.e. its activation increases. Several simulations of these processes were carried out in the framework of a spreading-activation model. At the moment no adequate model of decay and reactivation has been developed yet. Research in this project was

temporarily stopped due to the death of professor Roskam. The project is continuing with M. Koppen (NICI, U. Nijmegen).

9. Neurocognition of Language Processing

The year 1997 was an eventful year for the 'Neurocognition of language processing' project. In the first place, the work of the group was hampered by the move to the temporary accommodation. Thanks to the efforts of the Technical Group, one ERP laboratory was kept running, but unfortunately one laboratory had to be closed down for the duration of the rebuilding of the Institute. This closure has inevitably led to a reduction in the number of experiments that could be performed during 1997. A second major event followed from the fact that 1997 was the last year of the 5-year grant from the Netherlands Organization for Scientific Research (NWO). This required efforts to obtain further funding for the project, which is almost completely financed via external sources. In June 1997, notification was received from NWO that a grant proposal submitted by C. Brown, Hagoort, Indefrey, and Levelt, had been awarded. This will enable the group (in a slightly reduced size) to continue research for the period 1998-2002.

9.1 The neural architecture of language processing

9.1.1 The neural architecture of morphological processing

Indefrey, Brown and Hagoort, in collaboration with H. Herzog (Institut für Medizin, Forschungsanlage Jülich), R. Seitz and M. Sach (Heinrich-Heine-Universität Düsseldorf) completed the data analysis of a PET experiment on morphological processing (see Annual Report 1996). The PET experiment was designed to determine whether the same or different cortical loci subserve regular and

irregular morphological production. To this end, past tense and participle forms of verbs that were presented in the infinitive had to be produced and inserted in a neutral sentence frame. In a baseline condition, the verbs were already presented in their inflected form so that only repetition was required. The verbs were varied along the dimensions 'regular vs. irregular' and 'high vs. low frequency of inflected forms in spoken language'.

When compared to baseline, both regular and irregular verbal inflection induced significant regional Cerebral Blood Flow (rCBF) increases in midbrain and cerebellum, but showed no overlap in cortical areas (see figures 9.1 and 9.2). An analysis for areas that were sensitive to the regular-irregular distinction, irrespective of word form frequency, revealed twelve cortical areas with a significant rCBF increase for irregular verbs when directly compared to regular verbs, and two areas for the reverse comparison (see figures 9.3 and 9.4). Two areas were sensitive to word form frequency, irrespective of regularity (regular and irregular scans collapsed), with Broca's area (BA 45) being more active for low frequency verbs (see figures 9.5 and 9.6). The stronger cortical activation for irregular verbs, and the small overlap in activation for regular and irregular verbs are consistent with dual process models. This interpretation is supported by the reaction time data (see Annual Report 1996) showing a clear effect of the regular vs. irregular distinction. However, a characterization of the two processes as 'lexical' (irregular) vs. 'rule based' (regular) is not supported, since reaction times were equally increased for both low frequency regular and irregular verbs.

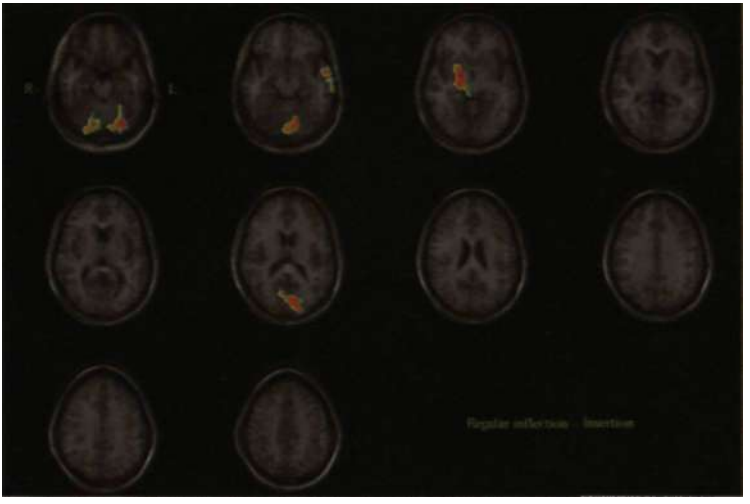


Figure 9.1. Significant ($p < 0.05$) rCBF increases for **regular inflection** versus **baseline** projected onto mean anatomical MR slices of the 12 participants. Slice distance = 6.43mm. Lowest slice approximately 14mm below AC-PC level, highest slice 39mm above AC-PC level. Activated areas (x,y,z coordinates) from lowest to highest slice (sup.=superior, inf.=inferior, ant.=anterior): Cerebellum (-26 -74 -17 / 12 -80 -17 / -12 -73 -12). Left sup. temporal gyrus, BA 38 (-53 -5 -9), Right midbrain/pallidum (15 -11 -3), Left cuneus, BA 17 (-10 -86 10), Right sup. parietal lobule, BA 7 (34 **-51** 49).

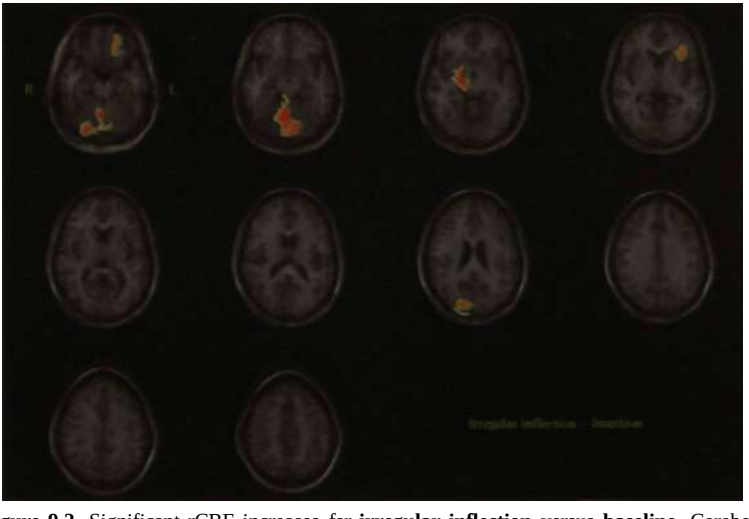


Figure 9.2. Significant rCBF increases for **irregular inflection** versus **baseline.** Cerebellum (0 -62 -11 / 23 -82 -17), Left inf. frontal gyrus, BA47 (-20 24-13), Right midbrain/pallidum (14 -16 -3), Left frontal operculum. BA 14 (-29 24 4), Right cuneus, BA 18 (12 -88 15).

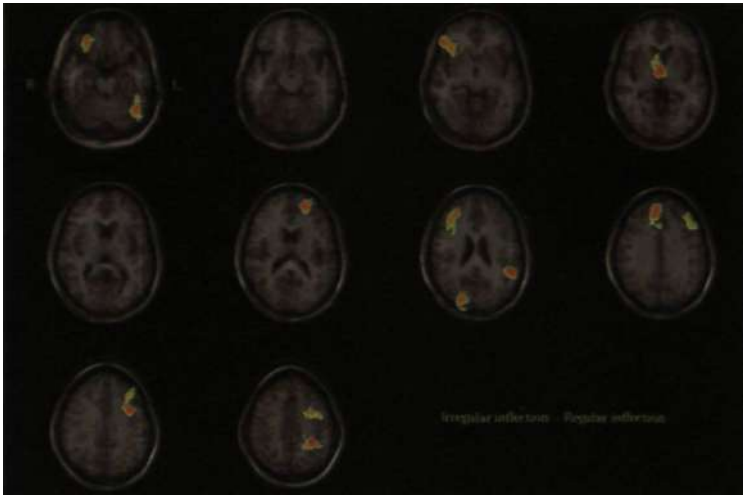


Figure 9.3. Significant rCBF increases for **irregular** versus **regular** inflection. Left fusiform gyrus, BA 37 (-43 -59 -16), Right middle frontal gyrus, BA 11 (27 38 -12), Right inf. frontal gyrus, BA 47 (49 31 0), Hypothalamus (0-10 2), Left sup. frontal gyrus, BA 10 (-21 46 17), Right middle frontal gyrus, BA 46 (28 32 22), Left sup. temporal gyrus, BA 22 (-52 -50 18), Right middle occipital gyrus, BA 18 (19 -88 15), Right sup. frontal gyrus, BA 9 (6 42 30), Left middle frontal gyrus, BA 9/46 (-45 2829 / 42 0 33 / -34 0 39), Left inf. parietal lobule, BA 40 (-33 43 36).

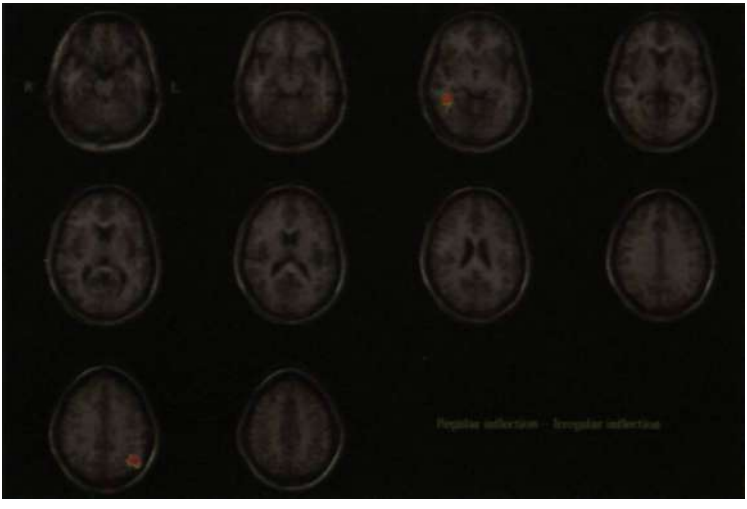


Figure 9.4. Significant rCBF increases for **regular** versus **irregular** inflection. Right ant. fusiform gyrus, BA 37/19 (32 -41 4), Left angular gyrus, BA 39 (-46 -70 29).

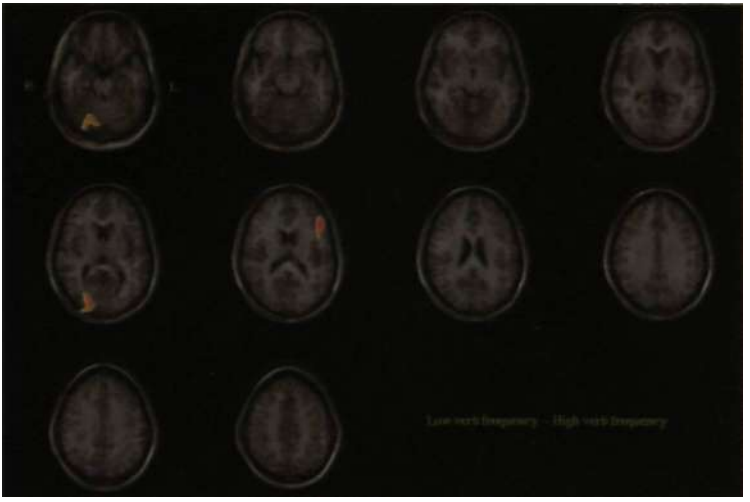


Figure 9.5. Significant rCBF increases for **low** versus **high** past tense/participle frequency. Cerebellum (12-70 -17), Right cuneus, BA 17(14 -91 4), Left inf. frontal gyrus, BA 45/44 (-50 20 16).

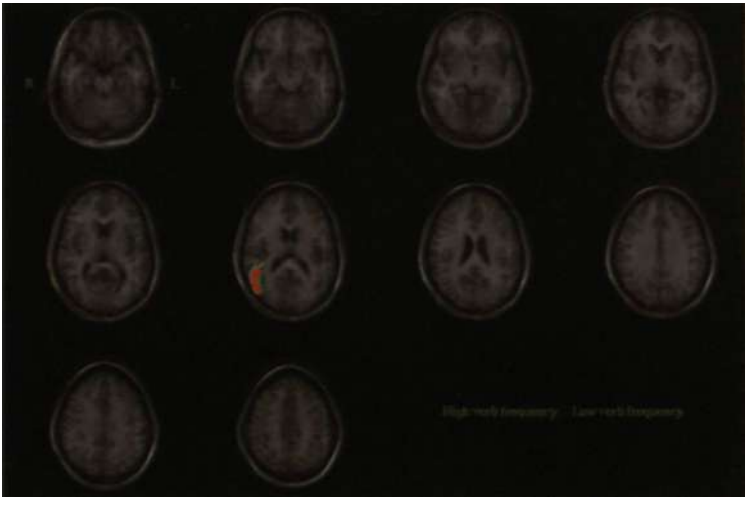


Figure 9.6. Significant rCBF increases for **high** versus **low** past tense/participle frequency. Right middle temporal gyrus/middle occipital gyri, BA 39/19 (41 -48 12).

9.1.2 The reading of words and pseudowords

Indefrey, in collaboration with O. Gruber (Heinrich-Heine-Universität Düsseldorf), A. Kleinschmidt (Wellcome Institute for Cognitive Neurology, London), and S. Posse (Institut für Medizin, Forschungsanlage Jülich) carried out a new fMRI experiment which was designed to replicate (a) the results obtained in a previous PET experiment on the reading of words and pseudowords (see Annual Report 1994), and (b) improve our understanding of the nature of left lateralized premotor activations that are found for pseudowords relative to words in the PET experiment when both kinds of stimuli were read aloud. One possible explanation of these activations was that they were elicited by the pronunciation of phonotactically legal but novel syllables contained in the set of pseudoword stimuli. In order to articulate novel syllables it is necessary to assemble a syllable motor code, whereas in the case of frequently used syllables such a code might be retrieved from a mental 'syllabary' (see Levelt 1989, p. 327). To test this hypothesis, four sets of bisyllabic stimuli varying both words and pseudowords along the additional dimension 'high vs. low syllable frequency in spoken language' were prepared. The stimuli were read out in a whispering voice. Single subject analyses of the fMRI data were carried out with SPM96. In six out of seven male native speakers of German, left lateralized premotor activations similar to those obtained in the PET experiment were replicated when comparing syllable frequency matched pseudowords to words. Conversely, direct comparisons of low versus high syllable frequency pseudowords and of low versus high syllable frequency words did not show (except for one subject in the case of words) any left lateralized premotor activations. The data provide evidence against the hypothesis that the additional activation of the left premotor cortex observed for pseudoword pronunciation is due to the assembly of syllable motor codes.

9.1.3 The neural architecture of mental calculation

Indefrey also collaborated with Gruber, Kleinschmidt, and Posse on an fMRI experiment on mental calculation. Models of mental calculation distinguish mathematical fact retrieval (e.g., 3 x 4 = 12) from calculation procedures applied for computation beyond the stored facts (e.g., 3 x 24 equals 3 x 20 plus 3 x 4). In addition, there is working memory involvement and language processing (inner' speech). There were five experimental conditions:

(a) silent serial multiplication and division with factors below 10;
(b) silent serial multiplication and division with one factor greater than 10;
(c) silent serial digit substitutions on 2-digit numbers;
(d) silent serial letter substitutions on 2-letter groups, and
(e) silent serial pseudo multiplication and division on letters with the instruction to mimic the subvocal sentence production involved in mental calculation (e.g., 'FH times D equals FH.').

A preliminary data analysis showed a bilateral parietal and prefrontal activation pattern which was similar in all tasks but with stronger left-dominant asymmetry in tasks (a) and (b).

9.1.4 The neural architecture of syntactic production

Indefrey, Brown and Hagoort, in collaboration with H. Herzog (Institut für Medizin, Forschungsanlage Jülich), and R. Seitz (Heinrich-Heine-Universität Düsseldorf) started the data acquisition of a new PET experiment on syntactic processing. While the results of a previous PET experiment suggested a role for the dorsal part of Broca's area in syntactic processing but did not allow to differentiate between syntactic parsing and encoding (see Annual Reports 1995 and 1996), it is the aim of the new experiment to isolate the syntactic processing involved in language production.

9.2 Electrophysiological signatures of visual lexical processing

Brown, Hagoort, and Ter Keurs completed the analysis of an extensive set of data on Event Related Brain Potential (ERP) manifestations of visual lexical processing (see Annual Report 1995 and section 9.4.1). This work focused on the lexical-categorical distinction between open- and closed-class words, and addressed the disputed existence of an electrophysiological marker of this distinction. ERPs were recorded from young subjects whilst they read a story. Separate waveforms were computed for open- and closed-class words. Two aspects of the waveforms could be reliably related to vocabulary class. First, an early negativity in the 230 to 350 ms epoch, with a bilateral anterior predominance. This negativity was elicited by open- and closed-class words alike, was not affected by word frequency or word length, and had an earlier peak latency for closed-class words. Second, a frontal slow negative shift in the 350 to 500 ms epoch, largest over the left side of the scalp. This late negativity was only elicited by closed-class words. Although, in contrast to some claims in the literature, the early negativity can not serve as a qualitative marker of the open- and closed-class distinction, it does reflect the earliest electro-physiological manifestation of the availability of categorical information from the mental lexicon. These results suggest that the brain honors the distinction between open- and closed-class words, in relation to the different roles that they play in on-line sentence processing.

9.3 Semantic and syntactic integration processes during comprehension: ERPs and parsing

9.3.1 In search of the Left Anterior Negativity (LAN)

Next to the Syntactic Positive Shift (SPS) a more anterior negativity with its strongest effect over the left hemisphere has been reported in the literature in relation to syntactic processing. Friederici has hypothesized that this so-called LAN-effect occurs when the structural expectation for a particular word category (e.g., noun, verb) is violated. However, not all findings of LAN-effects have been consistent with this hypothesis. Brown, Hagoort, and Remmerswaal decided to test this hypothesis explicitly in an experiment that carefully controlled for factors other than word category. For this experiment we constructed syntactic prose sentences in which the usual semantic/pragmatic constraints do not apply. In this way the cloze probability for the crucial words in the two conditions is equal, namely zero. Here is an example of the Dutch sentence pairs that were used (together with literal English translations):

(1 a) 'De anonieme adem geeft een bijzonder licht.'
(The anonymous breath gives a special light.)

(1 b) * 'De anonieme ademen geeft een bijzonder licht.'
(The anonymous [to breath] gives a special light.)

Sentence (1b) is grammatically illegal due to a word category violation in the first NP: The expected noun is replaced by a verb (the critical words in the two conditions are underlined). Note that noun and verb are selected such that they are semantically maximally alike. According to Friederici's hypothesis the critical word in the (1b) version of the sentences should result in a LAN relative to the (1a) version of the sentences.

The results of this experiment were as follows: The critical word violating the word category expectation led to a frontally distributed SPS effect relative to the critical word in the grammatically correct version of the sentences. This is compatible with earlier findings of SPS effects to syntactic violations, even in syntactic prose (Hagoort & Brown, 1994). Next to this SPS, a LAN-effect was obtained for the ERPs elicited by the following verb (in the example sentences: *geeft).* These data are incompatible with the Friederici hypothesis. What exactly drives the LAN-effect remains to be determined. An alternative proposal by Kutas and colleagues has linked LAN-effects to working memory load during on-line sentence processing. Although our experiment did not directly test this hypothesis, the LAN-effect on the word following the word category violation is not incompatible with such an account, under the reasonable assumption that a violation increases the working memory load for processes involved in sentence interpretation.

9.3.2 ERP studies on sentence processing in discourse

Together with Brown and Hagoort, Van Berkum explored various aspects of sentence processing in discourse by means of ERPs. Earlier research had shown that sentence processing is highly incremental, in that every word is immediately related to a syntactic and semantic representation of the unfolding sentence. A word that signals that the (only or preferred) syntactic analysis of prior sentence material must be abandoned, for example, often elicits an SPS in the ERP within about 500 ms. With most of the prior research using isolated sentences, however, little is known about the nature and time course of those aspects of sentence processing that are particularly relevant in ongoing discourse. We explored three of them within the same discourse ERP experiment (plus an isolated sentences control experiment).

9.3.2.1 Referential processing in discourse

When people encounter a definite NP, how quickly can they identify its referent(s) in earlier discourse? The picture that emerges from the literature on anaphor resolution is complex, with some data suggesting that people begin to look for referents as they process the noun, but with other evidence suggesting delayed processing. We addressed the issue by asking subjects to read (the Dutch equivalents of) sentences beginning like 'David told the girl that..' in short story contexts that had introduced either two referents for a critical NP, e.g., two girls, or just a single one. The ERP results revealed that this had a very rapid impact on processing at the noun: starting at about 280 ms after its onset, a noun like 'girl' elicited a significantly more negative ERP waveform in a 2-referent than in a 1-referent discourse context (see figure 9.7a). This early referential ambiguity effect shows that people not only begin to look for referents immediately at the noun, but can determine whether a definite NP has a unique referent in earlier discourse or not within a mere 280 ms.

9.3.2.2 Parsing in discourse

Can people use such referential information to help parse a subsequent structural ambiguity? Right after this NP, the sentence continuation was temporarily ambiguous between a complement clause ('David told the girl that there would be some visitors') and a relative clause ('David told the girl that had been on the phone to hang up'). Earlier research had suggested that if an ambiguous fragment like 'David told the girl that..' is presented in isolation, people implicitly expect it to continue with a complement clause. The results of our isolated sentences control experiment confirmed this: subsequent disambiguation as a relative clause (at 'had') elicited a SPS in the ERP waveform, which suggests that people were biased towards the complement clause. The results of our discourse experiment, however, clearly showed that such parsing biases are immediately adapted to the specific discourse context. In particular, whereas subsequent disambiguation as a relative clause elicited an

SPS in 1-referent discourse contexts, disambiguation as a complement clause elicited an SPS in 2-referent discourse contexts (see figure 9.7b). Together with several other results, this suggests that after a referentially ambiguous NP ('the girl' in 2-referent context), people are more inclined to immediately pursue the relative clause alternative, presumably because it may supply additional referential information (which girl? 'the girl that had been on the phone'). This finding is only consistent with models in which the parser is not an informationally encapsulated module.

9.3.2.3 Semantic integration in discourse

Finally, how quickly are the incoming words of a sentence related to a semantic representation of the prior discourse? To examine this, several target sentences in the discourse experiment contained a critical word that was semantically consistent with the local sentence environment, but not with the wider discourse (e.g., 'David told the girl that she was slow' in a discourse where this girl had in fact been fast). Relative to an acceptable control word (e.g., 'fast'), the anomalous word elicited a classical N400 effect (see figure 9.7c), which disappeared again when the same target sentences were read in isolation. This discourse-semantic violation effect shows that incoming words are very rapidly related to the semantics of earlier discourse, within about 200-250 ms.

Figure 9.7a. Discourse-referential ambiguity effect. Grand average ERP, at Fz, elicited by a singular noun (CW, critical word) presented in a 1 -referent discourse context (solid line) and in a 2-referent discourse context (dotted line). Negative is up.

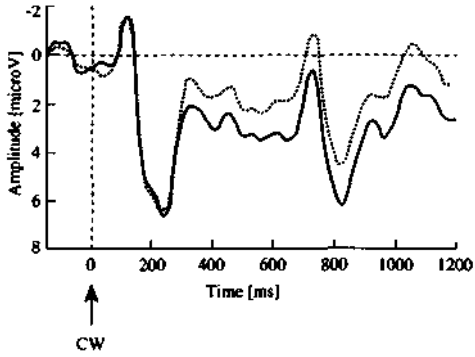


Figure 9.7b. A discourse-induced Syntactic Positive Shift. Grand average ERP, at Pz, elicited by a complement clause disambiguation (at the CW) in a 1-referent discourse context (solid line; biasing towards a complement clause) and in a 2-referent discourse context (dotted line; biasing towards a relative clause).

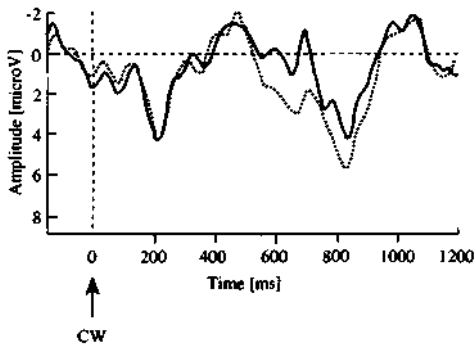
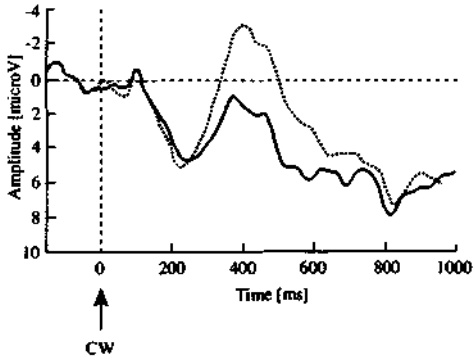


Figure 9.7c. Discourse-semantic N400 effect. Grand average ERP, at Pz, elicited by a critical word (CW) that is acceptable (solid line) or anomalous (dotted line) in current discourse.



9.4 ERP studies on language disorders

9.4.1 ERP characteristics of open- and closed-class words in Broca patients with agrammatic comprehension

Ter Keurs completed the full ERP data acquisition of an experiment which further examined the ERP characteristics of open- and closed-class words in Broca patients with agrammatic comprehension, and the relation between the impaired processing of these two word types and the patients' comprehension deficit. In a previous experiment, open- and closed-class words were presented in a short story, focusing on the functional role of these items (see Annual Report 1995,1996). In the present experiment, the same target stimuli as in the story experiment were presented, but now in random lists. This was done to further examine the role of context on the processing differences between the two word types, in addition to the possible role of lexical-statistical factors. From a considerably larger number of tested subjects, thirteen agrammatic patients, eight non-aphasic patients with a right-hemisphere lesion, and twelve healthy control subjects were selected for statistical analysis of the ERP data. Preliminary results show that there are clear electrophysiological differences in the processing profiles for the two word types during the early stages of word processing in the control subjects, but not so in the agrammatic aphasics. This early vocabulary-class effect for the control subjects can be related to differences in the lexical processing of the two word types. The findings confirm the results from the story-experiment indicating that a delayed and/or incomplete availability of the lexical-categorical information associated with open- and closed-class items is an important factor in Broca's agrammatic comprehension.

Characterization of the neural sources underlying late (language) scalp-recorded ERP components with a physiologically justified spatial-temporal source-analysis model is usually not feasible, because too many sources have to be modeled and too little a priori

knowledge exists as to their number (see Annual Report 1995). A reduction in the number of sources, particularly the ones that are common to different experimental conditions and thus less interesting, would therefore greatly benefit the analysis of these late ERP components. Therefore, G. Uijen (U. Nijmegen), D. Stegeman (U. Nijmegen) and Ter Keurs used a filtering technique (Generalized Singular Value Decomposition) that adequately discriminates between spatially unique and spatially common signals in different ERP data sets, independent of the time sequence and/or the amplitude of these sources.

9.4.2 Syntactic ERP effects in agrammatic comprehenders

Wassenaar continued the ERP data acquisition of an experiment on on-line syntactic processing in Broca aphasics with agrammatic comprehension. An earlier experiment (see Annual Report 1996) showed that Broca's aphasics with a severe agrammatic comprehension impairment differed in the way they deal with their syntactic comprehension disorder: some patients showed a relative delay in the time course of their syntactic integration process (delayed SPS-effect), others showed the use of a compensatory semantic strategy (N400-effect).

In the current study we tried to replicate these findings by again presenting subjects with (slightly different) spoken sentences containing violations of phrase structure rules (transpositions of adverbs and adjectives in Adv-Adj-N sequences). In addition, these syntactic violations were also embedded in so-called syntactic prose sentences (syntactic prose refers to sentences that are semantically uninterpretable, but are in accordance with the grammatical rules of the language). This syntactic prose manipulation was used to test whether an N400 effect would not appear in the syntactic prose condition, since a semantic compensatory strategy would not work for semantically incoherent sentences. In addition, sentences with sub-categorization violations (i.e., the constraint that obligatory

intransitive verbs cannot take a noun as direct object is violated) were also presented, both in a normal and in a syntactic prose version.

To date, 13 normal elderly control subjects, 10 young control subjects, 5 Broca aphasics with a severe and 3 with a moderate agrammatic comprehension impairment, and 3 patients with a right hemisphere lesion have participated in the experiment. Statistical analyses of the results of the normal elderly control subjects showed SPS effects for the phrase structure violations both in the normal and in the syntactic prose condition, albeit that the size of the effect was reduced in the syntactic prose condition. In the normal prose condition, this SPS effect was preceded by a frontally distributed negativity, which was absent in the syntactic prose condition. For the subcategorization violations significant SPS effects were only found in the normal prose condition.

So far, only a limited set of Broca aphasics with severe agrammatic comprehension problems have been tested. Preliminary statistical analyses for the phrase structure violations suggest no presence of an SPS effect in the normal prose condition. However, interestingly, an SPS effect was found in the syntactic prose condition, with what appears to be a small latency difference relative to the normal elderly controls. This suggests that when sentences offer the possibility to use a more semantically-driven interpretation strategy (as is the case in the normal prose condition) an SPS effect is absent in these agrammatic comprehenders. This idea fits with our earlier findings (see Annual Report 1996). The presence of an SPS in syntactic prose indicates that not all knowledge about syntactic constraints is lost in these patients. Presumably, under the additional requirement of a semantic interpretation the syntactic processor breaks down (cf. Linebarger et al., 1983). For the subcategorization violations no significant effects were found either in the normal or syntactic prose condition. Testing of additional

patients (agrammatic patients and patients with a right hemisphere lesion) is currently being carried out.

10. The Structure of Learner Varieties

This project continues the earlier Europe-wide research project on second language acquisition of adults outside the classroom (ESF-project). It differs from other institute projects in that concrete research is mainly done in cooperation with various research institutes in Europe, in particular the universities of Heidelberg, Pavia, Paris VIM and Paris X, Aix-en-Provence, FU Berlin and Humboldt Universität Berlin. Theoretically and empirically, it elaborates on the data and findings of earlier research. The project focuses on two phenomena of learner varieties: scope properties and referential movement. However, other aspects of second language acquisition, in particular its relation to first language acquisition, are investigated too. The following reports only include work directly done by researchers at the Institute.

10.1 The Basic Variety

In earlier work (see Annual Reports 1994, 1995), Klein and Perdue had shown that adult second language learners, when not under the influence of a particular teaching method, universally develop a well-structured, remarkably efficient and simple form of language - the BASIC VARIETY. This form is never observed in classroom acquisition nor in first language acquisition, but all second language learners in our sample have it. One third of second language learners 'fossilize' at this level. That is, these learners retain the structural properties of the basic variety and only expand their lexical repertoire during development. For other learners, the basic variety develops further to a greater or lesser extent.

The Basic Variety has three core properties. Firstly, the lexicon is essentially taken from the target language (with some borrowings from other sources). It consists mainly of uninflected and often phonologically distorted open-class items. Closed-class items appear but are rare, and new words are limited to noun-noun compounds. Secondly, the structure of the Basic Variety is characterized by a small set of phrasal, semantical and pragmatical principles. It is the interaction of these principles which determines the concrete form of utterances. These principles seem to be the same for all learners, irrespective of source and target language. What varies to some extent, however, is the way in which these principles interact, and, in particular, which constraints are abandoned in contexts where they come into conflict. Third, strikingly absent from the Basic Variety are: (a) free or bound morphemes with purely grammatical functions, and (b) complex hierarchical structures, in particular subordination.

These findings raise a number of questions. For example, why are 'fully-fledged' languages structurally more complex than the Basic Variety? Analyses of how the Basic Variety is put to use in various complex verbal tasks reveal that there are discourse contexts where its organizational principles come into conflict and where the variety breaks down. The relative structural complexity of 'fully-fledged' languages may serve to avoid such breakdowns in discourse by supporting grammatical devices needed to deal with complex verbal tasks across discourse contexts. A second question is: what is the status of this particular form of language within the various manifestations of the human language capacity? Klein and Perdue argue, based on the empirically established continuity of the adult acquisition process, that the Basic Variety is not a mode of linguistic expression (e.g., a 'protolanguage') distinct from that of 'fully-fledged' languages. Moreover, it is argued that the organizational constraints of the Basic Variety belong to the core attributes of the human language capacity. The structural complexity not attested in the basic variety reflects less central properties of this capacity, the

purpose of which is to deal with various types of displacement that interfere with a strict parallelism of 'phonological form' and 'logical form', as described in recent versions of generative grammar (Chomsky, 1995). Under the assumptions of the Minimalist Program, movements are triggered by 'strong features' of elements in the lexicon. This notion of feature strength allows a straightforward characterization of the Basic Variety as a special case of an 'I-language': specifically, a language in which all features are weak. Structurally, it is an 'ideal I-language' with certain communicative constraints. Its clear-cut structural organization cannot cope with diverging requirements imposed by particular communicative tasks. Under this perspective, the acquisition of an I-language beyond the Basic Variety can essentially be described as a change in feature strength. This perspective, if correct, yields a surprisingly simple picture of development. However, it is a picture confined to one particular aspect within the ensemble of linguistic capacities that the speaker has to master. Others, such as the acquisition of lexical items or the handling of given and new information in order to achieve particular communicative aims, are beyond its scope.

10.2 Temporal reference and spatial reference

Starren continued her investigation into the acquisition of temporal reference by Turkish and Moroccan learners of Dutch and French. Previous findings suggest that Moroccan learners of Dutch use the same structural embedding for proto-verbal markers of tense and aspect as they did for the embedding of lexical temporal adverbials in an earlier basic lexical stage of acquisition (see Annual Report 1995). These results, together with similar findings from the Turkish data (see Annual Report 1996) indicate that L2 learners use the iconic placement of temporal adverbials directly adjacent to the material in their scope as a general strategy for using free morphemes expressing tense and aspect. They do this before the specific morphosyntactic properties of the target language are

acquired. At the final stage of the stepwise process of acquiring morphosyntactic tense and aspect marking, Moroccan L2 learners have to learn how to package Dutch verbs with tense and aspect marking.

Hendriks continued her work on referential movement and discourse cohesion in child first language and adult second language acquisition. Part of this work is done in collaboration with Hickmann (U. Rene Descartes, Paris), and is jointly supported by the MPG and the CNRS. Data used for this project are narratives produced by monolingual 4- to 10-year-olds and adult speakers (Chinese, English, French and German) under identical conditions and by Chinese adults acquiring German and French as a second language.

Hendriks conducted a crosslinguistic study comparing new data on the acquisition of French by adult Chinese speakers collected and analyzed in 1997 and previously collected data on the acquisition of German by Chinese speakers. In the domain of temporal reference, parallel results were found in French L2 and in German *12.* Although Chinese adults learning German acquire more diverse target-like forms to express temporal reference with increasing proficiency, they simultaneously start diverging more and more from the language of native speakers, who frequently use the *Praesens* tense marking in all types of discourse contexts (cf. Annual Report 1996). Similar results were found for the Chinese French *12* speakers. French L2 differs from the language of French native adults in that the distribution of the *Passe Compose* vs. the *Present* and *Imparfait* shows a strong interaction with the Aktionsart of the verb. Bounded verbs are always marked with the *Passe compost* and the *Plus-que-parfait,* whereas unbounded verbs systematically combine with *Present* and *Imparfait* inflection. The German L2 of Chinese speakers showed a similar interaction (Annual Report 1996).

Hendriks also analyzed how child and adult learners of French, German and Chinese 'package' spatial reference in verbs and satellites. Typological research has shown that French does not easily combine manner+motion verb stems with satellites expressing path of motion. When it is done, the resulting phrase can never be used to express a change of location. French speakers use manner verbs either to focus on the manner of motion or to make reference to a general location. In contrast, German and Chinese can use manner+motion verbs to make reference to all kinds of locations. Analyses show that children more or less easily tune into how their native language packages manner, motion and path in verbs and satellites. Some evidence for the development in the acquisition of complex information-packaging has been found in the French L1 data. French children do not use complex verbs like *grimper* (motion, path and manner) before age 10. Instead, they use verbs like *monter* (motion + path). Adult L2 learners of French as well as of German start out using mainly deictic verbs to refer to changes of location and verbs of manner to make reference to general locations. The use of deictic verbs allows speakers to omit the relatum (the entity in relation to which something is situated). This allows narratives to be constructed in a very straightforward way with a minimum of information explicitly expressed. The adult system is at this time a simplified version of the target language and simultaneously a very sophisticated way of expressing all necessary information with a minimum of means.

11. Communication Under Impairment

This is a new project which is currently in the middle of its initial two year trial period. Although new, it has roots deep in one prior Institute project, 'Aphasia in Adults', and pursues some of the avenues of research suggested by that work. However, aphasia is not the sole concern, other forms of impaired communication are also investigated.

The shared features which bring the subprojects within this group together are as follows:

a) The focus is on natural discourse.
b) Much of the research centers on interaction, in particular, on the interaction of a communicatively-impaired person with a non-inflicted interlocutor.
c) The research is sensitive to the total communicative resources that patients and interlocutors draw on in discourse production. Thus, it is not only concerned with linguistic production, but also gesture, gaze, strategic use of silence, use of pointing boards, etc.
d) The investigators acknowledge the need to ground the research within an understanding of the particular cultural resources that are available for natural communicative interaction, and the need for cross-cultural comparisons where feasible.
e) A central area for investigation concerns the nature of adaptation to 'malfunction' in naturalistic discourse. Here adaptation refers both to: (i) the patient's own natural and learned adaptations that have been developed and deployed in order to compensate for shortcomings in efficient interaction caused by impairment, and (ii) the way in which both

interlocutors adapt to each other and the speech context in negotiating an interaction (in this sense the research is interested in the co-construction of text).

Below we report on four investigations.

11.1 Function of agrammatic telegraphic style in ordinary conversations

Heeschen continued conversation-analytic investigations of ordinary talk-in-interaction between agrammatic patients and unimpaired interlocutors. Special attention was paid to the potential interactional advantage of the adaptive use of elliptic-telegraphic style by patients. The major achievement of telegraphic style is that it prompts the unimpaired co-participant into active and enhanced co-construction. To date, three co-constructive practices have been observed:

(a) *Completion:* the patient designs his telegraphic expression in such a way that it can be easily completed by the co-participant.
(b) *Navigation:* the patient designs his telegraphic expression in such a way that the co-participant can ask goal-directed questions which, in turn, can be answered by the patients using very short and simple expressions.
(c) *Anticipation:* the unimpaired co-participant designs his turn in such a way that the patient can respond to it by a telegraphic expression which, in this sequential position, is entirely motivated and comprehensible.

Another observation is that the use of telegraphic style is not always advantageous. It strongly depends on the particular conversational partner. Enhanced and smooth co-construction may be achieved with one specific partner, but not with somebody else. This suggests that efficient interactional strategies are developed on a partner by

partner basis, fashioned over a long period of joint communication and crafted to meet the needs of both the patient and their interlocutor.

The conversation analytic approach to agrammatic speech enforced a reconsideration of Kolk and Heeschen's hypothesis that agrammatic telegrams are the same as elliptic constructions used by unimpaired speakers. The major difference between standard elliptic constructions and telegrams seems to be that agrammatic telegrams are frequently incomplete turn constructional units, due to the fact that they lack a recognizable completion point that signals to the co-participant to take over the floor. Such fragments were hardly ever found in ordinary talk-in-interaction between unimpaired interlocutors.

11.2 Normal ellipsis and agrammatic telegrams

Despite a somewhat abnormal use of telegrams in talk-in-interaction (as mentioned in the preceding section), telegrams might nevertheless be structurally related to a method of simplifying speech which has to be considered as a normal and socially accepted resource in German. In order to check this, Heeschen compared agrammatic telegrams and normal ellipses. This investigation is based on speech obtained in an informal interview-like situation. Elliptic-telegraphic expressions were defined and classified according to the scheme developed by B. Hofstede for Dutch (dissertation, U. Nijmegen, 1992). An ellipsis (or telegram) is here defined by the absence of a finite verb in an utterance. For unimpaired speakers, the major trends are the same in Dutch and German: (1) the overwhelming majority of elliptic constructions do not have a grammatical subject (80%); and (2) the two most frequent types of elliptic expressions are bare NP's (40%) and simplex non-finite verb forms (20%). This same general picture is found in agrammatic patients. There are, however, two differences

between unimpaired and agrammatic speakers: (1) the omission of grammatical subjects is even more marked in agrammatics than in unimpaired speakers (some agrammatics omit the subject in almost 100% of their telegrams); and (2) while unimpaired speakers almost always preserve the articles for NP's even in elliptic constructions, the agrammatics omit them - in their telegrams - in more than 50% of all obligatory contexts.

Although these may seem minor differences, they nevertheless require a modification of Kolk and Heeschen's original hypothesis since it maintained that there was identity between agrammatic and normal ellipses.

11.3 Agrammatism in the conversations of an Arrernte-English bilingual aphasic

Wilkins has been exploring the conversational interactions of M.H., an Arrernte-English bilingual aphasic. M.H. was 48 when she suffered a stroke in 1991. The stroke left her with a severe apraxia of speech and apparently agrammatic language. Her first language is Arrernte, an Australian Aboriginal language, but she also acquired English from later in childhood. Wilkins has worked with M.H. since 1982. Thus, he has worked closely with her both pre- and post-stroke, and can compare data from both periods.

One intriguing feature of M.H.'s post-stroke communication behavior is that, in both speaking and writing, she strongly favors English over Arrernte, even with Arrernte interlocutors and even though Arrernte was clearly her dominant language pre-stroke. An examination of her multi-word contributions to conversation reveals that while just over 60% of them are agrammatic, the distribution of her grammatical and ungrammatical utterances in interaction is not random. When M.H. herself initiates a conversation (usually after there has been a long pause), nearly 90% of her opening utterances

are grammatical. However, more than 75% of her multi-word contributions to ongoing conversation have agrammatic features. It appears that, when she has time to plan, she will construct grammatical utterances, but once she is in the rapid interchange of conversation she relies, perhaps strategically, on agrammatic utterances. While many of her English agrammatic utterances are telegraphic, a significant proportion show interference from Arrernte grammar. For instance, whenever a noun phrase is produced with the wrong word order for English, the ordering follows the NP structure rules of Arrernte. Thus, when, for example, she says 'breads white two', for 'two (loaves of) white bread' ('two white breads') she is reproducing the standard Arrernte ordering of the NP *merne mperlkere therre* ('bread white two').

11.4 Augmentative communication: Interaction and time

During his month-long visit at the Institute, Higginbotham (SUNY Buffalo) worked with Wilkins to explore the temporal characteristics of individuals using augmentative means of communication. In particular, they focused on the interactions of one individual (J.D.) who uses two different communication devices, a communication board and a computerized communicator.

J.D. is an American English speaker who, as a young adult, contracted encephalitis in 1967. This rendered her incapable of producing sustained vocal speech. Otherwise, her language abilities are intact. Her communication board consists of the alphabet, 281 alphabetized and color-coded words, regulatory phrases, punctuation, numbers, and the days of the week. Her computerized communicator, Dynavox, consists of a touch-sensitive screen, synthesized speech output and a word prediction display.

J.D. communicates at an order of magnitude slower than most English speakers (who average 150 - 200 words per minute). Using her communication board, she achieves rates averaging 19 words per minute. In this mode, interaction is a collaborative effort, involving a rapid interplay between her board indications and her interlocutor's responses. Here, her rate is determined by a functional interaction between her word choices (spelled or selected), the latency and duration of her interlocutor's response, and her interlocutor's deployment of interactional strategies such as guessing.

In contrast, J.D.'s productions on her Dynavox average only 6.5 words per minute. The collaborative effort of communication board use is largely absent, since she tends to compose her messages in silence while her interlocutors disattend from her ongoing activity. When the utterance is 'spoken' by the device, her interlocutors re-attend to the utterance production. Although it allows J.D. to construct utterances independently from her interlocutor, the Dynavox imposes significant temporal costs. Resultant delays during utterance composition range from about a quarter of a second to 4 seconds for each item selected, accumulating to a minute or more per utterance. These device-related delays impose significant limits on production rates - in this case contributing to the more than 65% percent decrease in speed compared with communication board use.

12. Other Research

12.1 Reference and coreference

12.1.1 Reference maintenance in child language

Hendriks, in collaboration with Hickmann (U. Rene Descartes, Paris), continued analyzing reference maintenance in L1 (English, French, German, and Chinese). Results show that local coreference is the crucial variable accounting for forms of subsequent mentions in L1. This result is extremely sturdy across child and adult languages, ages, stories, and referents.

Hendriks' and Hickmann's analyses show that, in all child languages but child German, the *position* of NPs is related to the semantical and grammatical roles of NPs in referent introductions and reference maintenance. Agentive and/or subject NPs used for subsequent mentions are often preverbal in child French, English and Chinese. Postverbal agents in passives are highly marked and postverbal subjects are reserved for referent introductions. However, NP role has no impact on variation in *form.* That is, agentives are just as likely to be pronominalized as nonagentive NPs. Although subjecthood is seemingly related to form (pronominals are often in subject role, nominals in other roles), coreference overrides this relation. Subject NPs are likely to be pronominalized only when they are coreferential with another subject NP in a preceding clause.

These general aspects of development apply to all child languages. However, others are clearly language-specific. Although NP position is hardly used at all to mark newness vs. givenness in adult and child German, it is often used in this capacity in child French.

In conclusion, children's acquisition of the devices necessary to mark information status is determined by several factors, including semantic and grammatical factors (affecting sentence-internal organization) and functional pragmatic ones (affecting discourse organization). With respect to reference maintenance, coreference has a similar impact on forms in all adult and child languages. However, other factors, such as parametric differences in the variable use of null elements and discourse pragmatic differences in the use of dislocations, result in crosslinguistic differences, some of which were expected given language-specific properties. Other crosslinguistic differences concerning the effect of referent on introductions and the variable levels of use of coreference across languages, were unexpected and require further research.

It is suggested that an adequate model of acquisition cannot do without the careful study of how languages map both discourse and sentential functions onto forms. This type of multi-functionality constitutes a fundamental problem to be solved during language acquisition.

12.1.2 Switch-reference and temporal dependence

Dickey examined switch-reference patterns in Miskitu, a Misumalpan language spoken in eastern Nicaragua. Switch-reference is a morphological device indicating the coreference or non-coreference of arguments (usually subjects) of adjacent clauses. In Miskitu, only temporally dependent (non-finite) clauses are marked for switch-reference. This close link between temporal dependence and switch-reference suggests that switch-reference marking is actually a by-product of the temporal dependence of non-finite clauses. This analysis recasts swith-reference as part of a wider system of cross-clausal dependencies and provides insight into the link between switch-reference and temporal dependence seen across languages.

12.1.3 NP gaps and coreference

During his visit to the Institute, Annamalai (Central Institute of Indian Languages, Mysore) continued his work on coreference in Tamil, focusing on the referential and argument-structural properties of NP gaps (i.e., missing arguments). Tamil, a free word order language, freely omits NPs in both autonomous sentences and discourse. How do listeners interpret these gaps? Annamalai found that no systematic distinction can be made between gaps that must be coindexed with an antecedent in the same sentence ('syntactic' gaps) and gaps that are syntactically unrestricted ('pragmatic' gaps). Gaps can be distinguished in terms of the likelihood that their referent will be understood to be specified by an antecedent in the same sentence, but most can have both intra-sentential and extra-sentential antecedents. There are gaps in specific syntactic constructions that exclude extra-sentential referents, but they are governed by the semantic properties of the predicates or by conceptualisation of a set of actions as a single conjoint event. Thus, they are not independent of semantic and pragmatic facts. The referent of the gap associated with a relativised pronoun is governed purely syntactically, but its absent case must be recovered semantically and pragmatically. Not all missing arguments are recoverable syntactically. In summary, in Tamil, the boundary between syntax and pragmatics is transparent, if not nonexistent, with regard to the referential properties of NP gaps.

12.2 Pragmatic and discourse structure

12.2.1 Generalized Conversational Implicature

Levinson completed a book manuscript on Grice's concept of Generalized Conversational Implicature (GCI). It is argued that this species of pragmatic inference has special, rather predictable properties, and is associated by default with linguistic expressions. Often confused with semantic specifications, GCIs are, in contrast,

defeasible or cancelable. A typology of such implicatures is presented, with many examples. It is shown that GCIs have rather radical implications for semantic theory because they intrude into the truth-conditions of utterances. In addition, GCIs are also shown to have important implications for syntactic theory. GCIs appear to be responsible for many aspects of anaphora normally attributed to syntactic rule. It is concluded that there is much greater scope for pragmatics in contemporary linguistic theory than is normally recognized.

12.2.2 Discourse structure and vocabulary structure

Together with Tweedie (Glasgow U.), Baayen continued his study of word frequency distributions. Baayen's earlier results traced deviations from the predictions of the urn model of discourse structure (Baayen, 1996). Tweedie and Baayen developed techniques to adjust Large Number of Rare Events (LNRE) models for the effects of discourse structure on the expectations of the vocabulary size and the frequency spectrum elements of text length (in word tokens). One such technique replaces the theoretically constant parameters of LNRE models by link functions that allow these parameters to vary systematically with the text length. Simple linear and power link functions often substantially improve the interpolation and extrapolation accuracy of LNRE models. Hence, they can be viewed as quantitative characterizations of the effect of discourse structure on vocabulary structure.

12.2.3 Pragmatic factors in meaning acquisition

E. Clark continued her work on pragmatic factors in word acquisition. When children hear an unfamiliar word, they must decide, on each occasion, what that word could mean. In doing this, they rely on joint attention and make use of any pragmatic directions adults offer about inter-word relations. They can also draw on coping strategies where pragmatic directions are absent or inadequate.

Pragmatic directions about the relations among words include use of forms like *is a kind of, is part of,* or *looks like.* Coping strategies rely on general knowledge and inferences in context. This account predicts that children will accept new words as they are offered and look for some meaning that contrasts with meanings already known, a prediction inconsistent with constraint-based accounts of early meaning acquisition. Both experimental work with 2- to 4-year-olds and observational data from 1- to 3-year-olds show that children readily acquire and use multiple terms for a single referent, counter to constraint-based predictions.

12.3 Formal semantics

12.3.1 Semantic incorporation and indefinities

Van Geenhoven continued developing her Semantic Incorporation theory of indefinites. In this theory, all indefinites are interpreted as non-quantificational expressions, but they are ambiguous between predicative and free variable expressions. The scope of a predicative indefinite is fully determined by a so-called semantically-incorporating verb. The scope of a free variable indefinite is determined by accommodation, a pre-interpretative mechanism adopted from presupposition theory. Semantically-incorporating verbs absorb predicative indefinites as one of their arguments, but not free-variable indefinites. According to the Semantic Incorporation theory, the study of the scope of indefinites should not only consider the meaning contribution of the indefinites involved but of the verbs as well. The theory is set up in such a way that it predicts reading preferences of indefinite descriptions and the relatively early acquisition of predicative expressions. This makes it attractive from a psycholinguistic and acquisition perspective (see report by Krämer).

The role of verbal argument structure in the determination of the meaning of indefinites has also been argued for in a study on intensional verbs conducted in cooperation with L. McNally (U. Pompeu Fabra, Barcelona). Van Geenhoven and McNally have also integrated the Semantic Incorporation theory into a new perspective on the well-known weak/strong distinction in the class of nominal expressions.

12.3.2 Nuclear stress and focus particle interpretation

Bierwisch explored certain intricate properties of scope-determining particles such as *also* and *again* and their German counterparts. The properties of some of these particles have been analysed in remarkable detail in the literature. However, characteristic patterns of their interpretation involving the interaction of syntactic position, stress, and scope assigment have not yet been investigated in detail.

A typical example of a relatively well-studied case is given in (6), the semantics of which is indicated in (7).

(6) Es ist unwahrscheinlich, daß *auch der* Präsident eine Rede hält
(It is unlikely that also the president will give a speech)

(7) Assertion: It is unlikely that the president will give a speech
Presupposition: For some x, x * the president, x will give a speech

In (6) *auch* has sentential scope. Its domain or focus consists of the NP *der Präsident,* which receives focal or nuclear stress. The effect of *auch* can be defined as follows:

(8) S' is true iff S is true, where S' results from S by the insertion of *auch,* and S' has the presupposition 3xP(x), where P(a) is the scope and a * x is the focus of *auch* in S\

What has not been well-studied is the effect of placing nuclear stress on the focus particle itself. Example (9) has essentially the same interpretation as (6) but only if *auch* carries nuclear stress. If the focal stress is on the VP *eine Rede hält* (resulting in pitch accent on *Rede),* it has the presupposition indicated in (10) rather than in (7).

(9) Es ist unwahrscheinlich, daß der Präsident *auch* eine Rede hält.

(10) Assertion: It is unlikely that the president will give a speech
Presupposition: For some x, x * give a speech, the president will do x.

Thus, if *auch* is stressed, the focus determining the content of the presupposition it introduces precedes the particle. If *auch* is unstressed, the pertinent focus is the stressed constituent to the right. In other words, identification of the focus bound to *auch* is crucially connected to the position of nuclear stress.

Stress placement also affects the interpretation of sentences with *noch* and *wieder,* but in different ways. For example, sentence (11) with *noch* has the semantic interpretation described in (12):

(11) Es ist unwahrscheinlich, daß der Präsident noch eine Rede hält
(It is unlikely that the President still gives a speech.)

(12) Assertion: It is unlikely that the president will give a speech
Presupposition (a): The president (already) gave a speech *(noch* is stressed)
Presupposition (b): For some x, x * give a speech, the president did x (already) *(noch* is unstressed)

Noch, like *auch,* requires clausal scope and a focus. If noch is unstressed, the focus is the stressed constituent to its right. If *noch* is

stressed, the focus is the whole clause. The semantic effect of noch can then provisionally be defined as in (13):

(13) S' is true iff S is true, where S' results from S by insertion of *noch,* and S' has the presupposition 3x [P(x) before P(a)] with x * a, where P(a) is the scope and 'a' is the focus of *noch* in S'.

The effect of stress on *wieder'is* illustrated in (14) and (15):

(14) Es ist unwahrscheinlich, daß der Präsident *wieder* weggeht
(It is unlikely that the president will leave again)

(15) Assertion: It is unlikely that the president will leave.
Presupposition (a): The president left before (repetitive sense).
Presupposition (b): The president was not present before (restitutive sense).

Like *auch* and *noch,* the addition of *wieder* only adds a presupposition. If *wieder* is unstressed, (14) introduces either presupposition (a) or (b). If weder is stressed, (14) may only introduce the presupposition (15a).

A rough approximation of the semantic effect of wieder is as follows:

(16) S' is true iff S is true, where S' results from S by insertion of *wieder,* and S' has the presupposition: 3p [p before p'] and p' is either
(a) the event described by the clause containing *wieder,* or
(b) the result of the event described by this clause.

If *wieder* has nuclear stress, only (16a) is available. If *wieder* is unstressed, (16a) or (16b) is available, in case the event has a specified result.

Further analyses will focus on which principles might possibly connect the syntactic, intonational and semantic aspects of focus particle interpretation.

12.4 Robotic instruction and machine learning

Böttner continued his research on variable-free semantics and machine learning of natural language. The focus of the project on variable-free semantics is on ternary relations and on their interactions with binary relations and anaphoric pronouns in Relational Grammar. This research has led to a reinterpretion of some relational constructions originally given by Peirce. Certain inadequacies in Peirce's proposals were pointed out and corrected.
Böttner's machine learning research is part of Suppes' machine learning project at CSLI Stanford. This research focuses on robotic instruction and physics word problems. One question in robotic instruction concerns how anaphors are linked to their antecedents. Given the instruction *Go to the screw. Pick it up.,* how does one learn to associate the pronoun *it* to the denotation of the expression *the screw!* A simple learning model was devised to answer this question. The model uses two features: depth of embedding of the antecedent denotation in the internal language and distance (i.e., number of words) between the antecedent phrase and the anaphoric term (distance). The model is able to learn to correctly associate occurrences of *it* with their antecedent referents for a small set of examples.

12.5 Evidentiality and epistemic expressions

Nuyts (U. Antwerpen) and Vonk continued their investigation of the role of evidentiality in the use of epistemic expressions (e.g., adverbs, predicative adjectives, mental state predicates, auxiliaries) (Annual Report 1996:122). This research seeks to achieve a better

understanding of the dimension of 'subjectivity versus objectivity' in epistemic evaluations and how it affects the use of epistemic expressions. One can interpret this dimension as involving either (1) the quality of the evidence for an epistemic evaluation (strong versus weak evidence), or (2) the (inter) subjectivity of the evaluation. For example, under the second interpretation, the speaker assumes personal responsibility for the evaluation rather than sharing this responsibility with others, particularly, the interlocutor.

An experiment was designed to test whether one or both of these interpretations actually effects the choice of expressions for an epistemic evaluation. The materials consist of stories presenting evidence (varied for factors (1) and (2)) leading to an epistemically modified conclusion by a protagonist. Subjects are asked to select from a set of alternative expressions the one which best matches the type of evidence available. Three pilot experiments have been conducted to test and improve the stories and expressions.

12.6 Child language negation

Jordens (F.U. Amsterdam) continued his research on the acquisition and use of the Dutch negative morphemes *nee* ('no'), *niet* ('not') and *geen* ('not a/no'). The development in children's positioning of these negative morphemes appears to be directly related to the acquisition of functional structure and scope. There appear to be four stages in this process. Initially, the non-anaphoric *nee* functions, unlike in the adult language, as a negative modal and appears in complementary distribution with other non-adult-like negative modals like *kan/mag+niet* ('cannot', 'not allowed'). At the second stage, modals begin to function as verbal heads, as in the adult language, and *nee* becomes obsolete. At the third stage, subject NPs occur between the finite verb and *niet* (as in (1)) but object NPs do not (as in (2)). This may be a reflection of the acquisition of 'Verb-Second' in Dutch.

(1) Nou is bloemetje **niet** op (Jasmijn 2;6).
Now is little-flower not on.
'Now the little flower is not on.'

(2) Ik vin **niet** pindakaas lekker (Jasmijn 2;6).
I find not peanut-butter tasty.
'I don't find the peanut butter tasty.'

Finally, as in (3), the child correctly positions *niet* before the nonfinite part of the predicate (e.g., *lekker)* and uses *geen* with nouns (as in (4)). This suggests that children at this stage can correctly choose between *niet* with sentential scope and *geen* with NP scope.

(3) Poes vindt ook schilletjes **niet** lekker (Jasmijn 3;0).
Pussy finds also peelings not tasty.
'Pussy doesn't find the peelings tasty.'

(4) Ik heb **geen** slabber voor (Jasmijn 3;0).
I have no bib on.
'I have no bib on.'

12.7 The German reflexive pronoun *sich*

Steinbach is currently completing his dissertation on middle voice and reflexivity in German. Like many Indo-European languages, German uses a (weak) accusative reflexive pronoun *(sich)* with reflexives, middle constructions, anticausatives and inherent reflexives to indicate valence reduction:

(5) a. Ralf rasiert sich endlich (reflexive)
Ralf (NOM) shaves REFL (ACC) finally

b. Der neue Mercedes fährt sich hervorragend (middle construction)
The new Mercedes (NOM) drives REFL (ACC) excellently

c. Der Stock bog sich im Wind (anticausative)
The stick (NOM) bent REFL (ACC) in-the wind

d. Hans-Martin erkältet sich (inherently reflexive)
Hans-Martin (NOM) catches-a-cold REFL (ACC)

Steinbach's research focuses on the syntactic and semantic properties of such transitive reflexive sentences. In the syntax, all of the examples in (5) are analyzed best as common transitive sentences. However, in the semantics, only the reflexive pronoun in (5a) introduces an argument variable of its own. The reflexive pronouns in (5b-d) do not introduce an argument variable. In these cases, the whole coindexed A-chain of nominative antecedent and accusative reflexive pronoun introduces only one argument in the semantic representation. This assumption on A-chains can be integrated into a slightly modified version of Reinhart and Reuland's (1993) binding theory, based on a distinction between structural and oblique case. With this we can explain several problematic facts, e.g. the well known fact that only the reflexive pronoun in (5a) can be coordinated, focused, modified by a focus sensitive operator, questioned or fronted. Furthermore, we can explain why constructions with dative reflexive pronouns parallel to (5b) and (5d) are ungrammatical. The dative case in German is an oblique case and therefore an A'-element. Hence, A-chain formation is impossible with dative reflexive pronouns.

13. Other Activities

13.1 Activities of the Technical Group

13.1.1 General

In 1997 the Technical Group was confronted with the task of organizing and carrying out the move of basically all equipment, and with setting up new infrastructures for general computation and experimental work. The focus was on enabling our scientific staff to start working again after only short breaks. Thanks to careful planning and preparation, the general computing facilities (the local area network, email, web access, application software) were running again after two days. The most important experimental labs were rebuilt within a few weeks.

A considerable amount of time was dedicated to planning, installing, and testing the new technical control system in the new conference room. This system allows the speaker to control all major presentation equipment, the lights, the curtains, etc. with the help of one small touch panel. The center of the presentation system is a large LCD-based screen projector which can easily be coupled with different video and computer sources. Further work on the user interface on the touch screen has to be carried out in early 1998.

For a large number of subjects mentioned below further information is available on the Institute's website.

13.1.2 MEID/WWW

The TG made improvements on the Institute's website. The website now contains an overview about public events such as talks, workshops, and dissertation defenses. This overview is part of the central event database which can be accessed by the MEID intranet system (Max-Planck Electronic Information Desk). Programs assure that only those events marked with 'public' are part of the agenda on the external website. Further, a set of scripts and forms was prepared to easily enable all employees to generate personal pages on the web. The TG added technical information to the website to give an overview of technical facilities of the Institute. Major publications such as the Annual Report are now available on the website.

The MEID intranet was also expanded. Users can now make specific requests to the TG using on line request forms. This expansion was a first small step towards a complete and transparent workflow system which will be completed in 1998. A user-friendly front end was added to allow users to enter periods of absence into a database.

13.1.3 Systems

A modern local area network (LAN) was installed in the new building. It is based on a Cat 5 cable system with star topology, i.e., all cables end up in one room, making it easier to establish various types of connections. Cat 5 copper cables were chosen over fiber optics because we do not use applications which have to support more than 100 Mbps streams to the desktop. Fiber optics cables were used only to establish high performance links between rooms with special infrastructures. The central LAN room is equipped with a modern type of cell-based switch and a number of hubs providing a large number of switched Fast-Ethernet and Ethernet connections. All servers are connected via 100 Mbps lines. Some multi-media

desktop computers are connected via dedicated 10 Mbps lines, which is enough to support MPEG1 media streams.

A router was bought to improve the connection between the Institute and the Dutch scientific network and to separate the administrative from the scientific data transfer. The router allows us to implement an improved security policy, offering only a selected number of IP-addresses to the outside world. Further, it will enable us to overcome the limitations of the C-class subnetwork by defining our own internal domain. The implementation work is to be carried out at the beginning of 1998.

Using internet services at home via ISDN connections still poses a problem, since the connections are not stable enough. However, accessing the Institute's mail host from home PCs via ECS mail is operating well.

Unix workstations (SUN, HP) and personal computers (PC, MAC) were added to the computing facilities. Tests using NT as a server were carried out. It was decided to make some services (printing, file service) available on NT rather than Netware during the coming years.

13.1.4 Experimental facilities

Setting up the various labs and new experimental rooms in the new Institute had the highest priority. Two eye-tracking facilities were installed. A number of labs still have to be set up at the beginning of 1998.

The NESU (Nijmegen Experiment Set Up) program has been extended. It has proved to be a very flexible and user-friendly tool to design and carry out experiments. The graphical user interface chosen for NESU has become a standard for experiment generators. The new software-based speech server (using a Soundblaster

compatible board) was further tested and found to have big advantages over the 'old' hardware-based speech servers. The new NESU-Box was extended with a 'vu-meter' which is a small LED-device which helps experimenters adjust acoustic recording levels easily during experiments to achieve optimal voicekey responses. An even smaller reaction device, the 'Mini-Box' (especially designed for field experiments) was developed. First experiments with random video segments were successfully carried out in the field with a hard-disc video recorder (DOREMI) controlled by a NESU-based PC.

A Synamps system for the new 64-channel based ERP-lab was purchased. The hardware was modified to satisfy the research needs of the neurocognition research group. It is now being connected to the NESU system using software means.

A new comprehensive and user-friendly NESU manual was written. Due to an increased demand from external NESU users, a two-day tutorial was organized and successfully run. Nevertheless, a considerable amount of time was spent to support external installation of NESU, and set up operational labs. A list-server is to be installed to improve the information network amongst NESU users.

The Institute decided to continue supporting NESU. Therefore the TG further discussed the design of 'NESU2000', a new version of NESU based on NT. Much work was put in investigating which programming environments will be used for the new NESU version and which specifications should be met.

13.1.5 Multi-media-corpora

The ESF Second Learner Corpus is currently being transformed to CHAT format under the guidance of the TG. The resulting corpus consists of textual material to which corresponding speech files are linked. A platform-independent tool called MED (MediaEditor) was

developed to do the time-consuming coding and labeling of the existing speech files. MED can also be used to do various sorts of analyses of the speech signal.

The tools developed to work with video material have been improved. TED (Transcript Editor) is now a mature tool which allows control of various types of video equipment, including certain Watchman types and hard-disc video recorders (DOREMI). In the beginning of 1998 a manual will be written to finish this project.

A major development at the Institute was the completion of MT (MediaTagger) and the user interface of the related gesture database. MT is a full multi-media tool programmed for the MAC which allows the user to work with corpora where textual material is combined with audio/video information (see: Annual Report 1996). The user interface enables the user to graphically specify his query structure, enter the appropriate query parameters, and to look into the transcripts and the corresponding video sequences. An MT manual is available. When the database part is added the MT project will be almost finished. *Currency* the gesture database consists of over 25,000 exactly time-aligned code entries referring to more than 70 digital video files of several minutes length.

The TG started a new development called EUDICO (European Distributed Corpora project) to meet the challenge of providing access to (multi-media) corpora via Internet. Here the idea is to enable users working somewhere on the web to access a multi-media database which can be distributed over several places independent of what type of computer they are working on. At the beginning two existing corpora will be included. It is assumed that within the next few years the available bandwidth in the wide area networks will be increased dramatically such that even video streams (MPEG1) can be transferred via the network. The project is based on the newest Java-based client-server and media technologies (Java Media Framework) and is supported by

SURFNET (Dutch scientific network) and SUN. A prototype was demonstrated successfully. The TG will devote considerable time to EUDICOin1998.

13.1.6 Spoken word recognition

The RAW model (see Annual Report 1994) was extended by a learning mechanism which was inspired by the work of Hintzman, Kruschke, and Rumelhart and Norman. In the first version, only a bootstrapping mechanism was implemented to test whether the chosen neural network structure was able to recognize words and simulate well-known psycholinguistic word recognition effects. Since bootstrapping the stored patterns with the help of only one token is not adequate, a fine tuning algorithm was added and optimized. Whenever new tokens are presented the neural network performs a recognition phase. If the target word is recognized and no competitor yields an equally high probability, the stored representations are accepted. If both the target and the competitors yield high probabilities with a too small difference the pattern of the target is made more general, i.e., a form of incremental averaging between the stored and the new pattern is carried out. The pattern of the competitors Is made more selective. In both cases a dynamic programming problem is solved implicitly by the chosen neural network architecture. In case that the target word only yields low probabilities, a new pattern is stored.

Tests with a small lexicon including highly similar words spoken by 4 female speakers with partly different dialects showed that this learning algorithm converges until all tokens are represented. The number of different traces needed per word depends on the relation between the differences among the tokens of a word and those amongst the different words, as expected.

13.2 CELEX: The Center for Lexical Information

At CELEX, the Dutch Expertise Center for Lexical Information, work continued on the German database. This was initially carried out by A. Krott until her departure in early 1997, and then taken over by S. Borgwaldt, who was appointed as a full-time collaborator in March 1997. Borgwaldt concentrated on testing the German database for accuracy and consistency, integrating the newly added 2000 lemmata, and modifying many morphological segmentations and inflectional paradigms in the process. This was in particular undertaken in preparation for the efficient disambiguation of German homograph frequencies on the basis of a 28 million token text corpus supplied by the Institut für Deutsche Sprache (IDS) in Mannheim.

Meanwhile, Piepenbrock, who continued his function as CELEX project manager, worked on applying Dutch spelling reforms to all lemma and wordform entries in close collaboration with the Nijmegen-based firm Polderland, a task which was completed by the end of the year. In a concerted effort with the DORO (Document Routing) project at the Computing Science Institute of Nijmegen University, all Dutch nominal and verbal argument structures, as well as their semantic features, such as selection restrictions on the verbs, were derived and converted to a format suitable for various language technology applications.

In the second half of 1997, an HP E35 dedicated database server, supplied by the Max-Planck-Gesellschaft in München, became operational for all interactive CELEX users inside and outside the Institute. Updated versions of the HP operating system and the ORACLE7 database manager were installed to ensure higher, more efficient performance, as well as improved system monitoring. Apart from on-line access to CELEX, the CD-ROM version remains available from the Linguistic Data Consortium (LDC) at the University of Pennsylvania.

Continued interest from the commercial world resulted in a number of lexical data license agreements with the firms Apricot Systems (which adapts and distributes Dragon speech software for the Netherlands), Eurospider Information Technology in Zürich, the Dutch KISS Information & Software Services, NEUROsoft therapeutic software in Münsingen, Germany, and Philips Speech Processing in Aachen, Germany.

As the five-year government-funded period for the CELEX project drew to a close, the University of Nijmegen announced that it would guarantee our services to the academic world for another three years. In this way, CELEX can be integrated with the recent Dutch-Flemish Spoken Corpus initiative in the coming years.

13.3 MPI Series in Psycholinguistics

In early 1997, the Ph.D. group decided to start a series in which to publish their theses. A committee consisting of Janssen, Van der Lugt, De Ruiter, Schultze-Berndt, and Wittek was formed to investigate matters. Their conclusion was that publishing in a series would give higher impact to the individual theses, and would be cheaper for the Ph.D. students. On the downside, some freedom in the cover and the layout had to be given up.

Following this investigation, publishers, printers, and graphical artists were contacted for information on price and possibilities. Of the many competing printers, Ponsen en Looyen was selected. For the cover design and the typography, Linda van den Akker was contracted. Many small problems were tackled, concerning, for example, copyright, Dutch and German thesis regulations, and ISBN numbers. Much time and effort were also spent on formulating restrictions on the cover design and the text makeup that all Ph.D.'s could agree with. Van der Lugt, Janssen and De Ruiter were

responsible for most of the negotiations with the printers and for making decisions in this phase.

Since the start of the series in Summer 1997, six books have appeared and two more are underway. Evaluating the results so far, it was more than worth the effort: With the *MPI Series in Psycholinguistics,* our Institute now has a representative and uniform platform for its theses. We think that the series will make both the quality and diversity of the research done at our Institute more visible to the outside world.

13.4 Nijmegen Lectures

The Nijmegen Lectures, which did not take place in 1996 due to the Institute's housing in temporary buildings, resumed in 1997. The 1997 Lectures were given in December by Michael K. Tanenhaus (U. Rochester).

In this series, titled 'Real-time language comprehension with natural tasks: A constraint-based perspective', Tanenhaus motivated and explained his visual world project. He showed how the paradigm is used to explore questions in word recognition, syntactic processing, incrementality in processing, and reference resolution.

The series was divided into two morning public lectures, 'Using eye movements to study real-time spoken language comprehension with natural tasks: An overview of the visual world project' and 'Integration of multiple constraints in language comprehension', and four seminars with discussants. Following the lectures there were two afternoon seminars: Tracking the time-course of lexical activation in continuous speech' (discussant McQueen), and 'Parsing preferences as emergent properties' (discussant D.C. Mitchell, U. Exeter). Two seminars closed the series: 'Incremental model-based interpretation: Evidence from the processing of

adjectives' (discussant G.L. Murphy, U. of Illinois at Urbana) and 'Constraints, reference resolution, and domains of interpretation' (discussant H. Clark, Stanford U.).

The Lectures were organized in cooperation with the Interfaculty Research Unit for Language and Speech (IWTS) of the University of Nijmegen. The series was organized by Hagoort, H. Kolk (U. Nijmegen), H. Schriefers (U. Nijmegen), and W. Vonk, with assistance from R. Zondervan.

13.5 The F.C. Donders Lectures on Cognitive Neuroscience

This lecture series is organized by C. Brown and Hagoort, in collaboration with the Nijmegen Institute of Cognition and Information (NICI). Speakers in the 1997 series were: D. Perrett (U. St. Andrews), M. Mishkin (National Institute of Mental Health, Bethesda), A. Cowey (Oxford U.), C. Frith (Wellcome Department of Cognitive Neurology, London), and J. LeDoux (New York U.).

13.6 Awards

Cutler and McQueen, together with D. Norris (MRC Applied Psychology Unit), were awarded the British Psychological Society Cognitive Psychology Award for 1997 for their work on the segmentation of continuous speech.

Van Turennout was awarded a TALENT Stipendium by the Netherlands Organization for Scientific Research.

The ministerial committee for the recognition of Dutch Sign Language, of which Levelt was a member, completed its work in May 1997 by publishing its report 'Meer dan een gebaar'.

13.7 Internal lectures and colloquia

Colloquia organized by the Institute's colloquium committee (Roelofs and Allen) included lectures by I. Maddieson (UCLA), R. Goebel (MPI Frankfurt), G. Humphreys (U. Birmingham), A. Verhagen (U. Utrecht), S. Loebner (U. Düsseldorf), J. Pierrehumbert (Northwestern U.), R Mayberry (McGill U.), and R. Scha (U. Amsterdam). Many informal lectures were also given by long-term and occasional visitors to the Institute.

13.8 Teaching

The staff of the Institute taught courses at the following institutions:

Baayen (ELSNET's 5th European Summer School, Leuven);
- Cutler (Ohio State U., U. Bochum, ESCOP Summer School on the Psychology of Language, Bressanone);

Danziger (LOT-Winterschool, Nijmegen);
Geenhoven and Drozd (internal course);
Hagoort (U. Amsterdam);
Hendriks (U. Paris VIII, U. Nijmegen);
Indefrey (Heinrich-Heine-U. Düsseldorf; Jahreshauptversammlung der MPG, Bremen);
Klein (LOT-Winterschool, Nijmegen; U. Heidelberg);
- McQueen (ESCOP Summer School on the Psychology of Language, Bressanone);
- Meyer (ESCOP Summer School on the Psychology of Language, Bressanone);

Nuyts (U. Antwerp);
- Roelofs (SISSA, International School for Advanced Studies, Trieste; ELSNET's 5th European Summer School, Leuven);
- Senft (U. Köln, U. Heidelberg);

Vonk, (U. Nijmegen);
- Wassenaar (U. Nijmegen, U. Groningen);

Wittenburg (U. Nijmegen).

13.9 Colloquia presented

The following members of the Institute and visitors (during their time at the Institute) presented colloquia at various institutions:

Allen (U. Toronto; U. Amsterdam; U. Victoria; Portland State U.);
Bowerman (Cambridge U.; Hebrew U., Jerusalem; U. Tel Aviv; U. Wales);
Baayen (U. Pompeu Fabra, Barcelona; U. Winnipeg, Manitoba);
Cutler (Indiana U.; Ohio U.; Cornell U.; Massachusetts Institute of Technology; Nat. U. Lesotho; U. Stellenbosch);
Danziger (U. Virginia; U. Michigan);
Geenhoven, van (U. Düsseldorf);
Grabe and Post (U. Saarbrücken);
Hagoort (U. California, San Diego; U. Washington, Seattle);
Heeschen (Jahreshauptversammlung der Max-Planck-Gesellschaft, Bremen; U. Helskinki; U. Turku; U. Stockholm);
Indefrey (Heinrich-Heine-U., Düsseldorf; Forschungszentrum, Jülich);
Kita (FU. Berlin; Ochanomizu Women's U., Tokyo; U. Maastricht);
Klein (Deutsche Gesellschaft für Sprachwissenschaft, Düsseldorf; U. Tübingen);

- Levelt (Rice U., Houston; CNRS, Paris; U. Edinburgh);
McQueen (U. Stellenbosch; House Ear Institute, Los Angeles);
Meyer (Wayne State U., Detroit);
- O'Seaghdha (U. Bielefeld);
Pederson (U. Oregon);
Piepenbrock (U. München);
Roelofs (U. Utrecht; Harvard U., Cambridge; U. Exeter);
Senft (U. Nijmegen; U. New South Wales and Centre for South Pacific Studies Sydney; U. Sydney; Australian National U., Canberra; U. Papua New Guinea, Port Moresby; Gymnasium am Rittersberg, Kaiserslautern);
- Steinbach (Humboldt U., Berlin);
- Turennout, van (Nat. Inst, of Mental Health, Bethesda);

- Walsh Dickey (U. Utrecht);
- Wittek, A. (U. Tübingen);
- Wittenburg (ICSI, Berkeley).

13.10 Workshops organized

Baayen, R. Schreuder (KUN), and A. Neijt (KUN) organized a workshop on spelling subsidized by the Dutch national graduate school for linguistics (LOT).

Kita organized a workshop on Pointing Gestures, which was held in Oud-Turnhout, Belgium, from 12th of June till 15th of June. Researchers from different disciplines who work on pointing gestures gathered to discuss issues including ontogeny, phytogeny, cultural variation, relationship to speech production, role of pointing in communication. Papers were presented by J. Haviland, A. Kendon, L. Versante, D. Wilkins, S. Kita, C. Goodwin, L Petitto, D. Povinelli, N. Masataka, G. Butterworth, S. Goldin-Meadow, E. Engberg-Pedersen, H. Clark, J.P. de Ruiter, P. Feyereisen, and A. Özyürek.

13.11 Presentations at conferences, congresses, and workshops

Alibali, M.W. "Social influences on cognitive development". The Annual Meeting of the Jean Piaget Society. Santa Monica, June.

Alibali, M.W., Miles, H. and Heath, D. "Do you see what I'm saying? Effects of visibility between speaker and listener on gesture". Annual Meeting of the Midwestern Psychological Association. Chicago, May.

Alibali, M.W., Sylvan, E.A., Fujimori, Y. and Kawanaka, T. 'The functions of teachers' gestures: What's the point?". The

Annual Meeting of the Midwestern Psychological Association. Chicago, May.

Alibali, M.W. and Perrott, M.A. "The role of encoding in Strategy Selection". The Biennial Meeting of the Society for Research in Child Development. Washington DC, April.

Allen, S.E.M. "Learning the structure of causatives in early Inuktitut". Workshop on Structure and Constituency in Languages of the Americas. Winnipeg, March.

Allen, S.E.M. "A discourse-pragmatic explanation for the subject-object asymmetry in early null arguments". Fourth GALA Conference. Edinburgh, April.

Allen, S.E.M. and Schröder, H. "Null subjects in discourse". Child Language Seminar. Garderen, September.

Baayen, R.H. "Stem productivity in lexical processing, or, How complex simplex words can be" (Invited speaker). 19. Jahrestagung der Deutschen Gesellschaft für Sprach-wissenschaft. Düsseldorf, February.

Baayen, R.H. "Corpora and lexical semantics" (Invited speaker). V. Jornada de Corpus Linguistics: els Corpus en la Recerca Semäntica i Pramätica. Barcelona, April.

Baayen, R.H. "Lexical statistics". 18th International ICAME Conference Chester, May.

Baayen, R.H. "Deconstructing texts with electronic dice: Monte Carlo methods in lexical statistics" (Invited speaker). Workshop on Computationally Intensive Methods in Quantitative Linguistics. Glasgow, September.

Baayen, R.H. and Renouf, A. "Aviating among the hapax legomena: On the birth of new affixes in current newspaper English". 18th International ICAME Conference. Chester, May.

Baayen, R.H. and Tweedie, F.J. 'The parameters of LNRE models a sample-size invariant: problems and opportunities". Third International Conference on Quantitative Linguistics. Helsinki, August.

Behnke, K. and Wittenburg, P. "Ein selbstorganisierendes Netzwerk zur Simulation früher Spracherwerbsprozesse bei Klein-

kindern". Workshop SOAVE97 Selbstorganisation von adaptivem Verhalten. Ilmenau, September.

Berkum, J.J.A. van, Brown, C. and Hagoort, P. "Rapid discourse effects in sentence processing: ERP evidence". The Fourth Annual Meeting of the Cognitive Neuroscience Society. Boston, March.

Berkum, J.J.A. van, Brown, C. and Hagoort, P. "Snelle effecten van discourse context tijdens zinsverwerking: ERP evidentie". The Sixth Winter Conference of the Dutch Psychonomic Society. Egmond aan Zee, December.

Bierwisch, M. "Mindestbedingungen lexikalischer Semantik". DFG Jahrestagung. Düsseldorf, March.

Bierwisch, M. "Erinnern und Vergessen". Computerlinguistisches Symposium 'Semantik, Syntax und das Lexikon - Theorie und Implementation'. Berlin, April.

Bierwisch, M. "Natürliche Sprache als formales Berechnungssystem". Ästhetik der Wissenschaft: Psyche und Physis. Frankfurt/Main, June.

Bierwisch, M. "Symmetrien und Lücken im Lexicon". Das Lexikon in der Grammatik: Symmetrien und Asymmetrien. Düsseldorf, June.

Bierwisch, M. "Reducing lexical information". Workshop 'Contrastive Lexical Semantics'. Münster, May.

Bierwisch, M. "Modularity of language - New perspectives on a traditional theme". 20. Internationales Wittgenstein Symposium. Kirchberg, August.

Bierwisch, M. "Das altägyptische Wörterbuch - Versuch einer strategischen Einordnung". Arbeitstagung aus Anlaß des Neubeginns der Arbeit am ägyptischen Wortschatz ein Jahrhundert nach der Gründung der akademischen Kommission zur Herausgabe des 'Wörterbuchs der ägyptischen Sprache'. Berlin, September.

Bierwisch, M. "Syntax in humans and birds". International Workshop 'Signal Sequence and Sense'. Berlin, October.

Bierwisch, M. "Almost, again: A speech for a lexicalist approach". 2. Jahrestagung der Gesellschaft für Semantik. Berlin, December.

Bohnemeyer, J. 'Time relations in discourse. Evidence from Yucatec Mayan". The 5th International Cognitive Linguistics Conference. Amsterdam, July.

Bohnemeyer, J. "Yucatec Mayan lexicalization patterns in time and space". Opening of the Academic Year of the CLS 1997/98. Nijmegen, October.

Böttner, M. "Der Peirce-Schröder-Kalkül als Universalsprache". 32. Linguistisches Kolloquium. Kassel, September.

Bowerman, M. "Puzzling over children's acquisition of predicates: Meaning, syntax, and event packaging" (Keynote address). Postgraduate Linguistics Conference. Manchester, March.

Bowerman, M. "Predicate semantics and lexicosyntactic development: A crosslinguistic perspective" (Plenary lecture). Fourth GALA Conference ('Language Acquisition: Knowledge Representation and Processing'). Edinburgh, April.

Bowerman, M. and Choi, S. "Development of spatial expressions: A cross-linguistic study in English and Korean". Symposium on Language and Thought: Putting the World into Words and Gestures, Society for Research in Child Development. Washington DC, April.

Bowerman, M. "Partitioning space: Crosslinguistic perspectives on how languages classify spatial relations and how children acquire the categories". NSF Workshop Visual Cognition and Decision-Making in the Spatial Domain. Ellicott City, May.

Bowerman, M. "Culture, cognition, and language development" (Plenary lecture). Jean Piaget Society Meetings. Los Angeles, June.

Bowerman, M. "Form-meaning mapping in first language acquisition" (Plenary lecture). Fifth International Cognitive Linguistics Conference. Amsterdam, July.

Bowerman, M. 'The structure and acquisition of external possessors in German, Dutch, and English". Conference on External Possessors. Oregon, September.

Bowerman, M. "Verbs for spatial situations - a crosslinguistic developmental perspective". Conference on Verbs and Situations: Verb Semantics in Linguistics and Connected Disciplines. Bielefeld, October.

Brown, C. "Neurocognition of sentence processing". The 16th International Congress of Linguistics. Paris, July.

Brown, C, Hagoort, P. and Vonk, W. "Semantic effects on syntactic analyses: Evidence from brain potential recordings". The Tenth Annual CUNY Conference on Sentence Processing. Santa Monica, March.

Brown, C, Hagoort, P. and Vonk, W. "Semantic effects on syntactic analyses: ERP evidence". The Fourth Annual Meeting of the Cognitive Neuroscience Society. Boston, March.

Brown, C, Hagoort, P. and Vonk, W. "Het samenspel van betekenis en grammatica tijdens zinsverwerking: Electrofysiologische evidentie". The Sixth Winter Conference of the Dutch Psychonomic Society. Egmond aan Zee, December.

Brown, P. "Early Tzeltal verbs: argument structure and argument representation". The 29th Annual Child Language Research Forum. Stanford, April.

Brown, P. "Children's first verbs in Tzeltal: evidence for an early verb category". Workshop on Language Acquisition, UNAM. Mexico City, July.

Brown, P. "Children's acquisition of spatial frames of reference in Tzeltal". The Biennial Meeting of the Psychological Anthropology Meeting. San Diego, October.

Brown, P. "Conversational structure and language acquisition: the role of repetition in Tzeltal adult and child speech". The Annual Meeting of the American Anthropological Association. Washington DC, November.

Brugman, H. "MediaTagger: building and using multi-medial gesture corpora on basis of digital video". Pointing Conference. Oud Turnhout, June.

Chen, C, Crago, M.B., Allen, S.E.M. and Genesee, F.H. "Syncretism in bilingual Inuit homes: The blending and dissociation of language and culture". International Symposium on Bilingualism. Newcastle-upon-Tyne, April.

Chen, H.-C. and Cutler, A. "Short-term and long-term phonological priming in Cantonese word recognition". The 38th Annual Meeting of the Psychonomic Society. Philadelphia, November.

Chen, H.-C. and Cutler, A. "Phonological priming in Cantonese word recognition". The 8th International Conference on the Cognitive Processing of Asian Languages. Nagoya, December.

Crago, M.B. and Allen, S.E.M. "Issues of complexity in English and Inuktitut child-directed speech". The 29th Annual Stanford Child Language Research Forum. Stanford, April.

Cutler, A. "Recognizing words in fluent speech". Approches Cognitives du Traitement Automatique du Langage. Geneva, January.

Cutler, A. "How can listeners find the right words?". International Association of Teachers of English as a Foreign Language, Listening Skills Conference. Cambridge, March.

Cutler, A. "Language and speech perception". Workshop Language Acquisition and Use in Multilingual Societies. Girona, May.

Cutler, A. "Word prosody in word recognition". Workshop Language and Music Processing. Marseille, September.

Cutler, A. "A viability filter for lexical access in spoken-word recognition" (Invited keynote address). The 11th Australian Language and Speech Conference. Melbourne, November.

Cutler, A. "Real words, phantom words and impossible words - word recognition in continuous speech" (Invited keynote address). Workshop Human and Machine Processing of Language and Speech. Bangkok, December.

Cutler, A. "Suprasegmental information in lexical access". Workshop, Human and Machine Processing of Language and Speech. Bangkok, December.

Cutler, A. "A viability filter for lexical access in spoken-word recognition" (Invited keynote address). The Sixth Winter Conference of the Dutch Psychonomic Society. Egmond aan Zee, December.

Danziger, E. "Second thoughts? Gender, space and relativity in Mopan Maya". Session of the Annual Meetings of the American Ethnological Society: 'Ethnolinguistic Relativism: Pre-Whorfian Roots and Post-Whorfian Branches'. Seattle, March.

Danziger, E. "Personal space: Place names in Mopan Maya. Language and space: Everyday constructions of inhabitable spaces" (Invited Session). The 96th Annual Meeting of the American Anthropological Association. Washington DC, November.

Danziger, E. and Pederson, E. 'Through the looking-glass: A cross-cultural survey of written language and mirror image discrimination". The Annual Meeting of the Linguistic Society of America. Chicago, January.

Dickey, M.W. and Vonk, W. "Center-embedded structures in Dutch: An on-line study". The Tenth Annual CUNY Conference on Sentence Processing. Santa Monica, March.

Dickey, M.W., Johnson, V., Roeper, T. and Seymour, H. 'Tense and discourse in African-American English". New Perspectives on Language Acquisition Conference. Amherst MA, June.

Dickey, M.W. "Clause chaining and switch-reference in Miskitu". The 28th Annual Meeting of the North Eastern Linguistics Society. Toronto, October.

Donselaar, W. van. "Lexicale klemtoon in het Nederlands". Meeting of the Nederlandse Vereniging voor Fonetische Wetenschappen. Nijmegen, October.

Donselaar, W. van and Cutler, A. "Exploitation of stress information in spoken-word recognition in Dutch". The 134th Meeting, Acoustical Society of America. San Diego, December.

Drozd, K.F. 'The syntax and semantics of 'no' and negative constituents in child English". Fourth GALA Conference. Edinburgh, April.

Essegbey J. "The syntax of inherent complement verbs in Ewe and the unaccusativity hypothesis". The 2nd World Congress of African Linguistics. Leipzig, July.

Fujimori, Y., Sylvan, E.A. and Alibali, M.W. "Gestures in the classroom in Japan and the United States". The Annual Meeting of the Jean Piaget Society. Santa Monica, June.

Geenhoven, V. van "On the discourse transparency of predicative indefinites". 19. Jahrestagung der deutschen Gesellschaft für Sprachwissenschaft. Düsseldorf, March.

Geenhoven, V. van and McNally, L. "De dicto readings via semantic incorporation". Texas Linguistic Society Conference on the Syntax and Semantics of Predication. Austin, March.

Geenhoven, V. van "On semantically non-vacuous type-lifting". Workshop on Semantic Variation held during the LSA. Ithaca, July.

Geenhoven, V. van "A semantic analysis of extemal possessors in West Greenlandic noun incorporating constructions". Conference on Extemal Possession and Related Noun Incorporation. Eugene, September.

Gerling, P.., Wittenburg, P. and Gelbe, B. "Sicherheit und Firewall-Konzepte". 14. DV-Treffen der Max-Planck-Institute. Görtingen, November.

Gijn, I. van, Kita, S. and Hulst, H. van der "Form characteristics of gestures and signs". Bielefeld Workshop on Gestures. Bielefeld, September.

Grabe, E. "An autosegmental-metrical comparison of English and German intonation". ESCA Tutorial and Research Workshop on Intonation: Theory, Models and Applications. Athens, September.

Grabe, E., Gussenhoven, C, Haan, J., Marsi, E. and Post, B. 'The meaning of intonation phrase onsets in Dutch". ESCA Tutorial and Research Workshop on Intonation. Athens, September.

Hagoort, P. "When syntax meets semantics: Who is doing what to whom?". The Tenth Annual CUNY Conference on Sentence Processing. Santa Monica, March.

Hagoort, P. "When syntax meets semantics: Who is doing what to whom?". The Fourth Annual Meeting of the Cognitive Neuroscience Society. Boston, March.

Hagoort, P. "HersenTAAL". Conference 'Language for the General Public'. Nijmegen, April.

Hagoort, P . "Zonder fosfor geen gedachten: Gagarin, geest en brein". Annual Meeting of the 'Reunistenvereniging Veritas'. Utrecht, May.

Hagoort, P. "Speaking as it unfolds in time: ERP and PET evidence". McDonnell-Pew Seminar. La Jolla, June.

Hagoort, P. "Electrophysiological and PET studies of language". The 1997 McDonnell Summer Institute in Cognitive Neuroscience. Hanover, July.

Hagoort, P. "Gagarin, mind, brain, and person". Vatican Observatory. Castel Gandolfo, September.

Hagoort, P. "The functional anatomy of syntactic processing: Evidence from brain imaging research". The 29th Annual General Meeting of the European Brain and Behaviour Society EBBS. Tutzing, September.

Hagoort, P. "From single words to syntax: The neural architecture as revealed by PET". Biomed Meeting 'Mapping Language Functions in the Brain'. Jena, September.

Hagoort, P. "Language and the brain: How many languages fit into one brain?". Taaldag', organized by the K.L. Poll Society and NRC-Handelsblad. Amsterdam, October.

Heeschen, C. 'The role of agrammatic telegraphic speech in talk-in-interaction". Disorder and Order in Talk: Conversation Analysis and communicative disorders. London, June.

Hendriks, H. "Processus de grammaticalisation dans l'acquisition d'une langue, une comparaison L1/L2". Journees de Rencontre entre les Differents Laboratoires Composant le GdR C.N.R.S. 113. La Baume des Aix, March.

Hendriks, H. "Spatial reference in narrative discourse: a comparison of French, German and Chinese". International Conference EUROSLA 7. Barcelona, May.

Hendriks, H. "Packaging of spatial information: a comparison of L1/L2 acquisition". Conference Internationale de Psychologie Developpementale, Symposium on 'Comparative studies of Language Acquisition'. Rennes, September.

Hoeks, J., Vonk, W., Hagoort, P. and Brown, C. "Processing coordination: Eye movements and ERPs". The Tenth Annual CUNY Conference on Sentence Processing. Los Angeles, March.

Hoeks, J.C.J., Vonk, W., Brown, C. and Hagoort, P. "Het verwerken van gecoordineerde structuren". The Sixth Winter Conference of the Dutch Psychonomic Society. Egmond aan Zee, December.

Indefrey, P., Brown, C, Hagoort, P., Herzog, H., Sach, M., and Seitz, R.J. "A PET study of cerebral activation patterns induced by verb inflection". The 3rd Human Brain Map Conference. Copenhagen, May.

Indefrey, P. "PET studies of language processing: from words to sentences". The 3rd BSA National Conference. Newcastle, September.

Janssen, D.P. and Doeleman, R. "Align, programma voor fonetische vergelijking van transcripten: Toepassing op een corpus van gesproken allochtoon en autochtoon Nederlands". Studiedag Gesproken Tekstcorpora. Tilburg, December.

Janssen, D.P. and Roelofs, A. "Production of verbal inflections: a special case?". 39. Tagung experimentell arbeitender Psychologen. Berlin, March.

Janssen, D.P. and Roelofs, A. "Productie van werkwoordsvormen". The Sixth Winter Conference of the Dutch Psychonomic Society. Egmond aan Zee, December.

Janssen, D.P., Roelofs, A. and Levelt, W.J.M. "Same sound, different frames: Inflection of Dutch verbs and nouns". International Cognitive Linguistics Conference. Amsterdam, July.

Jordens, P. 'The acquision of functional projections and scope. The case of negation in Dutch". International Conference EUROSLA 7. Barcelona, May.

Jordens, P. "Op zoek naar de default". Morfologiedagen 1997. Liege, September.

Jordens, P. and Hulk, A. 'Tweede-taalverwerving in discussie". Toegepaste Taalwetenschap in Discussie. Jubileum-conferentie t.g.v. het 25-jarige bestaan van de Nederlandse Vereniging voor Toegepaste Taalwetenschap. Rolduc, November.

Kita, S. "Japanese verbs of entering and exiting without semantic encoding of continuous motion". Annual Meeting of the Linguistic Society of America. Chicago, January.

Kita, S. "Non-verbal behaviors in human face-to-face interaction: some requirements for virtual social agents". ATR Workshop on Social Agents. Kyoto, April.

Kita, S. "Coordination of gaze/head and hand in pointing: a cross cultural study". Max-Planck Workshop on Pointing Gestures. Oud-Turnhout, June.

Köster, 0., Hess, M.M., Schiller, N.O. and Künzel, H.J. 'The correlation between auditive speech sensibility and speaker recognition ability". 9th Annual Congress of the International Society for Forensic Phonetics. Edinburgh, July.

Künzel, H.J., Köster, O. and Schiller, N.O. "Effects of cellular telephone transmission on speaker recognition". 9th Annual Congress of the International Society for Forensic Phonetics. Edinburgh, July.

Levelt, W.J.M. "A theory of spoken word production", (invited keynote lecture). Workshop on Lexical Access, University College. London, March.

Levelt, W.J.M. 'The place of cognitive psychology in the social sciences" (invited lecture). Conference on the Place of Psychology in Social Science, Ecole des Hautes Etudes en Sciences Sociales. Paris, April

Levelt, W.J.M. "A theory of lexical access in speech production" (keynote lecture). European Society for Philosophy and Psychology, 6th Annual Conference Padova, August.

Levelt, W.J.M. "Introduction Language Symposium". European Brain and Behavior Society, 29th Annual General Meeting. Tutzing, September.

Levelt, W.J.M. "Where do spoken words come from?" (opening lecture). International Clinical Phonetics and Linguistics Association. 6th Annual Conference. Nijmegen, October.

Levelt, C, Schiller, N.O. and Levelt, W.J.M. 'The effect of prosodic constraints on the lexical output of young children: An empirical study on one to three-year-old children". 19. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Düsseldorf, February.

Littleton, E.B. and Alibali, M.W. "What children's hand gestures reveal about learning to write". Symposium conducted at the Annual Meeting of the Conference on College Composition and Communication. Phoenix, March.

Loosbroek, E. van and Drozd, K.F. "Changes and variability in the interpretation of 'alleen' (only)". Congres Ontwikkelings-psychologie te Leusden. Leusden, September.

Lugt, A.H. van der "Sequential probabilities as a cue for segmentation". 5th European Conference on Speech Communication and Technology (EUROSPEECH '97). Rhodes, September.

McNally, L. and Geenhoven, V. van "Redefining the weak/strong distinction". Colloque de Syntaxe et Semantique 2. Paris, October.

McQueen, J.M. "Compensation for coarticulation is not modulated by the lexicon". Conference on Language Acquisition and Use in Multilingual Societies. Girona, May.

McQueen. J.M. "Possible and impossible words in spoken word recognition". Meeting of the NWO Onderzoeksgroep Taal en Geheugen. Utrecht, June.

McQueen, J.M. "Perceptual compensation for coarticulation is modulated by the probability of phoneme transitions but not by the lexicon". Meeting of the Nederlandse Vereriiging voor Fonetische Wetenschappen. Nijmegen, October.

McQueen, J.M. and Pitt, M.A. 'Transitional probability, not lexical knowledge, influences compensation". The 134th Meeting of the Acoustical Society of America. San Diego, December.

McQueen, J.M. "Commentary on: Tracking the time-course of lexical activation in continuous speech". M.K. Tanenhaus Nijmegen Lectures. Nijmegen, December.

Meyer, A.S. "Viewing and naming objects: Gaze control during noun phrase production". The Sixth Winter Conference of the Dutch Psychonomic Society. Egmond aan Zee, December.

Meyer, A.S., Roelofs, A. and Schiller, N.O. "Metrisches Kodieren von Wörtern mit regelmäßigem und unregelmäßigem Betonungsmuster" [Metrical encoding of words with regular and irregular stress pattern]. 39. Tagung experimentell arbeitender Psychologen. Berlin, March.

Meyer, A.S., Sleiderink, A.M. and Levelt, W.J.M. "Eye movement control during pattern description". The 38th Annual Meeting of the Psychonomic Society. Philadelphia, November.

Nolan, F. and Grabe, E. 'The transcription of intonational variation in the British Isles". ESCA Tutorial and Research workshop on Intonation. Athens, September.

Nuyts, J. "Layered models of qualifications of states of affairs: Cognition vs. typology?". International Cognitive Linguistics Conference. Amsterdam, July.

Nuyts, J. and Vonk, W. "An experimental investigation of the discourse structure of epistemic expression forms in Dutch". International Cognitive Linguistics Conference. Amsterdam, July.

Otake, T. and Cutler, A. "Early use of pitch accent in Japanese spoken-word recognition". 134th Meeting, Acoustical Society of America. San Diego, December.

Özyürek, A. "Do iconic gestures point?". The MPI Workshop on Pointing Gestures. Oud Turnhout, June.

Pederson, E. "Simply logical: linguistic reasoning and truth-functional connectives". The International Cognitive Linguistics Conference. Amsterdam, July.

Rijn, H. van and Vonk, W. "Oogbewegingen en de orthografische informatie in het begin van woorden". 20. Mini-symposium over Lezen. Nijmegen, May.

Rittle-Johnson, B. and Alibali, M.W. "Mutual interaction between concepts and procedures in children learning mathematical equivalence". The Biennial Meeting of the Society for Research in Child Development. Washington DC, April.

Roeck, A. de and Nuyts, J. 'Taal als een (troebel) venster op het autistische denken". Studium Generate. Maastricht, January.

Roelofs, A. and Baayen, H. "Semantic transparency in speech production: Testing WEAVER". 39. Tagung experimentell arbeitender Psychologen. Berlin, March.

Roelofs, A. and Meyer, A.S. "Applying the WEAVER model of speechproduction to metrical planning". Conference on Computational Psycholinguistics (CPL '97). Berkeley CA, August.

Ruiter, J.P.A. de "Pointing and speaking synchronized". Workshop on Pointing Gestures. Oud-Turnhout, June.

Schiller, N.O. "Silbe, Silbengrenze, ambisyllabische Konsonanten: Psycholinguistische Befunde zum Niederländischen". Journee des Sprachtypologischen Arbeitskreises der Universität Osnabrück am 10.01.1997 zum Thema

'Dynamische Konzepte in der Sprachwissenschaft /Sprachtypologie'. Osnabrück, January.

Schiller, N.O. "Der Einfluß phonologischer Output-Beschränkungen auf die Silbifizierung zweisilbiger Substantive". 23. Deutsche Jahrestagung für Akustik. Kiel, March.

Schiller, N.O. "Der Effekt von maskiertem Silbenpriming auf die Sprechlatenzen bei der Produktion zweisilbiger Substantive". 39. Tagung experimentell arbeitender Psychologen. Berlin, March.

Schiller, N.O. "Does syllable frequency affect production time in a delayed naming task?". 5th European Conference on Speech Communication and Technology (EUROSPEECH '97). Rhodes, September.

Schiller, N.O. 'The role of the syllable in speech production. Data from lexical statistics, metalinguistics, and masked priming". CLS (Centre for Language Studies) Opening of the Academic Year 1997/98. Nijmegen, October.

Schiller, N.O. 'The effect of masked syllable primes on word and picture naming". 134th Meeting of the Acoustical Society of America. San Diego, December.

Schiller, N.O. and Köster, O. 'The ability of expert witnesses to identify voices: A comparison between trained and naive listeners". 9th Annual Congress of the International Society for Forensic Phonetics. Edinburgh, July.

Schiller, N.O., Lieshout, P.H.H.M. van, Meyer, A.S. and Levelt, W.J.M. "Ist die Silbe eine artikulatorische Einheit in der Sprachproduktion? Hinweise aus einer EMA-Studie". 23. Deutsche Jahrestagung für Akustik. Kiel, March.

Schiller, N.O., Lieshout, P.H.H.M. van, Meyer, A.S. and Levelt, W.J.M. 'The articulatory timing of intervocalic consonants with different syllable affiliations: Results from an EMMA study". 6th Annual Conference of the International Clinical Phonetics and Linguistics Association (ICPLA). Nijmegen, October.

Schouten, C.H. and Vonk, W. "Indefinite subjects in context". 5th International Cognitive Linguistics Conference. Amsterdam, July.

Senft, G. "ENTER and EXIT in Kilivila". Third International Conference on Oceanic Linguistics. Hamilton, January.

Senft. G. "Elizitierung und lexikalisch-semantische Beschreibung von KOMMEN/GEHEN-Verben im Kilivila". 19. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Düsseldorf, February.

Senft, G. "Frames of spatial reference in Kilivila - studies in language, cognition and the conceptualization of space". Workshop in Spatial Cognition. Rome, September.

Senft, G. 'The presentation of self in touristic encounters. A case study from the Trobriand Islands". Oprichtingscongres Nederlandse Vereniging voor Azie en Pacific Studies. Utrecht, October.

Senft, G. "Weisen von Liebe und Tod auf den Trobriand-Inseln". ArToll Lyrik-Tage. Bedburg-Hau, October.

Slobin, D.I. "Language and thought: Putting the world into words and gestures". Society for Research on Child Development. Washington DC, April.

Slobin, D.I. "In a manner of going: Influences of lexicalization patterns on descriptions of motion events". Second Meeting of the Association for Linguistic Typology (ALT II). Eugene, September.

Slowiaczek, L.M., Soltano, E.G. and McQueen, J.M. "Facilitation of spoken word processing: Only a rhyme can prime". 38th Annual Meeting of the Psychonomics Society. Philadelphia, November.

Starren, M. "Do temporal adverbials shape morphosyntactic tense and aspect marking?". Fourth GALA Conference. Edinburgh, April.

Starren, M. "From scope adverbials to syntactic structure: the structural organization of temporality in learners discourse". International Conference EUROSLA. Barcelona, May.

Starren, M. "Het opzetten van een gesproken-tekstcorpus voor taalverwervingsonderzoek". Studiedag Stichting Tekst-corpora en Databestanden in de Humaniora. Tilburg, December.

Steinbach, M. "Adjunkte in Middles". GGS-conference. Wien, May.

Turennout, M. van, Hagoort, P., and Brown, C. "Structure before sound in speaking: Electrophysiological evidence". Fourth Annual Meeting of the Cognitive Neuroscience Society. Boston, March.

Tweedie, F.J. and Baayen, R.H. "How variable may a constant be? Measures of lexical richness in perspective". Joint Conference of the Association for Computers and the Humanities and the Association for Literary and Linguistic Computing. Kingston, June.

Vonk, W., Radach, R, and Rijn, H. van "Parafoveal preview and the saliency of word beginnings". ESCOP workshop on eye guidance. Chamonix, February.

Vonk, W., Radach, R., and Rijn, H. van "Eye guidance and the saliency of word beginnings". The Ninth European Conference on Eye Movements. Ulm, September.

Vonk, W. "Semantic and syntactic effects in processing relative clauses". Workshop on Processing Wh-Constructions, Groningen, May.

Vonk, W. and Hustinx, L.G.M.M. "Discontinuity markers and cohesion in discourse". International Workshop on Text Representation: Linguistic and Psycholinguistic Aspects. Utrecht, July.

Vonk, W. and Hustinx, L.G.M.M. "Understanding demonstrative noun phrases and class-membership inferences". The Seventh Annual Meeting of the Society for Text and Discourse. Utrecht, July.

Walsh Dickey, L. "Palatalization and the phonological structure of rhotics". Third Holland Institute of Generative Linguistics Phonology Conference (HILP3). Amsterdam, January.

Walsh Dickey, L. "Liquid dissimilation: Latin and Yidin/'. The Annual Meeting of the Linguistic Society of America. Chicago, January.

Wassenaar, M., Hagoort, P. and Brown, C. 'The Syntactic Positive Shift (SPS) in Broca's aphasics with agrammatic comprehension". 28. Jahrestagung der Gesellschaft für Angewandte Linguistik. Bielefeld, September.

Wassenaar, M., Hagoort, P. and Brown, C. "Syntactic ERP effects in Broca's aphasics with agrammatic comprehension". The 35th Annual Meeting of the Academy of Aphasia. Philadelphia, October.

Weijer, J. van de "Language input and word discovery". Child Language Seminar. Garderen, September.

Weijer, J. van de "Language input to a prelingual infant". Fourth GALA Conference. Edinburgh, April.

Wilkins, D. "Why pointing with the index finger is not a universal (in socio-cultural and semiotic terms)". Workshop on Pointing Gestures. Oud-Turnhout, June.

Wilkins, D. "Alternative representations of space: Arrernte narratives in sand". The CLS Opening Academic Year 1997/1998. Nijmegen, October.

Wittek, A. "Can children use linguistic cues in learning the meaning of verbs? Evidence from German: The adverb wieder ('again')". Child Language Seminar. Garderen, September.

Wittek, A. "Learning verb meaning via adverbial modification: Change-of-state verbs in German and the adverb wieder ('again')". The 22nd Annual Boston University Conference on Child Language Development Boston, November.

Wittenburg, P., Dashorst, M. and Kuijk, D. van "A real-speech model for human word recognition". First Conference of Computational Psycholinguistics. Berkeley, August.

Wittenburg, P. "Personalsituation in der DV in der Max-Planck-Gesellschaft". 14. DV-Treffen der Max-Planck-Institute. Göttingen, November.

Wittenburg, P., Redeker, G., Brugman, H., Broeder, D. and Piepenbrock, R. "Constructing and accessing multi-media corpora". STDH Studiedag Spoken Text-Corpora. Tilburg, December.

Zavala, R. "Inverse clause with non-agentive bivalent verbs in Oluta Popoluca". Inverse Workshop. Stanford, February.

Zavala, R. "External possession in Oluta Popoluca (Mixean): Applicatives and incorporation of relational terms". External Possession and Related Noun Incorporation Conference. Eugene, September.

Publications'

Alibali, M.W., Flevares, L. & Goldin-Meadow, S. (1997). Assessing knowledge conveyed in gesture: Do teachers have the upper hand? *Journal of Educational Psychology,* 89, 183-193.

Allen, S.E.M. (1997). A discourse-pragmatic explanation lor the subject-object asymmetry in early null arguments: The Principle of Informativeness revisited. In A. Sorace, C. Heycock & R. Shillcock (eds.). *Proceedings of the GALA '97 Conference on Language Acquisition* (pp. 10-15). Edinburgh, Scotland.

Allen, S.E.M. (1997). Review of Louis-Jacques Dorais: La parole inuit: Langue, culture et societe dans l'arctique nord-americain. *Anthropological Linguistics,* 39(2), 325-328.

Baayen, R.H. (1997). The pragmatics of the so-called tense forms in Biblical Hebrew. *Studies in Language,* 21,245-285.

Baayen, R.H., Dijkstra, T. & Schreuder, R. (1997). Singulars and plurals in Dutch: Evidence for a parallel dual route model. *Journal of Memory and Language,* 37,94-117.

Baayen, R.H. & Lieber, R. (1997). Word frequency distributions and lexical semantics. *Computers and the Humanities,* 30. 281-291.

Baayen, R.H., Lieber, R. & Schreuder, R. (1997). The morphological complexity of simplex nouns. *Linguistics,* 35, 861-877.

Baayen, R.H. & Neijt, A. (1997). Productivity in context: a case study of a Dutch suffix. *Linguistics,* 35,565-587.

Baumann, H., Nagengast, J. & Wittenburg, P. (1997). *Driver in Windows NT.* Göttingen, GWDG-Bericht, 45, 95-101.

Berkum, J.J.A. van (1997). Syntactic processes in speech production: The retrieval of grammatical gender. *Cognition,* 64, 115-152.

' This list contains a few publications from 1996, which did not appear in last year's Annual Report.

Biemans, M. & Weijer, J. van de (eds.) (1997). *Proceedings of the CLS Opening Academic Year 1997/1998.* Center for Language Studies, The Netherlands. (164 pp.).

Bierwisch, M. (1997). Universal grammar and the basic variety. *Second Language Research,* 13(4), 348-366.

Bierwisch, M. (1997). Comments on Zimmermann: Tertium evitari non potest: on Ede Zimmermann's bipartition of the lexicon. In H. Kamp & B. Partee (eds.). *Context-dependence in the Analysis of Linguistic Meaning.* Universität Stuttgart.

Bierwisch, M. (1997). Der Beitrag der Sprachwissenschaft zur Überwindung der Krise der Kommunikation. In G. Magerl, O. Panagl, H. Rumpier, E. Waldschütz (eds.). *Krise der Moderne und Renaissance der Geisteswissenschaften* (pp. 385-407). Böhlau: Wien, Köln, Weimar.

Bohnemeyer, J. (1997). Temporale Relatoren im hispano-yukatekischen Sprachkontakt. In A. Koechert & T. Stolz (eds.). *Convergencia e Individualidad - Las Lenguas Mayas Entre Hispanizaciön e Indigenismo.* Hannover: Verlag für Ethnologie.

Bohnemeyer, J. (1997). Yucatec Mayan lexicalization patterns in time and space. In M. Biemans & J. van de Weijer (eds.). *Proceedings of the CLS Opening Academic Year 1997/1998* (pp. 73-106). Center for Language Studies, The Netherlands.

Böttner, M. (1997). Natural Language. In C. Brink, W. Kahl & G. Schmidt (eds.). *Relational Methods in computer Science* (pp. 229-249). New York: Springer.

Böttner, M. (1997). Visiting some relatives of Peirce's. *RelMiCS 97. Third International Seminar on the Use of Relational Methods in Computer Science* (pp. 311-320). Hammamet.

Brown, P. (1997). Isolating the CVC root in Tzeltal Mayan: a study of children's first verbs. In E. Clark (ed.). *Proceedings of the 28th Annual Stanford Child Language Research Forum 1996* (pp. 41-52). Stanford: CSLI/Cambridge University Press.

Chen, H.-C. & Cutler, A. (1997). Auditory priming in spoken and printed word recognition. In H.-C. Chen (ed). *The Cognitive Processing of Chinese and Related Asian Languages* (pp. 77-81). Hong Kong: Chinese Univ. Press.

Clark, E.V. (1997). Conceptual perspective and lexical choice in acquisition. *Cognition,* 64,1-37.

Clark, E.V. & Svaib, T.A. (1997). Speaker perspective and reference in young children. *First Language,* 17, 57-74.

Clark, E.V. (ed.) (1997). *The Proceedings of the 28th Annual Child Language Research Forum 1996.* Stanford: CSLI/ Cambridge University Press.

Clark, H.H. (1997). Dogmas of understanding. *Discourse Processes,* 23, 567-598.

Crago, M.B. & Allen, S.E.M. (1997). Linguistic and cultural aspects of simplicity and complexity in Inuktitut (Eskimo) child-directed speech. In E. Hughes, M. Hughes & A. Greenhill (eds.). *Proceedings of the 21st Annual Boston University Conference on Language Development* (pp. 91-102). Somerville, MA: Cascadilla Press.

Crago, M.B., Allen, S.E.M. & Hough-Eyamie, W.P. (1997). Exploring innateness through cultural and linguistic variation. In M. Gopnik (ed.). *The Inheritance and Innateness of Grammars* (pp. 70-90). Oxford: Oxford University Press.

Cutler, A. (1997). The comparative perspective on spoken-language processing. *Speech Communication,* 21,3-15.

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