Max-Planck-Institut für Psycholinguistik

ANNUAL REPORT
2000

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Preface

The Annual Report for 2000 is organized as in the past six years by project areas, and strict limits have again been imposed on how much can be reported - that is, a lot more has been done than can be read in these pages. More information can be found at our website www.mpi.nl, which also now includes a preprint server where papers which are in press can be downloaded.

The year 2000 saw further strengthening of the Institute's research links with the University of Nijmegen. Cutler's Spinoza project was able to install a laboratory for infant speech perception research in the Faculty of Social Sciences. Then, in the most important development of the year, the F.C. Donders Centre for Cognitive Neuroimaging, in which the Institute is a partner, was formally initiated. The Donders Centre is off to a flying start - in May the Dutch research council NWO approved for the Centre an investment grant of 9.4 million guilders, complementing a 7.6 million guilder investment from the Max Planck Society.

There has been external recognition for our members: notably the election of founding director Willem Levelt as a foreign associate of the National Academy of Sciences of the US and of the Bayrische Akademie der Wissenschaften. The University of Nijmegen appointed Wietske Vonk to a personal chair in the Arts Faculty. There have been prizes and awards, among which major Dutch career development awards ("vernieuwings-impuls") for Jos van Berkum and Miranda van Turennout; the full list of awards, too long to recapitulate here, can be found on pp. 136-137. There have been new outside research grants: Wolfgang Klein was awarded 1.8 million German Mark by the Deutsche Forschungsgemeinschaft for the first phase of the project "Digitales Wörterbuch der Deutschen Sprache", located at the Berlin-Brandenburgische Akademie der Wissenschaften in Berlin. During 2000 the Institute further became the central archive for the Volkswagenstiftung's large project on documenting endangered languages.

Combined with the Institute's own holdings on endangered and other languages, this will make the Institute a leading centre for the documentation of linguistic diversity. The Technical Group, headed by Peter Wittenburg, has also received two major EU grants for technical developments in the field of electronic archiving and retrieval.

As usual, changes have taken place in the staff lists, including the departure this year of several staff members with very long associations with the Institute. However, the most radical staff change in the Institute this past year for once took place in the administration. After more than twenty years of keeping the Institute safely on the rails, Rolf Koenig steamed off into retirement at the end of the year. The Institute was fortunately able to locate a successor early enough for a long overlap period; Paul Lommen joined the institute in May 2000 and from 2001 is head of the administration.

Anne Cutler

Nijmegen, March 2001

Organization of the Institute in 2000

Scientific Council:

K. Bock	H. Kamp
H. Clark	J. Lucy
N. Evans	J. Miller
K. Forster	J. Schumann
B. de Gelder	D. Slobin
E. de Haan	

Directors:

A. Cutler

W. Klein

W. Levelt

S. Levinson, managing director

External Scientific Member

M. Bierwisch

Honorary Research Associate:

D. Ploog

Research Associates

F. Ameka	Leiden U.
R. van Hout	U. Nijmegen
D. Irwin	U. of Illinois, Urbana-Champaign
P. Jordens	Vrije U. Amsterdam

A. Kelly	U. Heidelberg
G. Kempen	Leiden U.
J. Nuyts	U. Antwerpen
E. Palancar	U. Compultense de Madrid
G. Reesink	Leiden U.
P. Seuren	U. Nijmegen

Visiting Research Fellows:

A. El Aissati (Spinoza)	Tilburg U.
M. Alibali	Carnegie Mellon U., Pittsburgh
S. Allen	Boston U.
K. Bock	U. of Illinois, Urbana-Champaign
M. Böttner	Stanford U.
M. Brysbaert	U. Gent
C. Davis	U. of Melbourne
A. Deutsch-Grossberg (Pionier)	Hebrew U. Jerusalem
R. Dietrich	Humbolt U. Berlin
C. Dobel	U. Konstanz
N. Duffield	McGill U., Montreal
M. Dunn	Australian National U., Canberra
N. Enfield	U. of Melbourne
R. Guirardello	Rice U., Houston
M. Gullberg	Lund U., Sweden
A. Kendon	Philadelphia U.
J.Kim	U. of Melbourne
D. Irwin	U. of Illinois, Urbana-Champaign
W. McGregor	U. of Melbourne
S. Meira	Rice U., Houston
A. Melinger	U. at Buffalo
M. Mudrow (Pionier)	Indiana U. Bloomington
T. Nearey	U. of Alberta, Edmonton
D. Norris	MRC Cognitive and Brain Sciences Unit, Cambridge/UK
T. Otake	Dokkyo U., Saitama, Japan

A. Özyürek	Koç U. Istanbul
C. Perdue	U. Paris VIII
S. Rushen	U. of British Columbia, Vancouver
D. Sandra (Pionier)	U. Antwerpen
U. Schade	U. Bielefeld
D. Slobin	U. of California, Berkeley
E. Spinelli	U. Paris V
A. Terrill	MPI for Evolutionary Anthropology, Leipzig
G. Vigliocco	U. of Wisconsin, Madison
A. Zucchi	U. di Salerno

Ph.D. Students:

P. van Alphen	M. Meeuwissen
D. van den Brink	F. van der Meulen
M. Broersma	F. Moscoso (Pionier)
G. Cablitz	O. Müller
J. Cholin	U. Nederstigt
N. Cooper	A. Salverda
C. Dietrich	B. Schmiedtová
B. Hellwig	M. Seyfeddinipur
N. de Jong (Pionier, NWO)	A. Sonnenschein
E. Korvorst	S. Sprenger
A. Krott (Pionier, NWO)	D. Vinson (U. Wisconsin)
M. Lauer (U. Wisconsin)	M. Vegnaduzzo
F. Lüpke	A. Weber
K. Mauth	

PROJECT DESCRIPTIONS

1 PHONOLOGICAL STRUCTURE IN COMPREHENSION

The Phonological Structure in Comprehension project investigates the ways in which the processing of spoken language input is constrained by the phonological structure of the input language. One line of research concerns infants' acquisition of the native phonology and an initial lexicon. 2000 has seen considerable progress in this subproject, as described in 1.1 below. Further research reported below concerns the role of phonological structure in the processing of segmental structure (1.2), in the parsing of continuous speech into words (1.3), in the recognition of spoken words (1.4), and in the recognition of longer utterances (1.5).

1.1 The development of native phonological structure

Swingley completed the construction and outfitting of a new infant testing laboratory within the Institute. The enthusiastic response from Nijmegen parents has been very encouraging; in 2000 the "Baby Research Center" received over 200 visits from parents of children under 24 months. A study of children's representation of the sounds of words, described in 1.1.1, produced the first results from the new lab. Further, a new Ph.D. project has begun in this area (1.1.2), and studies of infants' segmentation of words from surrounding speech contexts have been completed (1.1.3), linking to the adult word recognition component of the project.

1.1.1 Young children's phonetic representations of words

The first study performed in the new laboratory tested 19-month-olds' recognition of spoken words using a visual fixation procedure. Children saw two images on a large screen; one of these pictures was named in a sentence. Videotapes of children's eye movements were digitized and

analyzed using the Technical Group's MediaTagger software, permitting detailed evaluation of the time course of children's fixations to the named pictures. The goal of the study was to evaluate the specificity with which children represent the phonological forms of familiar words. Children's responses to correct and incorrect pronunciations of words were compared, whereby two factors were varied: the location of the mispronunciation (word-initial or word-medial), and the frequency of the substituted sound (common, such as /d/, which occurs in many Dutch words, versus rare, such as /g/, which is not a Dutch phoneme, and occurs only in loanwords such as *goal).* Children produced more correct fixations, and fixated faster, when they heard correct rather than incorrect pronunciations, and this pattern held for all four types of mispronunciation. These results indicate that children's representations of familiar words are really quite well-specified. Phonemes both in initial and medial position are clearly specified; and moreover, the rarity of /g/ in Dutch child-directed speech does not make mispronunciations involving /g/ (such as mispronouncing *baby* as *bagy)* any more or less consequential than those involving much more frequent sounds.

1.1.2   The development of suprasegmental contrasts

Infants become increasingly attuned to the phonological structure of their native language during the course of the first year; many of the non-native phonemic contrasts that are discriminated by infants at six months are no longer discriminated at twelve months. Although the developmental time-course of this fine-tuning of segmental contrasts has been intensively studied over the last decades, little is known about the fine-tuning of equivalent suprasegmental contrasts - e.g., the tonal contrasts as used phonologically by speakers of Mandarin or Thai. In her dissertation project, C. Dietrich initiated one of the first studies of infants' categorization of tonally varying speech stimuli, using the conditioned head-turn paradigm.

Six- to ten-month-old infants were trained to make a head-turn response to a video screen when a change occurred from one speech stimulus to another. During training this change was both segmental (e.g., *pa* to *na)* and tonal (e.g., rise to fall-rise) in nature. The test phase involved testing infants for maintenance of the trained change as well as for generalization to changes in either segmental or tonal features alone.

Infants responded most to those novel stimuli that corresponded to the training stimulus with respect to both its tonal and its segmental structure.

This finding confirmed that the link between the characteristics of the training stimulus and the reinforcer had been learned and retained. Changes in tones or segments alone resulted in fewer responses, to the same degree. Additional trials tested generalization to untrained segmental and tonal changes. Here, infants showed significantly greater generalization to untrained tonal changes than to untrained segmental changes. This may suggest that infants attended relatively more to the segmental information of the training stimuli than to the tonal information. It may also have been easier for them to categorize the segments. Further experiments are in progress to explore alternative interpretations of these results.

1.1.3 Infants' word recognition in fluent speech

In collaboration with Jusczyk and Johnson (Johns Hopkins U., Baltimore) and Norris (MRC Cognition and Brain Sciences Unit, Cambridge), Cutler continued a series of head-turning experiments exploring English-learning infants' ability to recognize word forms in a minimal context. In a first study (see Annual Report 1999), infants familiarized with monosyllabic words such as *rush* gave evidence of recognition when the words were later presented in syllabic contexts (e.g., *hethrush, shodrush)* but not when single-consonant contexts were used (e.g., *thrush, drush).* Four further studies were completed, all with 12-month-olds in an American English environment. Two of the studies used, in the test phase, words embedded in other real words (e.g., *rise* in *prize* versus *surprise,* or *win* in *wind* versus *window),* embedded in their turn in short passages of continuous text. In both experiments, the infants familiarized with the words in isolation listened by preference to passages containing the familiar words when these occurred in syllabic contexts (e.g., *window, winter, winsome),* but showed no such preference over other passages when the words occurred in single-consonant contexts *(wind, wince, winch* etc.). These results suggest that infants can segment familiar wordforms from surrounding syllables but cannot extract the wordforms as easily if a single-consonant residue remains, in striking parallel with evidence of a Possible-Word Constraint operative in adult spoken-word recognition (see section 1.3 below). However, in two further studies in which the test phase involved not continuous passages but isolated forms (e.g., a familiar word *dull* tested in *dulk* versus *dulkef),* infants did not show a preference for familiarized forms in bisyllabic contexts; possibly, presentation of lists of

words does not encourage use of word segmentation processes as effectively as does listening to fluent speech.

1.2   The role of phonological structure in segmental processing

The two lines of research in this part of the project during 2000 concerned the supposed neutralization of underlying contrasts in voiced stops in Dutch (1.2.1), and, linking to research in 1.3 below, Dutch listeners' perception of American English phonetic segments (1.2.2).

1.2.1   The neutralization of Dutch voicing contrasts

In collaboration with Jongman and Sereno (Kansas U.), Warner investigated the production and perception of Dutch word pairs such as *zweet* (/zwe:t/) "sweat" and *zweed* (/zwe:d/) "Swede", both realized phonetically as [zʋe:t] and hence said to be neutralized with respect to the voicing contrast. Past research on other languages (e.g., German, Polish, Catalan) has indicated that such pairs are not fully neutralized, i.e., evidence of a contrast remained. Previous studies (less thorough than in some of the other languages) had however found no differences in Dutch. In the production component of this study, the vowel preceding the neutralized stop proved to be significantly longer before underlying /d/ than /t/, although the effect is very small (3.5 ms). In the perception component, listeners were found to be able to identify which member of a pair they had heard only if stimuli were from a speaker who produced a relatively large difference in vowel duration. A further perception experiment in which only vowel duration was manipulated confirmed that listeners could use vowel duration as a cue to whether the final stop was underlyingly /t/ or /d/.

Although these results suggest that neutralization may not be complete, and that underlying representations may have a slight influence on phonetic realizations, there is another possibility: orthography may create such small differences. Warner et al. took a new approach to this question by testing word pairs in which there is no difference in the underlying representation, but there is a difference in orthography, e.g., *besteden* "to spend" and *besteedden* "spent (pl.)" (both underlyingly /bəste:dən/). A production study showed that the consonant is significantly longer and the vowel significantly shorter in the orthographically doubled case *(besteedden),* with the effect the same size as in the final devoicing study. This demonstrates that solely orthographic differences, not related to

underlying form, can also cause such slight durational changes. Thus, speakers and listeners may not have to allow for influence of underlying form on phonetic realizations, but instead, orthography may have a much more significant role in speech production and perception than a phonemic or phonetic representation allows.

1.2.2 Non-native perception of English phonemes

Cooper's pilot study exploring Dutch listeners' perception of American English phonemes (Annual Report 1999) was followed up with a full study of the same issue. Twenty Dutch listeners heard all possible English CV (22x15) and VC (15x21) syllables, embedded in multispeaker babble at three signal to noise ratios, which had been established in the pilot study to yield easy, intermediate and difficult phoneme perception. Identifying either the vowel or the consonant, listeners responded by clicking the word that contained the appropriate sound on a computer screen. The results allowed the construction of complete phoneme confusion matrices, plotting how often phoneme X was perceived given phoneme Y. These matrices give a detailed picture of the accuracies and inaccuracies in Dutch listeners' perception of American English phonemes, enabling potential prediction of how word recognition may be affected. The Dutch listeners' vowel confusions may also be compared with the vowel confusion matrix (with consonant identity held constant) constructed for the American English phonemes perceived by 26 Australian English listeners. These listeners will also have inexact perception of American English phonemes; however, their English vocabulary should be comparable in size to that of an American English listener, whereas the vocabulary of the Dutch listeners is likely to be smaller than that of Americans.

1.3   Phonological structure in lexical segmentation

This has been another very active part of the project, in particular as regards testing of the Possible-Word Constraint (PWC; see Annual Report 95-99). This hypothesis claims that lexical activation is modulated by a constraint that word candidates are viable only if they leave no vowel-less residue of the speech input; it is currently being tested in a number of languages which allow considerable vowel deletion, or syllables without vowels, namely Japanese (in collaboration with Otake, Dokkyo U.; see Annual Report 1998), Portuguese (in collaboration with Gontijo, UCLA) and Berber (in collaboration with El Aissati, Tilburg U.). A completed study of PWC effects involving syllables with weak vowels in English is

described in 1.3.1. Further work on lexical segmentation in Japanese is reported in 1.3.2 and 1.3.3.

1.3.1   Weak syllables and the PWC in English

Cutler and McQueen, with Norris and Butterfield (MRC Cognition and Brain Sciences Unit, Cambridge) tested whether the PWC is language-universal or language-specific. In English, although function words can consist of a single reduced syllable (reduced forms of *the, a,* etc.) content words cannot. If the PWC is sensitive to this phonological property of English words, English listeners should find it as hard to spot words embedded in weak syllable contexts (e.g., *sea* in *seasheb)* as in consonant contexts (e.g., *sea* in *seash),* since both **[ʃəb]** and **[ʃ]** are impossible lexical words of English. Listeners in fact found it easier to spot words in weak syllable contexts than in consonant contexts. There was therefore no suggestion that weak syllables violate the PWC. In line with earlier work on this issue in Sesotho and English (see Annual Report 1997), this result suggests instead that the PWC operates according to a simple language-universal principle: if a stretch of speech between a word and a likely word boundary contains a vowel, irrespective of whether that stretch of speech is a well-formed word in any particular language, it counts as an acceptable residue in the ongoing lexical parse, and neighboring words will not be disfavored. If there is no vocalic material in the residue, however, the PWC penalty will apply.

1.3.2   Mora boundaries and the PWC in Japanese

McQueen and Cutler, in collaboration with Otake, continued their investigation of segmentation in Japanese (see Annual Report 1996, 1998). Japanese listeners performed a word-spotting task. Target words like *uni,* "sea urchin", followed contexts consisting of a Consonant-Consonant-Vowel mora (e.g., *gya)* plus either a moraic nasal *(gyaNuni),* a vowel *(gyaouni)* or a consonant *(gyabuni).* Listeners spotted words as easily in the first as in the second context (where in each case the target words were aligned with mora boundaries), but found it almost impossible to spot words in the third (where there was a single consonant, such as the [b] in *gyabuni,* between the beginning of the word and the nearest preceding mora boundary). These suggest that Japanese listeners, like speakers of other languages, are sensitive to the viability of sound sequences as possible words in the way that they parse speech into words. These results, again in keeping with the PWC account of segmentation, also indicate that Japanese listeners use the rhythmic

structure of their language in segmentation: Moraic rhythm provides them with important segmentation cues.

1.3.3   Accentual phrases and lexical segmentation in Japanese

In collaboration with Arai (Sophia U.), Warner investigated the possibility that the nondistinctive rise in pitch at the beginning of an accentual phrase in Japanese could serve as a cue for segmenting the speech stream into words. Using a corpus of spontaneous Japanese speech, Warner and Arai located all accentual phrase rises and all word boundaries. They found that accentual phrase rises occur at the beginning of approximately 50% of all nonpostpausal words. (Since pauses are presumably a very strong word boundary cue, nonpostpausal words are of the most interest). Furthermore, less than 2% of such rises occur anywhere other than at the beginning of a word. Thus, if listeners hypothesized that a new word begins at each accentual phrase rise, they would correctly locate the beginning of approximately half of all nonpostpausal words based on this cue, and would almost never mistakenly hypothesize a word boundary where there is none. Accentual phrase rises are therefore potentially very useful as a supplement to other known segmentation cues, especially since the other main segmentation cue which has been proposed for Japanese (1.3.2 and Annual Report 1996, 1999), segmenting speech at mora boundaries, has a very high false positive *rate.*

To confirm that listeners actually do use this potential cue, Warner, in collaboration with Otake, carried out a word-spotting experiment. Indeed, Japanese listeners spotted words such as /medaru/ "medal" more quickly and accurately in the string /rakoyonemedaru/ when the string was produced with an accentual phrase rise at the onset of /medaru/ than when it was produced with the entire string as one accentual phrase. (Both are possible pronunciations of a two-word string in Japanese.) Thus, listeners do use accentual phrase rises as a segmentation cue. This furthers research of the group showing that listeners make use of factors specific to the phonology and prosody of their language in parsing speech.

1.4   Phonological structure in word recognition

This part of the project has involved studies of native (1.4.2, 1.4.3) and of non-native listening (1.4.1, 1.4.2). In addition, a new Ph.D. project by Broersma will further explore the activation of and competition between word candidates in non-native listening. Although the vocabulary of a non-

native listener is likely to be smaller than that of a native listener, suggesting fewer competitors, the fact that non-native listeners may be less reliable in processing phonemes, as described in 1.2 above, may lead to the activation of spurious lexical competitors.

1.4.1   Native word candidates in non-native listening

Competition between candidate words is the core assumption of most models of spoken word recognition, including Shortlist (see Spoken Word Recognition). Words sharing initial segments are briefly activated during the recognition of spoken words. When one listens to a non-native language, words from the native language might also share initial segments with the non-native input. Weber has been testing whether native competitors are activated during the recognition of non-native spoken words. She monitored the eye movements of Dutch participants who followed spoken instructions in English to click on pictures (using a computer mouse). A target picture (e.g., the picture of a desk) was presented along with distractor pictures. The Dutch name of a distractor picture was either phonologically related to the English name of the target picture (e.g., English target *desk,* /dɛsk/ and Dutch competitor *deksel,* /dɛksəl/, "lid", or it was phonologically unrelated (e.g., *bloem,* "flower" or *schommel,* "swing"). Participants fixated distractor pictures with phono-logically related Dutch names more than distractor pictures with phonologically unrelated names. The results demonstrate that listeners apparently cannot avoid considering native-language candidates for recognition of a non-native word, even though the native candidates are irrelevant for the task.

1.4.2   Lexical stress in the recognition of English words

Further comparisons of Dutch versus English-speaking listeners' use of lexical stress information were carried out by Cooper and Cutler, with Wales (U. Melbourne). Cooper's earlier experiments on this topic (Annual Report 1998) had included fragment priming studies with monosyllabic fragments such as *mus-* from *MUsic* versus *muSEUM.* In a new experiment with the same methodology, Dutch and Australian listeners were presented sentences ending with bisyllabic word fragments such as *admi-* from *ADmiral* versus *admiRAtion.* Lexical decision response times were measured for words presented visually at the offset of the auditory prime. Dutch listeners showed fastest response times (RTs) to matching prime-target combinations (e.g., for ADMIRAL, following *ADmi-),* intermediate RTs to mismatching combinations *(admi-)* and slowest RTs

after unrelated control primes; for Australian listeners, RTs to matching prime-target combinations were faster than RTs to mismatching or control primes, while the latter two conditions did not differ. This finding suggests that given two syllables English-speaking listeners can make full use of lexical stress information in discriminating between word forms, although the earlier results had indicated that one syllable alone provides more stress information to a Dutch listener than to an English listener.

1.4.3   Rhythmic categories in lexical activation

Cutler and Otake followed up their experiments with the word reconstruction task (Annual Report 1999) by examining analogous data from natural language play. In word reconstruction, listeners hear nonwords and must turn them into real words by making a minimal change; Cutler and Otake's study showed that though Japanese listeners regard the task as one of changing morae (CV sequences such as *za, ze, re),* they nonetheless find reconstruction easier when only a single phoneme has been changed (e.g., *panorama* presented as *panorema* or *panozama)* than when a whole CV mora has been changed (e.g., *panorama* presented as *panozema).* Word reconstruction draws on listeners' abilities to manipulate speech input, for instance in order to appreciate natural-language word play such as puns. Cutler and Otake examined a well-known corpus of nineteenth-century Japanese puns on Japanese place names, and compared the actual distribution of substituted elements with the distribution which would be predicted given random selection from the phonological substitution possibilities offered by the language. Their comparison demonstrated that the puns were more likely than would be predicted by chance to preserve partial morae. Like the word reconstruction results, this finding argues against recent proposals that the mora functions as an integral level of representation in Japanese spoken word recognition. It is, however, consistent with the proposal of McQueen, Otake and Cutler (see section 1.3.2 above) that morae participate in Japanese speech recognition by virtue of their function as rhythmic categories; the boundaries of rhythmic units (morae; or stress units in English, or syllables in French) play a role in lexical segmentation.

1.5   Phonological structure in sentence processing

Renewed attention to sentence-level processing within the project in the past year concentrated particularly on processing of the accentual structure of utterances (1.5.1, 1.5.2, 1.5.3).

1.5.1   Accent in reference resolution

Dahan, in collaboration with Tanenhaus and Chambers (U. of Rochester), investigated the role of accent in reference resolution by studying visual fixations to lexical competitors (e.g., *candy, candle)* as participants followed pre-recorded instructions to move objects above or below fixed geometric shapes using a computer mouse. In an initial experiment, the first utterance instructed participants to move one object above or below a shape (e.g., *Put the candle/candy below the triangle)* and the second utterance used a definite noun phrase with an accented or deaccented noun either to refer to the same object or to introduce a new entity (e.g., *Now put the CANDLE above the square* vs. *Now put the candle ABOVE THE SQUARE).* Fixations to the competitor (e.g., *candy)* demonstrated a bias to interpret deaccented nouns as anaphoric and accented nouns as nonanaphoric. A second experiment used only accented nouns in the second instruction (e.g., *Now put the CANDLE above the square),* varying whether the referent of this second instruction was the Theme of the first instruction (e.g., *Put the candle below the triangle),* the Goal (e.g., *Put the necklace below the candle),* or the Theme when the Goal was one of the moveable objects (e.g., *Put the candle below the necklace).* Fixations to the displayed pictures, and in particular to the unmentioned competitor entity (e.g., *candy)* revealed that participants preferred to interpret accented noun phrases as referring to a previously mentioned but non-focused entity (the Goal), rather than as introducing a completely new entity. This research demonstrates that accentual information is used extremely quickly during real-time processing in constraining reference resolution.

1.5.2   Accent and the strength of associative priming

Cutler and McQueen, with Norris and Butterfield, examined the relative strength and time-course of cross-modal associative priming; for further description of their studies see section 2.6.2 below. The experiments included comparisons of, for instance, lexical decision RTs to *TAKE,* presented visually immediately after the word *give* had been heard in a sentence, versus after a control word in a sentence containing no words

related to the target. In one study, the experimental prime word in the sentence was either accented (e.g., *The artist decided to GIVE the sculpture to the old people's home)* or deaccented (e.g., *The artist decided to give the sculpture to the OLD people's home).* Lexical decisions to the target words were made significantly faster (compared to the condition with the control prime) after both accented and deaccented experimental primes; however, the experimental/control difference was somewhat greater for accented primes.

1.5.3   Accent and semantic focus

English listeners use prosodic information to direct attention to accented words. Cutler (1976) found that RTs to detect /b/ in *The couple had quarreled over a book...* were faster when the sentence had been spoken: *The couple had quarreled over a BOOK they had read* than when it had been spoken: *The couple had quarreled over a book they hadn't even READ;* upper case indicates contrastive accent. In both cases the word *book* had been removed and replaced by identical copies of a third, neutral, version of the same word, so that the only difference between the two sentences was the prosody applied to the words before the target. This preceding prosody must thus have affected listeners' processing of the target. Cutler & Fodor (1979) further showed that when the acoustic form of the sentence was held constant but semantic focus was manipulated, by means of a question preceding the sentence, RT was faster to targets in focussed position. Cutler & Fodor explained this effect as direction of attention to semantically more important locations in the sentence, and argued that the prosodic effect of Cutler (1976) had the same origin.

During her internship with the Comprehension Group, Akker (U. Groningen) tested this claim by comparing accent and focus effects in one experiment. Her study, which formed her final-year research project, examined target words which were acoustically identical but (a) were focussed or not, focus being defined as providing the answer to a preceding question, and (b) were accented or not, accent or its absence being determined by the prosodic environment into which these identical elements had been spliced. English listeners detected targets in focussed position faster than targets in unfocussed position, and accented targets faster than unaccented targets. However, the presence of focus more than halved the size of the accent effect, producing a significant interaction. This result supported Cutler and Fodor's interpretation of the accent effect

as exploitation of prosody to locate focussed (semantically central) information.

Akker extended her project by replicating the English experiment in Dutch. Dutch and English function similarly in semantic contrast and prosodic focus. Dutch listeners indeed showed very much the same pattern in their native language as English listeners had shown in theirs. In a final experiment Akker then presented the English materials to Dutch listeners. These non-native listeners were easily able to perform the task and showed again the same general pattern of results - in particular, both focus and accent main effects were significant. However, one difference appeared: whereas in both of the native-listening experiments, the size of the accent effect when focus was present was less than half the size of the effect without focus, the presence of focus did not significantly reduce the size of the accent effect for the non-native listeners. The combined results suggest that processing speech in a native language is so fast that when focus (the actual goal of accent evaluation) is present, adding accent information hardly reduces RTs. For non-native listeners, on the other hand - even those as expert as Dutch listeners to English - processing of semantic information is slower, and thus there is room for improvement by adding accent even when focus is present.

2 SPOKEN WORD RECOGNITION

Research in 2000 on spoken word recognition took the form of six interlocking subprojects. The framework around which all this research was based is that provided by the Shortlist model (see Annual Reports 1994-1999). Word recognition in Shortlist involves the activation of lexical hypotheses which match the speech signal, and then competition among those candidate words. One key issue which was addressed was the nature of the input to Shortlist, at the prelexical level of processing (2.1). The phonetic categorization task has continued to be used to address questions about the way in which listeners make decisions about speech sounds (2.2). Experiments using the phonological priming paradigm have also been carried out to address the way in which the speech signal is mapped onto the lexicon (2.3). Another central issue in spoken word recognition that has received further attention this year is segmentation: how do listeners segment continuous speech into discrete words? (2.4) Research in 2000 has also continued to address the effects on lexical access caused by subtle variation in the information in the speech signal. Two lines of enquiry on this topic have been pursued: the influence of subsegmental variation on lexical access (2.5), and the special case of the activation of words embedded in other words (2.6).

2.1   Prelexical representation

2.1.1   The input to Shortlist

Smits, Warner, McQueen and Cutler have completed a large gating experiment, the ultimate purpose of which is to make the prelexical level of Shortlist sensitive to time-varying probabilistic information about speech sounds (see Annual Report 1999). Nineteen listeners were presented with portions of all 1,179 diphones of Dutch, gated at six points during the

diphone, and were asked to identify both phonemes. In total, 488,520 categorizations were collected. Smits conducted a number of analyses of these data. These analyses showed that with increasing gates the average percentage correct phoneme identification smoothly rises to levels above 90%, both for consonants and for vowels. The data exhibited all major confusion patterns that were expected on the basis of previous gating studies and of the overlapping acoustic properties of various speech sounds. The data set was therefore judged to be clean and reliable. Additional analyses led to three important conclusions. First, differences in intelligibility of unstressed versus stressed vowels and consonants were negligible. Second, response biases due to phoneme frequency effects were limited. Only one simple bias was found: in the absence of reliable acoustic information, the originally foreign consonants /dʒ, ʒ/ were selected less frequently than other sounds. Finally, effects of transitional probabilities between successive phonemes were entirely absent. Smits is now working with Norris (MRC Cognition and Brain Sciences Unit, Cambridge) on modifications to Shortlist, so that lexical activation will be derived from the time-varying activation of multiple segments (as derived from the gating data), rather than (as in the original version of Shortlist) a string of discrete phonemes.

2.1.2   Fuzzy prelexical representations

Smits previously conducted an analysis showing that it is beneficial for a spoken word recognition system to employ a fuzzy rather than a crisp prelexical layer, where a "crisp" prelexical layer transforms the incoming speech signal into a string of phonemes (for example), while a "fuzzy" one transforms the input into a set of phoneme likelihoods which are fed into the lexicon (see Annual Report 1999). Together with McQueen, Smits has since carried out a listening experiment to test these alternatives. Based on natural utterances of the words *vis* "fish" and *zeef* "sieve", a three-dimensional stimulus continuum was created. *Vis* and zeef formed two of the vertices of the resulting stimulus "cube", while the other six vertices corresponded to nonwords like *vees* or *zif.* Listeners were required to categorize all stimuli as either *vis* or *zeef.* Fuzzy and crisp prelexical layers predicted different categorizations of ambiguous items. Model-based analyses of the categorization data generally supported the use of a fuzzy prelexical layer. Such analyses clearly motivate the modifications to Shortlist which are currently underway (2.1.1).

2.2   Phonemic decision making

2.2.1   Strategies in sound categorization

Smits continued the joint research project with Jongman and Sereno (Kansas U.) which attempts to uncover the fundamental mechanism by which phonemes are categorized (see Annual Report 1999). Do listeners use a boundary-based, prototype-based, distribution-based, or exemplar-based strategy in the categorization of sounds? Inharmonic complex tones filtered by a formant-like resonance were used as stimuli, with either duration or formant frequency as the manipulated stimulus dimension. Two categories A and B were represented by overlapping Gaussian probability-density functions (pdfs) on each of these stimulus dimensions. In each case, four experimental conditions were created by orthogonally manipulating the variance and overlap of the pdfs associated with the two categories. The boundary-based hypothesis assumes that listeners base their categorizations only on the midpoint between the pdf means. In the prototype-based hypothesis the distance between the means is also used. The distribution- and exemplar-based hypotheses assume that listeners use the full distributional information. Subjects were trained to classify stimuli drawn from the pdfs in one of the four training conditions and were subsequently tested on a fixed stimulus continuum.

When formant frequency was the stimulus dimension, the slopes of the categorization curves measured in the test phase were not different for the four conditions. This supports the boundary-based hypothesis. When duration was the stimulus dimension, however, there were significant differences between categorization function slopes for different conditions, supporting a distribution-based mechanism. Two further experiments adopted two of the previously used training conditions, but now the size of the test continuum was varied. Positive effects supporting the boundary-based hypothesis were observed for both stimulus dimensions. Strong support was therefore found for a boundary-based mechanism underlying the categorization of sounds varying in formant frequency, while sounds varying in duration appear to be categorized via a mixture of boundary-based and distribution-based mechanisms.

2.2.2   Morphology in categorization

Mauth continued to investigate morphological influences on phonetic decision making. She examined whether the effects found in previous categorization experiments could be attributed to the listeners' processing

of the sentential context (see Annual Report 1999). In a follow-up categorization experiment, the materials that had appeared sentence-finally in the earlier experiments were presented in isolation (e.g., the noun-nonword continuum *plaat-plaak,* with the noun *plaat* "record" at the /t/-endpoint; the verb-nonword continuum *gaat-gaak,* containing the inflected verb *gaat* "goes"; and the nonword-nonword continuum *snaat-snaak).* Listeners did not give significantly more /t/-responses in either the nominal or verbal contexts than in the nonword contexts, suggesting that the lexical effects previously observed in sentences could indeed be attributed to the processing of the context. It was concluded that listeners benefited from the morphological status of the last phoneme in a word when not only the word but also its inflection was predictable from the context.

In a further categorization experiment, Mauth presented listeners with more variable sentence contexts. The last phoneme of sentences ending either in a noun or an inflected verb again varied along a place of articulation continuum *(It/ - Ikl).* As baseline the same contexts were also presented with nonwords as sentence-final items. In contrast to earlier findings (a stronger lexical effect for verbs than for nouns), the results showed that there was a strong bias towards /t/-responses in the nominal condition but not in the verbal condition. This result again suggests that biases in categorization due to the morphological status of a word's final phoneme, as with the *IV* in a Dutch inflected verb, may depend on how predictable that morpheme is.

2.3   Phonological priming

2.3.1   Foiling strategic responses

Responses to *bench* tend to be faster after hearing a rhyming word (e.g., *wrench-bench)* than after hearing a phonologically unrelated word (e.g., *limp-bench).* This phonological priming effect may reflect automatic processes in lexical access (such as the repeated access of prelexical representations), but may also be due to strategies which listeners adopt when they detect rhyming pairs of words. Norris, McQueen and Cutler examined this issue in four phonological priming experiments. In the first, employing the lexical decision task in a standard design, robust rhyme-based facilitation was observed. In the second, the same materials were used, but foil trials were included, where nonword targets overlapped with primes on all but their final phonemes (e.g., *rust-lusk).* Such trials prevent

listeners from anticipating rhyming target words *(lust* after *rust,* but therefore also *bench* after *wrench).* Under these conditions lexical decisions were not significantly faster to *bench* after *wrench* than to *bench* after *limp,* suggesting that rhyme-based facilitation in lexical decision is due largely to strategic processes. In the third and fourth experiments, listeners were required to name the target words, either with or without foil trials. Responses were again faster after rhyming primes than after unrelated primes, but this effect was not reliably modulated by the presence or absence of foils. This suggests that rhyme-based facilitation in naming is not strategic. There may therefore be both automatic and strategic components of rhyme priming, the relative contributions of which appear to depend both on the listeners' task and on the make-up of the experimental materials.

2.3.2 Pitting strategies against automatic processes

The same issue has also been pursued in an ongoing collaboration between McQueen and Sereno. If there are both automatic and strategic components to phonological priming, it ought to be possible to pit them against each other. Dutch listeners were trained to expect targets with particular phonological structures. For example, they could be told to expect words rhyming with /ʌŋk/ whenever they heard the prime /hɒmp/ *homp* "lump", or to expect words rhyming with /ɑxt/ whenever they heard the prime /nɑxt/, *nacht* "night". Lexical decision responses to targets in these conditions were faster than in control conditions, suggesting that listeners could indeed learn to use explicit expectancy strategies. This facilitation, however, was greater when prime and target actually rhymed *(nacht-jacht* "night-hunt") than when they did not *(homp-flink* "lump-considerable"). More dramatically, responses to occasional unexpectedly related targets *(homp-klomp* "lump-clog", when an -/ʌŋk/ word was expected) were almost as fast and as accurate as those to expected related targets *(nacht-jacht).* This suggests that there are automatic processes producing rhyme facilitation which act even when expectancy strategies are operating. Other conditions, involving different phonological overlaps, different control conditions and different prime-target intervals, are still being investigated. It is hoped that this research, together with that in 2.3.1, will allow conditions to be specified where only automatic components of phonological priming are operating; experiments employing these conditions should then be able to yield important insights into the nature of the lexical access process.

2.4   Lexical segmentation

2.4.1   Morphology in segmentation

Mauth continued her research on the potential role of morphology in segmentation (see Annual Report 1998). As in earlier studies, listeners had to spot words (such as *mobiel* "mobile") in three different following contexts: morphological *(mobielt,* where the /t/ is an verbal inflectional marker which does not normally attach to *mobiel),* consonantal *(mobielk),* and syllabic *(mobieltaaf).* There were also filler items that had words embedded in preceding contexts (e.g., *lepel* "spoon" in *blepel):* these were present to force listeners to process each complete utterance. In line with previous results - and in contradiction of the Possible-Word Constraint (PWC; see Annual Reports 1995-1999) - listeners spotted words fastest in the consonantal and morphological conditions and slowest in the syllabic condition. It remains to be determined why words were spotted more slowly in the syllabic condition than in either of the single-consonant conditions. Because no difference was found between the morphological and consonantal conditions, however, it can be concluded that morphemes are not perceived differently from meaningless consonants and thus that the PWC is not sensitive to morphological information. See section 1.3 in the chapter on the Phonological Structure in Comprehension project for discussion of other research on the PWC.

2.4.2   Segmenting the first words

Swingley has carried out computational work to evaluate the lexical knowledge that infants may gain through the interaction of perceptual grouping mechanisms and the statistical characteristics of the speech sequences infants hear. Previous perceptual experiments have suggested that infants cluster together syllable sequences that cohere probabilistically. A simple model of this clustering was applied to pseudo-phonological text corpora of infant-directed speech in English (from the CHILDES database) and Dutch (the Van de Weijer corpus; see Annual Report 1998). The results showed that statistical coherence (implemented using a standard measure called *mutual information),* together with frequency, characterizes words in infant-directed speech. Thus, if infants indeed cluster statistically coherent syllables, as has been suggested in experimental work, this clustering may provide English- and Dutch-learning infants with a primordial lexicon of word forms even before infants are learning word meanings. Furthermore, analyses showed that the syllable sequences extracted by the algorithm tended to exemplify the

Strong-Weak prosodic pattern which is characteristic of these languages, and which infants appear to use in parsing speech. It is not necessary to postulate a special bootstrapping mechanism to account for learning this parsing heuristic; rather, it may emerge as a generalization from words detected using experimentally-demonstrated statistical sensitivities.

2.4.3 The case of liaison

Spinelli (U. Paris V), in collaboration with McQueen and Cutler, investigated how French listeners segment and recognize resyllabified words, and more specifically, how they recognize vowel-initial words in liaison environments. In liaison, the final /t/ of *petit* is not pronounced in *petit lapin* "little rabbit", where *lapin* begins with a consonant, but is pronounced and resyllabified into the following syllable in a liaison environment like *petit agneau* "little lamb", where *agneau* begins with a vowel. Subjects made visual lexical decisions to vowel-initial targets (e.g., AGNEAU) more rapidly after hearing that word in a context where the preceding word has a liaison consonant (e.g., *petit agneau)* than in a context where the preceding word has no underlying final consonant (e.g., *demi-t-agneau* "half-t-lamb"). This facilitation was reduced but not reversed when the consonant and following word were cross-spliced (e.g., the *tagneau's* from *petit agneau* and *demi tagneau* were exchanged). The results suggest that resolution of liaison depends both on the availability of lexical hypotheses to which liaison consonants can be attached and on acoustical cues which signal liaison.

In another series of cross-modal identity priming experiments, listeners heard ambiguous sentences like C'est *le dernier oignon/rognon* "It's the last onion/kidney", recorded where the speaker intended either one of these two readings. There were durational acoustic differences between the two readings. Listeners had to make visual lexical decisions either to the vowel-initial word *(OIGNON)* or the consonant-initial word *(ROGNON),* presented half way through the final word of the sentences. Facilitation was observed when the speaker's intended segmentation matched the target, but was weaker (for consonant-initial targets) or absent (for vowel-initial targets) when the speaker's intended segmentation did not match the target. Listeners could therefore exploit the cues provided by the speaker to retrieve the correct segmentation when resyllabification due to liaison occurred. The results from both of these series of experiments are consistent with the idea that segmentation is based on competition

between activated candidate words (as in Shortlist), and suggest that this competition process is influenced by acoustic cues to word boundaries.

2.5   The influence of subsegmental variation

2.5.1   Prevoicing in Dutch

Previous research by Van Alphen on the effects of subphonemic variation on lexical access suggested that VOT variation does not affect lexical access (see Annual Report 1999). Van Alphen has since carried out two control experiments. The first was a discrimination task to find out whether listeners were able to detect differences in VOT in Dutch voiced plosives. The results clearly indicated that listeners can hear the differences between 0, 6 and 12 periods of prevoicing. The second control experiment was conducted to examine whether the identity priming task is sensitive enough to show effects of phonemic differences on lexical access. If not, it will surely show no effect of subphonemic differences. The results showed that RTs were significantly slower to visual targets preceded by a prime starting with a voiceless stop *(ploem - BLOEM* "flower") than to targets preceded by identical primes *(bloem - BLOEM).* This means that effects of phonemic variation can be measured by this task.

The influence of lexical competitor environment on effects of subphonemic variation was then examined in another identity priming experiment. Targets were words or nonwords that became either words or nonwords when their initial voiced plosive was replaced by the voiceless counterpart. There were therefore four conditions: word -competitor *(BLOEM,* where *ploem* is a nonword); word +competitor *(BEER* "bear", with the competitor *peer* "pear"); nonword -competitor *(BEUS,* where *peus* is a nonword); and nonword +competitor *(BRINS,* with the word competitor *prins* "prince"). Primes were versions of the target, varying in the amount of prevoicing on the initial plosive. There was again no effect of the VOT manipulation for the words, but in the nonword +competitor condition there was an effect. RTs to targets preceded by primes with 0 periods of prevoicing were significantly slower than to targets preceded by primes starting with 6 or 12 periods of prevoicing. This suggests that words starting with a voiced plosive without prevoicing also activate voiceless word competitors, indicating that VOT variation can influence lexical access. It appears that subsegmental effects on lexical access depend on the lexical competitor environment of the word that is heard.

2.5.2 Coarticulatory information in vowels in English

Dahan, in collaboration with Magnuson, Tanenhaus, and Hogan (U. of Rochester), also investigated the effect of lexical competition on lexical access, looking specifically at the time course of the access process. Participants' eye movements were monitored as they followed spoken instructions to click on a pictured object with a computer mouse (e.g., *Click on the net).* On some trials, the name of the target picture was edited so that it contained mismatching coarticulatory cues in the vowel (i.e., coarticulatory cues inconsistent with the following consonant). Participants were slower to fixate the target picture when the onset of the target word originated from a competitor word (e.g., *ne[ck]* + *[ne]t)* than from a nonword (e.g., *ne[p]* + *[ne]t).* This was found when the picture of the competitor word (e.g., *neck)* was present on the display, as well as when this competitor word was neither named nor pictured during the experiment. This provides strong evidence of lexical competition between activated candidates, as predicted by current models of spoken word recognition, including Shortlist and TRACE. Simulations with TRACE captured the major trends of fixations to the target and its competitor over time. This empirical demonstration of lexical competition contrasts with lexical-decision latency patterns observed in previous studies using the same design and comparable stimuli. Eye movements provide a fine-grained measure of lexical activation over time, and appear to reveal effects of lexical competition that can be missed using response measures such as lexical decisions.

2.6   Activation of embedded words

2.6.1 Onset-embedded words

The findings of both Van Alphen and Dahan (2.5) converge with those of Spinelli (2.4.3) in suggesting that spoken word recognition depends on competition between activated candidate words, as in Shortlist, and that this competition process is influenced by subsegmental information in the speech signal. Such results motivate the revisions that are being made to the input to Shortlist (2.1.1). Salverda has begun to investigate competition and subsegmental variation in the special case of words embedded in other words. Consider the lexical interpretation of spoken input (e.g., /ham/) that may be ambiguous between a word (*ham)* and the onset of a longer carrier word (e.g., *hamster).* Is the word recognition system capable of using information in an ambiguous syllable to favor or disfavor lexical

alternatives depending on whether it was produced as a real word or as the initial syllable of a carrier word?

Subjects were presented with a set of pictures on a computer screen. Their eye movements to the displayed pictures were monitored as they listened to short sentences. The subjects were instructed to move the picture that was mentioned in the sentence, which was always the carrier word (e.g., *hamster).* The set of pictures consisted of the target picture *(hamster),* a competitor picture *(ham)* and two unrelated pictures. It is assumed that the locus and latency of fixations to the pictures during the processing of the name of the target picture reflect lexical activation. In the sentences, the initial syllable of the carrier word was replaced by a recording of the monosyllabic competitor word or by the initial syllable of another recording of the carrier word.

It was found that as subjects were processing the spoken input, they were more likely to fixate on the *hamster* or the *ham* pictures than on the unrelated pictures, reflecting simultaneous activation of the words *hamster* and *ham,* which matched the speech signal phonemically. Subjects were more likely to fixate on the *ham* picture, however, when the first syllable of *hamster* was the recording of the word *ham.* Furthermore, the size of this effect was modulated by the exact nature of the acoustic context in which the word *ham* had been recorded. These results suggest that the word-recognition system uses subtle information in the speech signal to favor the correct interpretation of lexically ambiguous spoken input.

2.6.2 Offset-embedded words

Cutler, McQueen, Norris and Butterfield (MRC Cognition and Brain Sciences Unit, Cambridge) have continued their investigation of a different kind of lexical embedding: words like *bone* embedded in the offset of carrier words like *trombone.* In previous research (see Annual Report 1997), listeners heard the carrier words or the embedded words in isolation, and then made lexical decisions to visually-presented associates *(DOG),* presented either immediately at offset of the spoken prime or after a 500 ms delay. Robust priming effects were observed for the stand-alone primes (e.g., *bone-DOG)* at both delays. The embedded primes (e.g., trombone-DOG), however, produced no facilitation in either experiment.

In the two new experiments the same primes were spoken in sentences (e.g., *He placed the {TROMBONE/old BONE} on the table very carefully).* The sentences contained no other words strongly associated to the prime,

and the part of the sentence preceding the prime did not allow the prime word to be predicted. Again the target occurred at prime offset in one experiment and 500 ms later in the other. No significant priming effects occurred in either experiment, for either stand-alone or embedded primes. Words which occur spuriously embedded in other words do not appear to be sufficiently activated to produce associative priming (perhaps because of acoustic differences between embedded and nonembedded words and/or because of lexical competition). More generally, the disappearance of priming for the stand-alone words in sentence contexts suggests that cross-modal associative priming in sentences is not a direct reflection of lexical activation. Closely related research on the influence of sentence prosody on cross-modal associative priming is reported in section 1.5.2.

2.6.3 Offset- and onset-embedded words

McQueen, Cutler and Norris have used the identity priming task, which is more sensitive than associative priming in measuring lexical activation (2.4.3, 2.5.1 vs. 2.6.2), to examine the activation of words embedded across word boundaries (i.e., embedded both in a word offset and the following word onset, like *VERSCHIL* "difference", in *liever schilder* "rather painter"). In the first experiment, listeners were no faster to decide that *VERSCHIL* (presented visually at the offset of the first syllable of the second auditory word) was a word when hearing *liever schilder* than when hearing an unrelated nonsense phrase, but they were more accurate. In the other two experiments an attempt was made to increase this facilitation by forcing listeners to attend more carefully to the auditory materials. In one case, listeners had to judge after every five trials whether a word had appeared in those trials; in the other, they simply had to repeat the pair of auditory prime words after every visual lexical decision. In both cases there was no evidence of facilitation. Instead, there were non-significant inhibitory effects (slower responses to *VERSCHIL* in *liever schilder).* This inhibition may reflect the fact that the embedded words were activated but then rejected from the candidate set. It seems clear, however, that embedded words of this type (just like *bone* in *trombone)* are not strongly activated during spoken word recognition.

3 SIMPLE UTTERANCE GENERATION

This project investigates how simple noun phrases, locative expressions, idioms, and increasingly also more complex expressions are produced. This year, the project has undergone a major change in personnel. Three new staff members, Abdel Rahman, Schiller, and Van Turennout, and three new Ph.D. students, Cholin, Korvorst, and Meeuwissen, have joined the project. Furthermore, Melinger joined the project as a post-doc, with a major assignment in the Gesture Project. The project greatly benefited from the research fellowship of Vigliocco (U. of Wisconsin) and the presence of her students Lauer and Vinson. It also welcomed Bock and Irwin (U. of Illinois), who are spending their sabbatical year at the Institute. The project concentrated on four broad themes. It continued, first, its work on lexical access, the process by which single words are produced in elementary noun phrase contexts, including single noun utterances. Semantic, syntactic, phonological and articulatory aspects of the process were the object of study. Second, issues of attentional control in the production of words and simple phrases became a core issue in the project. Third, the work on fixed expressions was continued and extended. Finally, word and constituent ordering in the generation of complex expressions was the object of computational modeling in the context of Performance Grammar.

3.1   Lexical access in simple noun phrase contexts

3.1.1   Lexical competition in picture and word naming

The first stage of lexical access, selecting the semantically appropriate lexical item *or* lemma, is characterized by semantic competition, as a long tradition of speech error research and picture/word interference studies has demonstrated. In the present study, and those described in 3.1.2,

3.1.3, and 3.1.6, the experimental paradigm developed by Kroll and Stewart (1984) was further developed and applied to address new issues. The paradigm establishes the effect of semantic competition by having subjects name pictures under two conditions. In one condition, all pictures are of the same semantic category (for instance, all depict vehicles). In the other condition, the pictures are of mixed semantic category (for instance, a vehicle, a vegetable, an animal, etc.). WEAVER++, but also other theories of lexical access predict slower naming responses in the semantically homogeneous category than in the heterogeneous one. In WEAVER++ this is due to activation spreading among semantically related items, which then compete for selection.

In a first experiment, Damian, Vigliocco, and Levelt replicated this effect with a picture naming task in which visual overlap between category members was largely avoided. The subjects repeatedly named 25 pictures, 5 pictures from five different categories each. The five experimental blocks were either semantically homogeneous or semantically heterogeneous. The results showed a substantial interference effect generated by a semantically homogeneous context. In contrast, a control experiment that replaced picture naming with a non-verbal button-press task yielded no such effect, suggesting that the semantic interference is specifically one of lexical retrieval in speaking.

A second experiment extended these findings to word reading, an area in which homogeneous semantic context usually yields facilitation rather than interference. The experiment tested the claim that this discrepancy between picture naming and word reading is due to the required processing level rather than the input format: picture versus word. A task in which participants read aloud German words (noun reading) was contrasted with one in which they named them with their corresponding determiner, which was not presented (determiner + noun naming). The latter task requires the retrieval of grammatical gender, which is specified at the lemma level. As expected from the reading literature, a homogeneous semantic context displayed a facilitatory influence in the noun reading condition. In contrast, in the determiner + noun naming condition, the effect of semantic context was one of interference and thus resembled the results from the picture naming experiment. These findings implicate competition as a crucial component of lexical retrieval in speaking. Semantic context interferes with retrieval only when a task requires the active retrieval of a candidate among a set of co-activated

competitor lemmas, which is the case in picture naming and in determiner + noun naming, but not in bare noun reading.

The results are consonant with the WEAVER++ model of competition for lexical selection, with its close, two-way linkage between the conceptual and syntactic levels of lexical representation. Still, competition for selection can be modeled in other ways as well. WEAVER++ offers an account based on the so-called Luce ratio. There is no inhibitory mechanism that pushes activation levels below baseline. Some connectionist models, however, suggest the use of lateral inhibition for competition (Berg & Schade 1992). During a visit, Schade (U. Bielefeld) performed a computer simulation study to examine what predictions differentiate the models. A decisive case appeared to be one in which one target lemma competes with two semantically related distractors that are not semantically similar to each other (e.g., target *chalk,* distractors *pencil* versus *blackboard).* According to WEAVER++, lemma selection in such a situation should be slowed down compared to a situation with only one distractor. In contrast, models based on lateral inhibition predict mutual inhibition of the distractors resulting in an acceleration of target selection. The empirical test is still to be performed.

3.1.2 An MEG study of semantic competition in lexical selection

Competition for selection as measured by the above-mentioned semantic blocking procedure can be used as a litmus test for the temporal and spatial localization of lexical selection in the brain. Damian, Meyer (U. of Birmingham) and Levelt together with Maess and Friederici (MPI for Cognitive Neuroscience, Leipzig) replicated the first experiment of the previous section (i.e., comparing picture naming in semantically homogenous and semantically heterogeneous blocks) while the brain's response was registered using magnetoencephalography (MEG).

Fifteen out of twenty participants showed longer response latencies in the homogeneous compared to the heterogeneous condition. Event-related MEG signals for the participants showing the interference effect were submitted to a current source density (CSD) analysis. A principle component analysis (PCA) was applied to decompose the grand average CSD distribution into nine spatial subcomponents (factors). One of the nine factors showed a time course of activation that was significantly different for the homogeneous and the heterogeneous condition. The difference arose in a short time frame around 200 ms post picture onset,

exactly the time window for lexical selection as measured in Chronometric picture naming studies (Levelt, Roelofs & Meyer 1999). The spatial factor revealing this effect was localized in the left lateral temporal lobe. This reconfirms the outcome of a meta-analysis by Indefrey & Levelt (2000) of neuroimaging studies, demonstrating that lexical selection involves (at least) activation of the midpart of the middle temporal gyrus.

3.1.3 Semantic competition and syntactic facilitation

In this project semantic competition was again a core issue. But here semantically driven lexical selection was studied in relation to accessing the target word's syntactic properties, in particular a noun's gender. Two questions were raised: How closely are the meaning and syntax of words linked in the lexical representation? And how is their retrieval orchestrated? In a series of studies using both naming latencies and speech errors as dependent measures, Vigliocco in collaboration with Vinson, Damian, Indefrey, F. Hellwig, and Levelt addresses these two questions.

In a first series of three experiments in German, they examined whether in semantically related substitution errors, the target and the intruding noun share the same gender. Semantically related word-substitution errors such as saying "foot" when "hand" was intended are generally accounted for in terms of a derailment in the mapping between the speaker's intended meaning and a lemma. These errors obey syntactic constraints. For example, the intruder is nearly always of the same grammatical category as the target (e.g., both are nouns). Furthermore, it has been reported that for gender-marking languages (e.g., German) the target and the intruder tend to be of the same grammatical gender. This can be accounted for in different manners. Some researchers have proposed that syntactic features, even those that are not conceptually motivated like grammatical gender, are part of the semantic representation of the word. Alternatively, as proposed by Levelt et al. (1999), syntactic features such as gender are only accessed during the grammatical encoding of a phrase or sentence. According to the first hypothesis, the syntactic constraint should be present both when phrases and single words are produced. According to the second hypothesis, however, the constraint should be found when phrases rather than single words are produced. Using a picture-naming task, speakers of German were presented with blocks of pictured objects from the same semantic category. The results showed that semantic errors were not constrained by the gender of the target noun when bare

nouns were produced. The syntactic constraint was found only when phrases were produced. This finding falsifies the view that gender is part of the semantic representation of words, and supports the view that the syntactic constraint on errors arises during the grammatical encoding of a phrase or sentence.

The next question is then how the processing of the meaning and syntax of words is orchestrated. Both aspects of lexical access could be addressed by means of the blocking paradigm introduced above (3.1.1). However, Vigliocco, Lauer, Damian, and Levelt turned the picture naming task into an English-to-Dutch translation task (see Annual Report 1999: 21) requiring participants (bilingual Dutch-English speakers) to produce adjective/noun phrases. The English stimulus was a word (for instance *dog*) printed in either large or small font. The subject responded by producing the Dutch translation equivalent *(hond)* preceded by the size adjective corresponding to the type of print (for instance *grote hond,* "big dog"). There were six semantic categories, each consisting of six items. In a first experiment the semantic interference effect was re-established for this version of the paradigm: speakers were slower in producing phrases when the experimental blocks were semantically homogeneous than when they were semantically heterogeneous.

In a second experiment the paradigm was used to study the effect of gender homogeneity vs. heterogeneity. WEAVER++ predicts facilitation from gender homogeneity. Dutch has two genders and adjectives are gender marked. Indeed, speakers were faster in producing phrases when all the words in a block had the same gender than when the genders were mixed. In the crucial, third experiment, semantic category (same-different) and gender (same-different) were factorially crossed. If the processing of a word's semantics and syntax is interactive, one should find an interaction between the two manipulations. If, however, gender does not feed back to word meaning, as proposed by Levelt et al. (1999), the effects should be additive. The results showed that the two factors affected production times in purely additive fashion. This finding demonstrates that syntactic (gender) information does not bias semantically driven lexical retrieval.

It should be noticed that these effects were obtained in adjective/noun phrase production, where gender is marked on the adjective. Many Chronometric studies of gender access have been using tasks in which article/noun phrases are produced, where the articles reflect the nouns'

gender. That raises special issues, which were addressed in the next project.

3.1.4   Gender or determiner congruency?

In collaboration with Caramazza (Harvard U.), Schiller continued to investigate the so-called gender congruency effect. Schriefers (1993) had discovered that picture naming is slowed down when pictures to be named by determiner + noun phrases in Dutch are paired with gender-incongruent distractor words as compared to gender-congruent ones. Schriefers accounted for this effect by competition at the lemma level: gender-incongruent distractor words activate their corresponding gender node, which is incompatible with the gender node activated by the target.

However, it has recently been suggested by Miozzo and Caramazza (1999) that the competition may also take place at the level of determiner selection. According to their hypothesis, congruency effects can only be obtained when (a) determiner selection depends on the gender of the corresponding noun alone and (b) a selection from a set of different determiner forms has to be made. This is the case in Dutch *(de, het)* and German *(der, die, das)* - but only in the singular. In the plural, however, there is only one determiner for all genders: *de* and *die* for Dutch and German, respectively. Therefore, the gender selection and determiner selection hypotheses can be contrasted in a straightforward way. If the gender selection hypothesis is correct, gender congruency effects are expected in the singular as well as in the plural. If, instead, the determiner selection hypothesis is correct, gender - or better: determiner - congruency effects should be found in the singular, but not when targets are in the plural.

Several experiments in German and Dutch yielded gender congruency effects in the singular but not in the plural. This seems to support the determiner congruency account but not the gender congruency account. However, this cannot be the full story since determiner-congruent plurals (e.g., target *de poezen* "cats"; distractor [de] *tafel* "table", both common gender) are *not* systematically produced faster than determiner-incongruent plurals (target de *poezen,* common gender; distractor [het] *boek* "book", neuter gender). Therefore, further experiments are carried out at the moment to settle the issue of gender versus determiner congruency.

3.1.5 Syllables in adults' and children's phonological encoding

Levelt et al.'s (1999) theory of lexical access lacks syllable representations in the form lexicon. This predicts total absence of syllable priming effects in picture/word interference tasks, which measure the retrieval of lexical phonological codes. Syllables emerge "on the fly" at the later stage of prosodification. This process can be tapped by means of the implicit priming paradigm and syllabic priming effects are to be expected.

Schiller continued his critical crosslinguistic tests of syllabic priming in picture/word interference tasks. He had earlier shown that a segmental overlap effect was obtained in Dutch when word or picture targets are preceded by a masked string of letters. The larger the segmental overlap between prime and target is, the shorter the naming latencies. But the position of syllable boundaries do not play a role (Schiller 1998). Recently, he extended these results to English (Schiller 1999, 2000). Participants were shown to be faster in naming the picture of a pilot or reading the word *pilot* aloud when the prime *pil* preceded the target as compared to *pi*. This effect was independent of prime visibility or SOA between prime and target, as shown by Schiller and Costa (Harvard U.). Results from Spanish also support the segmental overlap hypothesis, without an effect of syllable boundary position. Data from French are, however, still inconclusive.

Cholin began investigating whether effects of syllable structure can be obtained by means of the implicit priming paradigm. She used the *odd-man-out* variant (see Levelt et al. 1999). Initial results suggest that the paradigm is indeed sensitive to syllable structure.

Together with Schiller and Levelt, C. Levelt was able to show that the acquisition of syllable structure by children acquiring Dutch as their first language follows a pattern that can be captured by an OT *(Optimality Theory)* grammar (Levelt, Schiller, & Levelt 2000). Generally, more complex syllable structures (e.g., CVCC, CCVCV, VCC, etc.) are acquired later than more simple ones (e.g., CV, V, CVC, etc.). Moreover, it could be shown that young children follow one of two different "routes" to acquire the system of Dutch syllable structure. These routes can be explained by ranking and subsequent reranking of structural constraints and some local conjunctions thereof. Furthermore, the developmental order of syllable structure was compared to frequency data of the language surrounding the learner. An interesting correlation between these frequencies and the order of development was found. Still, the child is not simply frequency

matching. Rather, every time different rerankings of the grammatical constraints are possible, the learner opts for the reranking that maximizes the probability of producing the most frequent syllable types in the surrounding language.

3.1.6   Is articulation always modular?

In research on speech production, it is commonly assumed that the stage at which a word is articulated is modular with regard to earlier, semantically and phonologically constrained stages of lexical access (e.g., Levelt et al. 1999). A common experimental measure of articulatory processes is response execution duration, that is, the temporal difference between onset and offset of acoustic energy. The modularity assumption predicts that articulatory duration should be unaffected by the manipulation of semantic or phonological experimental factors. Kello, Plaut, and MacWhinney (2000) recently challenged this claim. In a color-word Stroop task, response durations were not affected by the Stroop manipulation under "normal" instructions to the participants. However, when a response deadline was imposed, durations were prolonged in the Stroop conflict condition relative to a baseline. Kello et al. interpreted these findings as evidence that the architecture of speech production can flexibly shift from a modular to a cascaded nature, dependent on circumstantial variables such as task demand.

Damian tested this flexibility claim with a range of commonly used speech production tasks, but failed to obtain any supporting evidence. A first experiment consisted of a picture-word interference task in which semantic and phonological relatedness between picture and distractor was manipulated, and "normal" instructions were provided to the participants. As expected, response execution durations were unaffected by the semantic and phonological manipulation. However, contrary to Kello et al.'s predictions, the same pattern was obtained in a second experiment when a response deadline was imposed on participants, suggesting that even under increased task demand, articulation is encapsulated from word planning processes. In one further experiment the semantic blocking paradigm introduced in Section 3.1.1 was used. Pictures were repeatedly named within blocks of items that were either from one, or from various, semantic categories. In one condition the names were monosyllabic, in a second condition they were bisyllabic. As predicted, homogeneous semantic context slowed naming latencies for both conditions. In another further experiment the implicit priming paradigm was used. The words in a

block were either phonologically homogeneous in that they shared their first phoneme, or they were heterogeneous. Again monosyllabic and bisyllabic target words were used. As predicted, phonological homogeneity facilitated the response. However, in both experiments response durations were constant across conditions, failing to show any evidence for the claim that, when task demand is increased, articulatory duration is affected by earlier processes of word planning. Contrary to Kello et al., these findings therefore suggest that the articulatory processing stage is informationally encapsulated from the preceding stages under all circumstances.

3.2   Attentional control

Speaking is an attentional, goal-directed process. Perceiving objects in the scenes we continuously encounter, or hearing and reading words, does not unavoidably lead to naming them. This is under the control of a speaker. How is this control exerted? This is the topic of the following three projects.

3.2.1   Attentional control in Stroop-like tasks

The attentional control of spoken word production has in its simplest form perhaps been most intensively studied using the Stroop color-word task (Stroop 1935). A decade ago, MacLeod (1990) published a list of key findings based on a review of the Stroop literature covering over 400 articles. A central finding is that color naming is interfered with by incongruent color words, but word reading not by incongruent colors. Furthermore, maximal impact of incongruent words on color naming is observed when the distractor words appear within 100 ms of color patches, whereas facilitation from preexposed congruent words is constant. In analyzing extant models, Roelofs found that they fail to explain the time course of the effects and several other key findings. Models appear to fail because they assume that attention works by biasing activation levels of words.

By contrast, in WEAVER++ selection occurs through explicit reference to goals ("verification"). Roelofs further developed the attention mechanism of WEAVER++ and applied the model to the findings on MacLeod's list. The addressed findings ranged from the time course of interference and facilitation in color naming and word reading with color-word, word-word, and color-color stimuli to the effect of response set membership, semantic distance, task uncertainty, spatial certainty, manual responding, and

amount of training. Furthermore, the classic findings from the picture-word task and from different age groups, bilinguals, and clinical groups were addressed. Computer simulations showed that WEAVER++ accounts for all findings. In total, there were 250 data points from 16 different studies in the literature, which were accounted for using 3 free parameters. The correlation between model and data was .98, which means that the model accounts for 96 percent ($.98^2$) of the variance in the real data. In addition, Roelofs conducted two empirical studies testing WEAVER++'s account.

The first study, run with Dutch speakers, concentrated on the finding that incongruent colors do not interfere with word reading - the absence of a so-called "reverse" Stroop effect. According to WEAVER++, there is no reverse Stroop effect because reading can be achieved by a shallow form-to-form mapping and because only selected lemmas activate their word forms; lemmas are not selected for color patches when the task is reading the words. This account was tested by a combination of the Stroop task and the double-task paradigm used by Peterson and Savoy (1998). Color patches had to be named and on one third of the trials a word had to be read aloud instead (presented 100 or 200 ms after the color). The results showed that a color patch facilitates reading a form-relative of the target but it has no effect on reading a form-relative of a semantic-relative of the target. For example, a red patch facilitates reading the written word *roof* (form related to *rood,* English "red") but it has no effect on reading *groep* (related to *groen,* English "green"). This suggests that only the form of a selected lemma becomes active and that word reading does not necessarily require lemma selection, supporting WEAVER++'s account of the absence of a reverse Stroop effect.

The second study, again run with Dutch speakers, tested the prediction that colors and pictures do have to affect word reading when the lemma level is forced to be involved in responding to the word, such as in word categorizing or in reading a noun while preceding it by its gender-marked article. For example, word categorizing involves saying *wapen* "weapon" to the written word *pistool* "pistol", and reading with a determiner involves saying *het pistool* "the pistol" to *pistool* (this is the same task as was employed by Damian, Vigliocco, and Levelt, described in section 3.1.1 above). The latter task requires retrieval of the grammatical gender of the noun to determine the right article, *de* or *het.* Importantly, WEAVER++ predicts semantic facilitation from *distractor pictures* in word categorizing and reading with a determiner, in contrast to the semantic interference

predicted (and typically obtained) from word distractors in picture naming. These predictions were tested by examining the effect of semantically related and unrelated distractor pictures on word reading, word categorizing, and word reading with a determiner. The results showed that distractor pictures have no impact on reading aloud, whereas they yield semantic facilitation in word categorizing. The critical new finding was that when participants have to generate the word together with a gender-marked article, semantic facilitation from distractor pictures is also obtained. These results support WEAVER++.

3.2.2 Visual attention in descriptions of multi-object scenes

Van der Meulen continued her research on the link between visual attention (as evidenced by eye gaze) and speech planning. Such a link was found in earlier experiments: each object of a multi-object display was inspected shortly before it was mentioned. The viewing time for an object depended, among other things, on the processing time for the object's *name.* In these earlier studies, speakers were explicitly instructed in which order to name the objects. The aim of a new study was to find out how eye gaze and speech are coordinated when speakers are allowed to freely determine themselves in which order to name the objects. Speakers saw displays of three of four objects. They had to produce utterances such as *The fork and the pen are above a cup* when the bottom objects were identical, or *The fork is above a cup and the pen is above a key* when they differed. In some blocks, all displays were of the same type (fixed condition), in other blocks they were mixed (variable condition) (see also Annual Report 1999). The results showed that in the fixed condition, speakers fixated upon each object just before mentioning it and they rarely looked ahead to obtain information about later targets. In the variable condition, however, speakers often engaged in a "preview" of the bottom objects to decide which sentence structure to use. Then, during speech planning, they fixated upon each object in the order of mentioning. This is the so-called "main view". Thus, speakers relied on the visual information rather than a representation of the objects obtained during preview. Furthermore, the preview on the objects reduced the viewing times for the objects during the linguistic scan path. To find out more about the underlying processing of preview and main view, objects with high or low frequency names were used, and presented in a contour-deleted or complete version. Unfortunately, the results were equivocal. The main

conclusion, namely that information retrieved during the preview could be used during linguistic planning, remains.

Dobel, in collaboration with Levelt and Meyer, investigated how syntactically primed descriptions of complex scenes are preceded and accompanied by eye movements. As in syntactic priming paradigms, participants read a prime sentence that contained either a double object (*The sailor writes his girlfriend a letter)* or a prepositional object phrase (*The sailor writes a letter to his girlfriend).* Prime trials were succeeded by target pictures consisting of an agent, an object and a recipient, which were best described using one of the two sentence types. The results showed only a very small, insignificant effect of priming. The main determinant of sentence type turned out to be the location of the agent. When the agent was located to the left, participants produced more prepositional object than double-object phrases, whereas the proportions were equal when the agent was located to the right. Regarding fixation behavior, participants fixated the object first and then the agent before they started describing the scene. One may assume that participants derive the verb from the object upon which the utterance is constructed. During description, the naming of an item was, within a time window of 400-700 ms, preceded by a fixation on the item. This corroborates the findings in the previous section. Consequently, the order of mention became visible in the order of fixation.

3.2.3 Attentional control in number naming

The same type of attentional control could be observed in subjects' number naming. Levelt measured naming latencies for all Arabic numbers ranging from 1 to 999. The naming latencies could be largely accounted for by assuming an attentional control mechanism with the following properties: (1) The default attentional order is from the first to the second to the third digit (and mutatis mutandis for 2-digit and 1-digit numbers); (2) Attention is never spent on the digit 0; (3) An additional attentional step is spent on the second digit for number names that require a naming reversal (Notice that a Dutch number like 27 requires reversal - *zeven en twintig* - just like English 17); (4) This additional step is dispensed with in numbers ending on two equal digits (such as 377). This attentional mechanism closely corresponds to the order of mention (e.g., left to right with an extra step for reversals, no attending to 0 which is never pronounced).
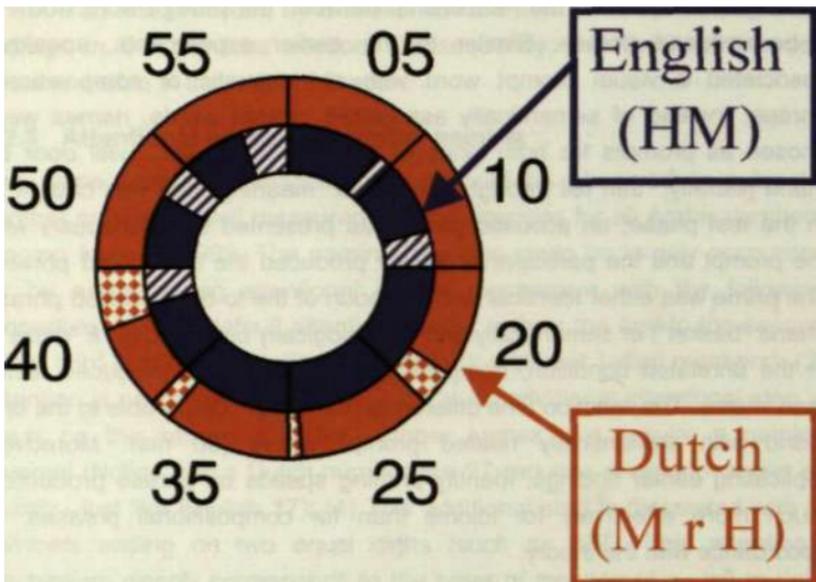
3.3   Fixed expressions
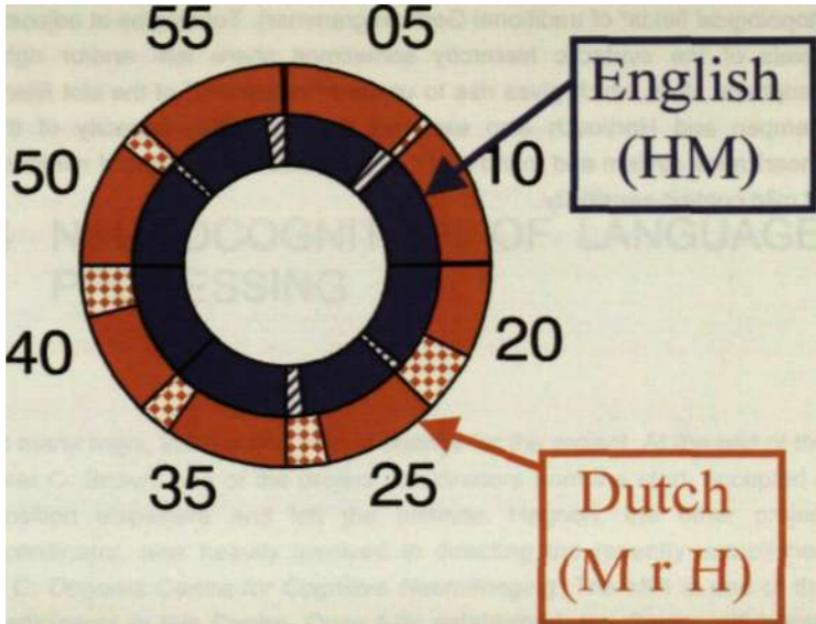
3.3.1   Producing idioms

In two experiments, Sprenger tested an extension of Levelt et al.'s (1999) theory of lexical access to the production of fixed expressions. The theoretical proposal is to represent idioms as "superlemmas" in the lexical network. Superlemmas are activated by their own characteristic idiom concept. Upon selection, a superlemma activates its constituent simple lemmas, affecting their syntactic potential. Earlier findings (see Annual Report 1999: 26-29) supported the superlemma theory, showing a different time course of the production of idioms compared to compositional phrases, as well as a differential effect of priming. In a follow-up study in Dutch, Sprenger tested to what extent the effects with respect to time-course differences are independent from the experimental paradigm used. Examining the ease with which idiomatic and compositional phrases can be associated with a semantically related prompt word, she found a high positive correlation between the number of trials required to learn the association and the production latencies. Since such an effect is likely to cover up any reaction time differences that are due to processing differences between the two types of sentences, Sprenger manipulated the relationship between the prompt word and the to-be-produced phrase. Similar to the earlier experiments, speakers associated a visual prompt word with an idiomatic or compositional phrase. Instead of semantically associated prompt words, *names* were chosen as prompts for both kinds of phrases (e.g., *Jan... viel door de mand* [literally, "Jan fell through the basket" meaning "Jan was caught"]). In the test phase, an acoustic prime was presented simultaneously with the prompt and the participants quickly produced the associated phrase. The prime was either identical with the noun of the to-be-produced phrase *{mand* "basket") or semantically and phonologically unrelated *(jurk* "dress"). In the unrelated condition, compositional phrases were produced faster than idioms. The reaction time difference (52 ms) is comparable to the one found with semantically related prompt words (60 ms). Moreover, replicating earlier findings, identity priming speeds up phrase production much more effectively for idioms than for compositional phrases, in accordance with the theory.

3.3.2 Clock time expressions

In collaboration with Irwin and Levelt, Bock initiated a project on how speakers produce time idioms in Dutch and English. The goal of the project is to examine the temporal relationships between perceptual components of time-telling (extracting information from analog and digital clock displays) and the processes required to select and encode alternative expressions of time (e.g., for 1:35, *twenty-five to two* or *one thirty-five).* Of special interest is the existence of alternative reference points for time-telling. In English, the hour serves as the linguistic reference point regardless of the time expression used: minutes are calculated as deviations from a whole hour. In Dutch, by contrast, both the hour and the half-hour serve as reference points, depending on the time and the type of expression (e.g., 1:35 is typically *vijf over half twee* [literally, "five after half two"] but can be *één uur vijfendertig* [literally, "one hour thirty-five"]). Preliminary norming results suggest that analog and digital clocks yield different patterns of variation in Dutch and English. With analog displays, variations in Dutch and English cluster near the half and whole hours, respectively. With digital displays, variations are spread more uniformly around the hour (see figures 3.1 and 3.2).

Figure 3.1: Analog clock: deviations from modal expressions. (Without cardinal times)

Figure 3.2: Digital clock: deviations from modal expressions. (Without cardinal times)

3.3.3 Constituent ordering

Kempen, in cooperation with Harbusch (U. Koblenz-Landau), developed a linearization model that captures a broad range of constituent order phenomena in clauses of Dutch, English, and German (clause union, cross-serial dependencies, scrambling, verb clusters, wh-fronting, extraction, extraposition, etc.). The model is part of the psycholinguistically motivated formalism of Performance Grammar, which has separate components for assembling the hierarchical and the linear structure of sentences. It was demonstrated that a few narrowly localized, relatively minor variations of the model suffice to account for a great deal of the - sometimes widely diverging - word order patterns in the three target languages, and of the constraints that apply to them. This is the first reason for calling the approach "uniform". The other reason is that the system allows the various linear order phenomena to be viewed as manifestations of the same basic mechanism, which was dubbed topology sharing. Here, a topology is a one-dimensional array containing a limited

number of left-to-right positions ("slots") for clausal constituents (cf. the "topological fields" of traditional German grammar). Topologies at adjacent levels of the syntactic hierarchy sometimes share left- and/or right-peripheral slots, which gives rise to upward "movement" of the slot fillers. Kempen and Harbusch also explored the generative capacity of the linearization system and found that it approaches the theoretical minimum of mild context-sensitivity.

4 NEUROCOGNITION OF LANGUAGE PROCESSING

In many ways, 2000 was a year of change for the project. At the end of the year C. Brown, one of the project coordinators from the start, accepted a position elsewhere and left the Institute. Hagoort, the other project coordinator, was heavily involved in directing the recently established *F.C. Donders Centre for Cognitive Neuroimaging.* The MPI is one of the participants in this Centre. Once fully established, the Centre will house imaging facilities that are central to the neurocognition project. For this reason it was decided that from the fall of 2001 the project members will be housed in the Donders Centre until the end of the project (December 2002).

Other changes of staff occurred in the course of 2000. Van Berkum accepted a position as assistant professor at the University of Amsterdam. This position started in September. However, intensive research collaboration with the project will continue at least until the end of the DFG-grant (second half of 2001). Bastiaansen joined the project in April. His research contribution focuses on alternative methods of extracting relevant information from electrophysiological recordings, including event-related synchronization and desynchronization. Finally, Coles (U. of Illinois) spent his sabbatical year as a guest research fellow of the neurocognition project. The changes of staff in the research group required some reorganization within the project: Indefrey took over the position of C. Brown as project coordinator and Bastiaansen will be involved in coordinating ERP research within the project.

The last year was also marked by a number of honors and awards for the project. Van Berkum and Van Turennout, both former members of the research group, received the very prestigious *Vernieuwingsimpuls-award*

4.1   The neural architecture of language processing

4.1.1   The neural architecture of lexical access and lexical retrieval

Indefrey, C. Brown, Hagoort, F. Hellwig, Kooijman, and Van Dijk, in collaboration with Herzog (Research Centre Jülich) and Seitz (U. Düsseldorf) conducted an experiment on graphemic and phonological lexical access routes involving the combined registration of ERP and PET data. In reading, the meaning of regular words can in principle be accessed in two ways: via the visual word form, or via phonological recoding based on regular spelling-to-sound correspondences. In this study we assessed the neural correlates of these lexical access routes using stimuli that, for successful recognition, rely selectively on one of the two processes: the meaning (and sound) of irregular words (W, e.g., *pint)* can only be accessed via the visual word form, the meaning of homophonic pseudowords (H, e.g., *brane,* for *brain)* only via phonological recoding. In order to verify access to meaning without an additional contaminating task we simultaneously recorded ERPs to identify the so-called N400-effect, reflecting the semantic relation between words. The ERP results indicated that the meaning of both words and homophonic pseudowords was accessed. In the PET data significant regional cerebral blood flow (rCBF) increases were detected in the following contrasts (see figure 4.1): (i) comparing both meaningful stimuli (W and H) to meaningless pseudowords (P), activation was found in the left inferior frontal gyrus (BA 47). This suggests that independent of the access mode, the retrieved lexical semantic information is further processed in the left inferior prefrontal lobe; (ii) comparing irregular words (W) to homophonic
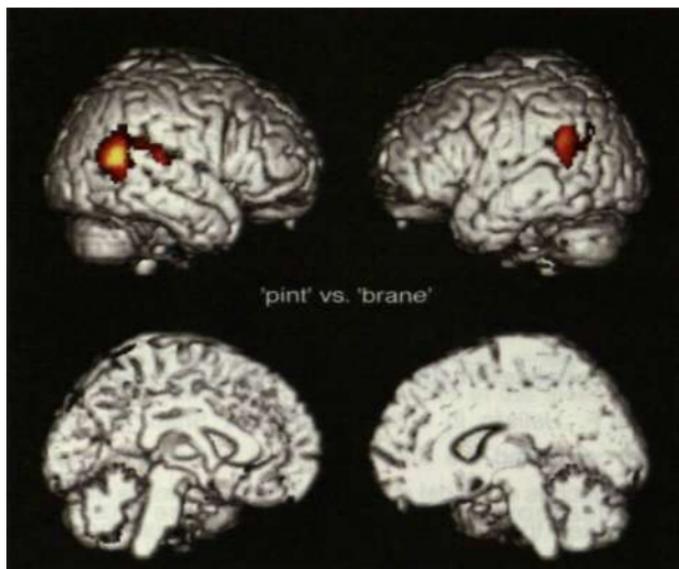
pseudowords (H), activation areas were observed bilaterally in the posterior middle and superior temporal gyri. This suggests that lexical access via the visual word form involves these regions (see figure 4.1); (iii) comparing homophonic pseudowords (H) to irregular words (W), activation areas were found in the inferior occipital gyri, the left posterior fusiform gyrus, the left precentral gyrus, and the left posterior inferior frontal gyrus (Broca's area). This confirms earlier studies suggesting this network of areas to be involved in processes related to phonological recoding (see figure 4.2).

4.1.2   Neural correlates of strategic effects in visual word processing
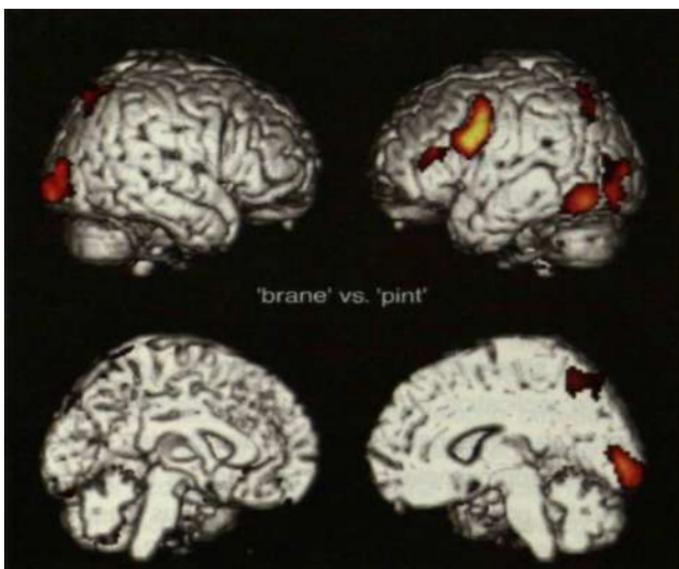
Indefrey and F. Hellwig in collaboration with Shah (Research Centre Jülich) have completed the data acquisition of an fMRI experiment on strategic modulations of lexical access from written words. It is known from behavioral studies that readers more strongly rely on the visual or the phonological recoding access route, depending on which of the two is more "successful" given the nature of the written stimuli. In the fMRI experiment regular words were either preceded by irregular words (enforcing visual lexical access) or by homophonic pseudowords (enforcing phonological recoding). The differential processing of regular words under both conditions was compared. Preliminary results suggest that for skilled readers the cortical activations induced by regular words of low to medium frequency are similar to those induced by irregular words. Phonological recoding enforced by preceding homophonic pseudowords was not carried over to the following regular words.

4.1.3   A meta-analysis of the neurocognition of syntactic parsing

Indefrey conducted a meta-analysis of 28 neuroimaging studies involving syntactic processing during sentence comprehension. The reported cerebral activation sites were recoded in a common anatomical reference system. Reliable replication of findings was assessed using a binomial statistical filter. The meta-analysis showed that the left posterior inferior frontal gyrus (with approximately equal frequencies for Brodmann areas 44 and 45) and the posterior superior temporal gyrus were reliably found across all techniques and experimental procedures. Reports of additional frontal areas depended on the control conditions (involving syntactic processing or not). Additional temporal areas (bilateral superior temporal gyri, left middle temporal gyrus) were reliably replicated for auditory but not for visual sentence presentation. There were no major differences depending on the imaging technique (PET or fMRI).

Figure 4.1 Significant cortical activations comparing irregular words to meaningful homophonic pseudowords. Activation foci were located in the posterior superior temporal lobes bilaterally (BA 39, x,y,z-coordinates according to SPM96 = 60 -62 12 and -62 -50 24).

Figure 4.2 Significant cortical activations comparing meaningful homophonic pseudowords to irregular words. Activation foci were located in the triangular part of the left inferior frontal gyrus (BA 45, x,y,z-coordinates according to SPM96 = -56 12 26), the left premotor cortex (BA6, x,y,z = -50 0 40), the left fusiform gyrus (BA19, x,y,z = -42 -64 -12), the inferior occipital gyri bilaterally (BA18, x,y,z = -32 -80 -2 and 18 -88 2), as well as the precunei bilaterally (BA7, x,y,z = -28 -64 38 and 22 -60 54).

4.2   Error monitoring in language production

Coles, C. Brown, and Hagoort investigated error monitoring in language production. The ability to monitor one's own behavior is a critical aspect of human executive function. Previous research has identified an electrical brain signal (the error-related negativity or ERN) that is associated with the commission of errors when the monitoring system detects that intended actions were not accomplished. This signal appears to be generated in the anterior cingulate cortex, a neural structure traditionally associated with executive function. The focus of previous studies has been on errors defined as incorrect responses with the hands or feet. In the present study, we sought to extend this research by evaluating the electrical brain response that followed speech or vocal errors. Is the same neural system involved in monitoring these kinds of errors? We began by trying to devise a paradigm which would reliably produce speech errors. However, after several attempts which yielded inconsistent data, we turned our attention to vocal errors - for example, saying the word *rechts* "right" to a stimulus that required the response *links* "left". We conducted an experiment in which subjects were required to respond to visually presented words *(links* or *rechts)* or arrows (pointing to the left or right), either vocally by saying the appropriate word, or by making a button-press response with the left or right hand. Errors in the manual response condition were associated with a negative brain potential (the ERN), whose characteristics matched those previously observed following manual errors. However, errors in the vocal condition were associated with a positive potential. Although the polarity of the brain potentials was different for the two kinds of errors, it is possible that activity in the same neural structure is involved in their generation: the ventral bank of the anterior cingulate sulcus in the case of manual errors, and the dorsal bank in the case of vocal errors. We are currently evaluating this possibility using dipole source analysis procedures.

4.3   The time course of lexical access during word comprehension

In the course of his Ph.D. project, Müller, under the supervision of Hagoort, set up an EEG experiment to investigate the time course of access to lexico-syntactic and lexico-semantic information in the reading of words. The study's rationale follows the earlier project research of Van Turennout et al. on the time course of speech production, using a two-choice go/nogo task and deriving the Lateralized Readiness Potential (LRP). Participants saw single Dutch words on a computer screen and had

to perform two decisions regarding a pushbutton response. In one set of instructions, grammatical gender of the noun prescribed with which hand to respond (left/right) and the word's membership in a particular semantic category prescribed whether a response had to be executed at all or not (go/nogo); in another set of instructions, semantic category determined response hand, while grammatical gender determined response execution. The LRP indicates the onset of response preparation and, in combination with a two-choice go-nogo task, delivers evidence on which of two kinds of information is available earlier than the other (here, grammatical gender and semantic category). On nogo-trials (no response executed) an LRP should be observable if the response hand depends on the earlier available word property and response execution depends on the later available property: preparation can start before response execution is halted by later incoming nogo-information. However, if the early available word information determines response execution, any preparation is discarded right away. Furthermore, a frontal N200 effect will be examined, which in similar studies has been reported to indicate the time when inhibitory information is available. Data collection is still on-going but a preliminary inspection of LRPs averaged over 8 participants suggests that a nogo-LRP occurs if gender determines the response hand but not if it determines response execution. This would mean that gender is available earlier than semantics.

4.4   Syntactic and semantic integration processes during comprehension

4.4.1   Context effects during spoken word recognition

Van den Brink, with involvement of C. Brown and Hagoort, continued her Ph.D. research on the time-course of contextual influences in the on-line recognition of spoken words, using ERPs. A follow-up experiment was designed to investigate the eliciting conditions of a negative component preceding the N400 component that had been obtained in the previous experiment (see Annual Report 1999). In this previous experiment it was concluded that, whereas the N400 reflects semantic integration, the early negative component (N200) could be an indicator of the earlier lexical selection process, where word-form information resulting from an initial phonological analysis and content information derived from the context interact. If the different functionalities of the N200 and N400 were to hold, presenting only a small initial part of the sentence-final word should initiate

the lexical selection process, thereby eliciting an N200, but not the semantic integration process as reflected by the N400. Subjects were presented with Dutch sentences that ended with a sentence-final word that was either congruent or semantically anomalous beginning with phonemes that differed from the congruent completion and that was either fully presented, or only partially (preceding the isolation point of the word as assessed in a gating study): "The zookeeper gave the monkey a tasty *banana/temple/ba/te".* For the fully presented completions, isolation point (IP) information was used to assess whether the semantic integration process is time-locked to this point. The results show that the factor early or late IP did not affect the onset (nor the peak) of the N400. In fact, in words with late IPs onset of the N400 occurs well before the IP. This indicates that semantic integration begins before the actual word's isolation point is reached. A preliminary analysis of the partially presented data indicates the presence of an N200 effect in the absence of an N400 effect, indicating that the two components indeed reflect two distinct processes. A more detailed analysis of these data is currently ongoing.

4.4.2   A unification-based account of syntax-related ERP effects

Hagoort developed an explicit account of syntax-related ERP effects based on a computational model of parsing developed by Vosse and Kempen (2000), here referred to as the Unification Model. According to this model each word form in the lexicon is associated with a structural frame. This parsing account is "lexicalist" in the sense that all syntactic nodes are retrieved from the mental lexicon. There are no syntactic rules that introduce additional nodes. In the on-line comprehension process, structural frames associated with the individual word forms incrementally enter the unification workspace. In this workspace constituent structures spanning the whole utterance are formed by a unification operation. During this unification operation binding links between lexical frames are formed dynamically, which implies that the strength of the binding links varies over time until a state of equilibrium is reached. Due to the inherent ambiguity in natural language, at any point in the parsing process usually alternative binding candidates will be available. The state of equilibrium is reached through a process of lateral inhibition between two or more incompatible links (for details, see Vosse and Kempen 2000). The advantage of the model is that (i) it is computationally explicit, (ii) it accounts for a large series of empirical findings in the parsing literature, (iii) it belongs to the class of lexicalist parsing models that have found

increasing support in recent years. This model is used to account for the two major syntax-related ERP effects, namely the (Left) Anterior Negativity (LAN) and the P600/SPS. The P600/SPS is reported in relation to syntactic violations, syntactic ambiguities, and syntactic complexity. The LAN, in contrast, has so far only been observed with syntactic violations. In the Unification Model, binding (unification) is prevented when either a syntactic building block does not find another syntactic building block with an identical node to bind to, or when the agreement check finds a serious mismatch in the grammatical feature specifications of the nodes. The claim is that an anterior negativity (LAN) results from a failure to bind, as a result of a negative outcome of the agreement check or a failure to find a matching category node. In the context of the model, the P600/SPS is suggested to be related to the build-up of the strength of the unification links. This strength and the time it takes to build up the links are affected by ongoing competition between alternative binding options (syntactic ambiguity), by syntactic complexity, by recovery operations, in the case of syntactic violations, and by semantic influences. Prima facie, this model provides a fairly natural account of syntax-related ERP effects that have been reported in the literature and are found in the research of the neurocognition project.

Hagoort and Kempen, with the help of Commandeur (Leiden U.), predicted on the basis of this model that the severity of the syntactic violation influences the activation and binding dynamics of the Unification Model and its reflection in the syntax-related ERP componentry. To test this prediction, they designed an experiment in which the severity of word-category violations was manipulated, as can be seen in the following example sentences:

(1a)   De houthakker ontweek de SCHROEF op dinsdag.   (Synt +)

         "The lumberjack dodged the PROPELLER on Tuesday."

(1b)   De houthakker ontweek de SCHROEFT op dinsdag.   (Synt -)

         "The lumberjack dodged the PROPELLED on Tuesday."

(1c)   De houthakker ontweek de ZODRA op dinsdag.   (Synt--)

         "The lumberjack dodged the AS SOON AS on Tuesday."

In (1b) the Noun slot is filled by a verb form. This word-category violation has been found to result in both an anterior negativity between 300 and

500 ms, and a posterior positive shift in the ERP waveforms starting between 500 and 600 ms. In (1c) the Noun slot is filled by a closed class element, such as wh-question markers or S-comp markers. Reconstructing the sentence to its original structure (recovery & reanalysis) is much harder in (1c) than in (1b). The results show that the stronger violation results in a much earlier P600/SPS than the standard word-category violation. In (1c) the P600/SPS starts at 350 ms, whereas the onset of the positive shift in (1b) is about 300 ms later. In addition, the P600/SPS has a much stronger frontal component in (1c) than (1b). Finally, the anterior negativity seen in (1b) is less visible in (1c). However, this could be an overlapping component problem, due to the early onset of the P600/SPS in (1c). Further analysis of these data is ongoing.

4.4.3 The processing of syntactic gender and number agreement in comprehension

Van Berkum, C. Brown, and Hagoort, in collaboration with Zwitserlood (U. Münster), and the student-assistants Kooijman, De Waele, Van Dijk, and Van der Linden, conducted an ERP study to explore the use of syntactic gender and syntactic number features in parsing. The main purpose was to test a recent claim that syntactic number features are taken into account by initial parsing operations _very_ rapidly, whereas syntactic gender is used in a substantially delayed and qualitatively different stage of processing (De Vincenzi 1999). They explored this prediction in an ERP experiment with written Dutch sentences that included a number violation, a gender violation, or no violation at all. The critical sentences were designed such that the number and gender agreement violations became apparent with the same critical noun that also served as the grammatically correct noun in the control condition, as illustrated below (COM = common gender, NEU = neuter gender, no gender marking exists in the plural).

(2a)   Ik zag een donkere WOLK aan de horizon.   (correct control)

      "I saw a dark$_{COM}$ CLOUD$_{COM}$ on the horizon."

(2b)   Ik zag een donker WOLK* aan de horizon.   (gender violation)

      "I saw a dark$_{NEU}$ CLOUD$_{COM}$* on the horizon."

(2c)   Ik zag enkele donkere WOLK* aan de horizon. (number violation)

      "I saw several dark CLOUD* on the horizon."

Relative to the correct control sentence, both types of agreement violations elicited a large symmetrically distributed P600/SPS effect, starting at about 500 ms after presentation of the noun at which the violation became apparent, and followed by a second, somewhat right-lateralized positivity from about 850 ms onwards. The identical onset of the P600/SPS effect across violation types implies that both types of agreement had been processed by the syntactic parser within 500 ms at most. This implies that there is no (large) principled delay in the processing of gender agreement relative to that of number agreement. In addition, the fact that violations of grammatical gender and number elicited a qualitatively identical pattern of ERP effects suggests that the two violation types share several processing consequences, presumably associated with either the increased difficulty of syntactic integration, or with error detection, diagnosis, and repair (see section 4.4.5 for a qualitative *difference* between gender and number violations revealed in an event-related [de]synchronization analysis of the same EEG dataset). A final observation is that in the ERP data, number agreement violations do *not* elicit a standard N400 effect, in spite of the fact that such violations have not only a syntactic, but also a semantic/conceptual component.

Van Berkum, C. Brown, and Hagoort, in collaboration with Zwitserlood, continued the research on the ERP correlates of referential processes in language comprehension (with the assistance of Kooijman, De Waele, Van Dijk, and Van der Linden). In a written-language variant of an earlier spoken-language experiment (Annual Report 1999: 35-37), they mani-pulated the number of available referents for a singular pronominal NP by contrasting such sentences as below:

(3a) David schoot op John terwijl HIJ over het muurtje dook. (2 referents)

"David shot at John as HE jumped over the wall."

(3b) David schoot op Linda terwijl HIJ over het muurtje dook. (1 referent)

"David shot at Linda as HE jumped over the wall."

(3c) Jane schoot op Linda terwijl HIJ over het muurtje dook. (0 referents)

"Jane shot at Linda as HE jumped over the wall."

In line with the prior spoken-language findings, preliminary analyses of this written-language replication suggest that relative to referentially unambi-guous (1 referent, 3b) pronouns, referentially ambiguous (2 referents, 3a)

written pronouns elicit a relatively sustained frontal negativity, whereas pronouns without any overtly introduced antecedent (0 referents, 3c) elicited a P600/SPS effect. More detailed analyses are currently being conducted.

4.4.4 Event-related power changes during sentence processing

The research initiated by Bastiaansen aims at identifying frequency-domain correlates in the human EEG of different aspects of sentence processing. Initially, the focus has been on the analysis of the reactivity of various EEG rhythms (theta, roughly from 4-7 Hz, and alpha, roughly from 8-12 Hz) during sentence processing by means of computing event-related power changes. The rationale behind this type of analysis is that there are theoretical and functional differences between *evoked* and *induced* EEG responses. Induced responses can be defined as responses that are not *directly* driven by external stimuli or internal-state changes, whereas evoked responses are. Induced EEG responses are time-locked, but not phase-locked to an event. In contrast, ERPs are not only time-locked but also phase-locked to an event. For the computation of ERPs (the *evoked* changes in EEG activity) single epoch data are averaged in order to improve the signal-to-noise ratio of the ERP. Through this averaging procedure the non-phase-locked, event-related changes in *induced* EEG activity cancel out. Therefore, these changes are not contained in the ERP. However, there is a growing body of evidence showing that these *induced* changes may contain relevant information.

A technique that has been termed Induced Band Power Analysis (IBP) is used to quantify the *induced* EEG changes in the theta, alpha, and gamma frequency ranges. Four studies were carried out in parallel.

As a first step, Bastiaansen in collaboration with Van Berkum, C. Brown, and Hagoort analyzed the event-related alpha and theta responses of subjects reading normal sentences that contained no violations. This analysis established that each word in a sentence induces a phasic increase both in theta power (maximal between 300-500 ms after word onset) and in alpha power (maximal between approximately 100-300 ms after word onset). Furthermore, preliminary results indicate that as a sentence unfolds over time, there is a slow, tonic increase in theta power, on top of which the phasic responses to each word are superimposed.

Subsequently, event-related alpha and theta responses elicited by the reading of sentences with syntactic violations were quantified. The

syntactic violations were either number or gender agreement violations. The results show that the phasic theta increase is larger for the words constituting the violation than for the same words in control sentences. Again, this differential effect is maximal in the interval of 300-500 ms after word onset. In addition, there was a qualitative difference in the scalp topography of this differential effect: number agreement violations produced a left-frontal theta increase, while gender agreement violations produced a right-frontal theta increase. No differential effects of syntactic violations were found in the alpha frequency band (see figure 4.3).

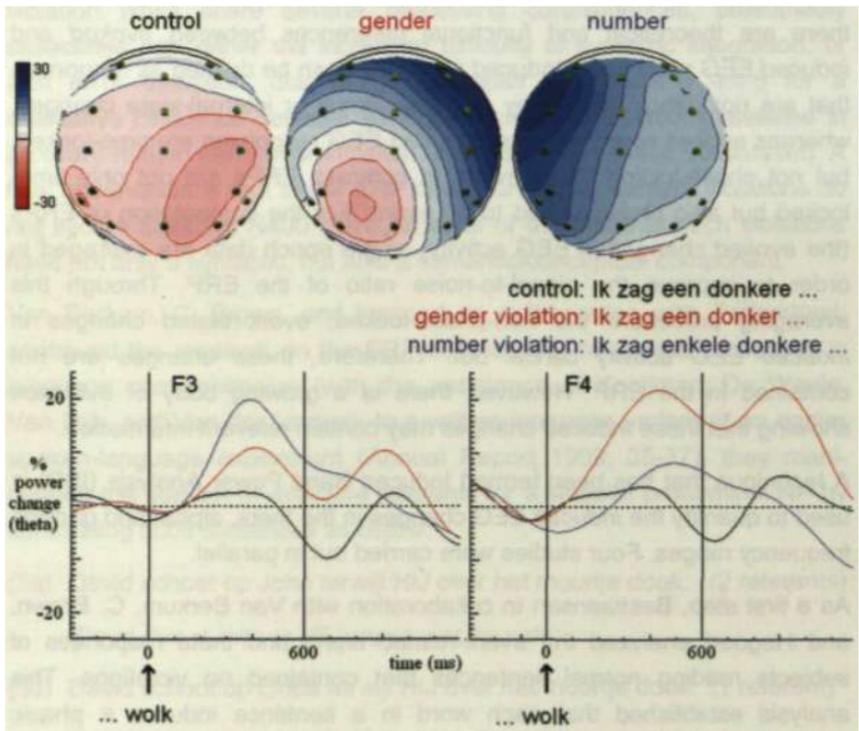Figure 4.3. Grand average (N=18) changes in induced theta power from a baseline interval (-300 to 0 ms) in response to correct words, words constituting a gender violation, and words constituting a number violation. Bottom: time courses at electrodes F3 and F4. Top: topographic distribution at 400 ms after onset of the critical word. Note the qualitative difference in the theta response to number and gender violations.

4.5   ERP studies on language disorders

Wassenaar, Hagoort and C. Brown continued their research on on-line syntactic comprehension problems in patients with Broca's aphasia. In this context a new experimental paradigm was designed and implemented: an on-line ERP version of a sentence-picture matching task. Throughout the, years, the study of agrammatic comprehension has often been approached by using sentence-picture matching tasks. In this task, patients are shown a picture (or a number of pictures) together with a spoken sentence. The patient's task is to determine the correspondence between the sentence and (one of) the picture(s). However, the task has one major disadvantage: its off-line nature. Therefore, we developed an on-line version of a sentence-picture matching task. Pictures and sentences (with different syntactic complexity) were derived and slightly adapted from the Dutch version of a German test for syntactic comprehension (see Annual Report 1994: 115). Sentences were paired with the pictures and belonged to three different conditions, namely, (i) semantically irreversible sentences with active voice; (ii) semantically reversible sentences with active voice; (iii) sentences with passive voice. The sentences either matched or mismatched some syntactic aspect of the picture. For sentence type (i) the mismatch was realized by reversing the grammatical subject and object of the matching sentence. For sentence type (ii) and (iii) the mismatch was realized by showing pictures in which the thematic roles of agent and patient had been reversed.

Subjects were shown a picture on a computer screen. After some inspection time had passed, a spoken sentence was presented. For example, subjects saw a picture of a man photographing a child, and heard the sentence "The man in this picture is being photographed by the small child". During presentation of the spoken sentence, ERPs were recorded. After hearing the sentence, subjects had to decide (by pressing a button) whether the sentence matched or mismatched the picture.

To date, 15 healthy elderly control subjects, 11 college-aged subjects, 10 patients with Broca's aphasia, and 5 patients with a right hemisphere lesion (RH patients) have participated in the experiment. Preliminary analyses of the results of the elderly control subjects showed that the mismatch between the event structure of the picture and the event structure of the sentence was detected as soon as the verb (for the two types of active sentences) or the auxiliary *wordt* (for the sentences with passive voice) was presented. This mismatch was reflected in the ERP

waveform by a negative deflection immediately followed by a positive shift. The negative deflection had a very early onset (about 100 ms after the vowel). The onset of the effect indicates how quickly incremental sentence interpretation takes place against the event structure that is generated on the basis of the visual information in the picture. For the mismatching active sentences, but not for the passive sentences, a negative shift was present for the sentence-final nouns. This sentence-final negativity presumably reflects semantic analysis problems originating from the mismatch. A more detailed analysis of these data is ongoing. The patients with a right hemisphere lesion showed a pattern of result that is similar to the young and elderly control subjects. The results of the Broca's aphasics did not show ERP-effects for active reversible and passive sentences that did not fit the event structure of the picture. Nevertheless, in their off-line performance they showed an above chance level performance in detecting the mismatch. However, the ERP data suggest that this mismatch is "reconstructed" off-line instead of during the on-line incremental sentence interpretation process. Testing of additional Broca and RH patients and young control subjects is currently being carried out.

5 GESTURE PROJECT

This year, the Gesture Project welcomed some new members. In February, Gullberg joined the project. Toward the end of the year, Melinger and Enfield also joined the project.

The Gesture Project saw continuing work on themes that have been developing for the last few years, namely the ethnography of pointing and the gestural facilitation of speaking (see Kita & Essegbey 5.4), and the gestural expression of motion events (see Kita, Senghas, and Özyürek 5.5). There are also several new lines of research, namely Seyfeddinipur's project on speech dysfluency and gesture (5.1), Gullberg's work on how gesture influences recipients' gaze movement (5.2), and Lausberg's investigation of the hemispheric specialization of various types of gestures, based on data from (split-brain) callosotomy patients (5.3).

Hence, the Gesture Project encompasses several major areas of inquiry: the relationship between speech production and gesture production, the role of gesture in communication, the ethnography of gestural communication, the relationship between brain and gesture, and the relationship between an emerging sign language and gesture.

5.1   Gesture and speech dysfluency

Seyfeddinipur investigated the synchronization patterns of gestural movement and dysfluencies in speech. She examined whether and how gesture is affected by self-interruption in speech. The analysis is based on a corpus of speech dysfluencies produced by 12 native German speakers, who describe their houses and apartments.

Seyfeddinipur analyzed utterances with self-initiated repairs, in which a gesture accompanies the suspension word (i.e., the last word before the

utterance is suspended for a repair. For example, "two" is the suspension word in an utterance, "there were two, uhm, three windows in the kitchen"). Just as speech can be suspended, so can gesture be suspended in the following two ways:

1) The preparation or the stroke of a gesture goes into a hold (temporary cessation of movement);

2) The preparation or the stroke of a gesture is immediately followed by a new preparation for a different gesture.

It was found that a gesture accompanying a suspension word was more likely to undergo either of the aforementioned changes (75% of the time) than a gesture accompanying a randomly selected word in a baseline fluent utterance (8 %).

Seyfeddinipur also examined the temporal relationship between the moment when these gestural movement changes happen and the moment of speech interruption (i.e., the end of the suspension word). It was found that 84% of the gestural movement changes were either anticipatory of, or simultaneous with the speech interruption and that 16% of them followed the moment of speech interruption.

To summarize, when speech is interrupted, gesture is suspended and possibly followed by the regeneration of a new gesture. These gestural changes often happen before, or simultaneously with the moment of suspension. This indicates that the execution and monitoring of speech and the execution and monitoring of gesture are closely coordinated.

5.2   Gesture and recipient's gaze behavior

Gullberg, in collaboration with Holmqvist (Lund U., Sweden), takes a new approach to the role of gesture in communication. Eye-tracking techniques are used to explore if and when recipients visually monitor gestures in interaction. Recipients' gaze on gesture can have two communicative consequences. First, if recipients consistently attend to gestures visually, then subsequent "intake" of the information conveyed in gestures is more likely. Second, the recipient's gaze on a gesture may influence how the interlocutor's subsequent utterances unfold.

In order to determine factors that affect recipients' gaze movement onto gesture, it is necessary to develop an experimental paradigm with video

stimuli, where a set of stimuli with specific gesture features can be presented to the recipient. Such an experimental paradigm, however, requires methodological preliminaries that ensure comparability of gaze movements in response to video stimuli on the one hand and gaze movements in live interaction with a speaker on the other hand. Thus, the initial study compared recipients' fixations of naturally occurring gestures in face-to-face interaction (baseline, live condition) with fixations of gestures presented on screen (video condition).

In the live condition, eight narrators retold a printed cartoon in Swedish to recipients wearing a head-mounted SMI iView eye-tracker. In the video condition, 16 new Swedish recipients were presented with video recordings of the first set of narrators filmed *en face.* Fixation data were thus collected for exactly the same gestures presented both live and on video. The new recipients were seated in front of a video screen, and the SMI iView remote set was placed between the recipients and the screen.

The results from these studies show that the recipients' fixation behavior towards speakers and their gestures is remarkably similar across conditions. In both conditions, recipients predominantly fixate speakers' faces and only devote 1-2% of the time to gestures. Most gestures are thus perceived through peripheral vision. Gestures that do attract direct fixations are typically performed in peripheral gesture space, contain holds (i.e., temporary cessations of movement), or are gestures that are fixated by the speakers themselves. Fixated gestures often display combinations of these features. Recipients thus fixate gestures directly when peripheral vision is insufficient or unreliable - for example, when gestures are performed in peripheral gesture space or without motion - or when principles of joint attention lead them to follow the speakers' gaze. Moreover, the features that determine whether gestures are fixated operate independently of the medium of presentation. These results substantiate ecological validity of video-based experiments in studies on the effect of gesture on the recipient's gaze movement.

5.3   Hemispheric specialization in nonverbal gesticulation investigated in patients with callosal disconnection

In a project funded by the German Research Society (DFG), Lausberg and Kita investigate hemispheric specialization of gestures in split-brain patients. The study is realized in collaboration with Ptito (Montreal Neurological Institute) and Zaidel (UCLA).

Split-brain patients have had two brain hemispheres operatively disconnected (callosotomy). Thus, with these patients it is possible to investigate the role of the separate right and left hemispheres in gesticulation. The hemisphere that generates a gesture can be determined by the hand used to perform it because callosal disconnection results in the left hemisphere controlling only the right hand and vice versa. Using this direct link between the hand choice and a hemisphere, this study aims to determine hemispheric specialization of different types of gesticulations (e.g., pointing gestures, iconic gestures, and batons).

In the current study, we tested three patients with complete callosotomy, and as control groups five patients with partial callosotomy and eleven healthy subjects. (The degree of callosotomy is confirmed by MRI and functional disconnection signs). The three groups are matched as closely as possible with respect to the distribution of gender and of native languages (English and French). However, there is a mild difference in mean age, which has to be considered in the interpretation of the results. All subjects but one in the two patient groups are within the low IQ-range (according to Wechsler Adult Intelligence Scales). Healthy controls are distributed almost equally over the three IQ-groups: low, average, and high IQ. The handedness was established by questionary and by spontaneous hand preference in pantomime and object use. All subjects are right-handed except for one healthy control, who is ambidextrous. The three groups did not differ in basic sensorimotor functions such as strength and sensory perception; however, slight general motor slowing due to anti-epileptic medication was found in the two patient groups. In other words, difference in gesture behavior among the three groups cannot be due to sensorimotor deficits in the patient groups.

In normal subjects, the hand and arm are mainly controlled by the contra-lateral hemisphere; however, split brain patients can develop some degree of ipsilaterai control over time (e.g., the right hemisphere 's control over the right limb). Therefore, it was necessary to establish the degree of ipsilaterai motor control for each complete callosotomy patient in our study. We tested this for shoulders, elbows, wrists, and fingers in order to examine how straightforward the mapping is between the hand choice for a gesture and the hemisphere that generates the gesture.

The degree of ipsilaterai control of the hand/arm in complete callosotomy patients is evaluated by the following type of sensorimotor tasks. In these tasks, the investigator touches a part of the limb of the participant, who is

blindfolded. In response to the stimulation, the participant has to move the corresponding part of the other limb in a specific way (e.g., the investigator touches the left index finger, and the participant has to raise the right index finger). Normal controls can achieve this by transferring information between two hemispheres via the corpus callosum. Since complete callosotomy patients cannot use callosal transfer of information (partial callosotomy patients, only to some degree), the only way for them to achieve the goal is by ipsilateral motor control.

In the investigation of ipsilateral control of fingers, the patients with complete callosotomy show a success rate of 25%, which is just above the chance level for this task (20%). The success rate is significantly lower than that of the patients with partial callosotomy (87%) and healthy controls (97%). This indicates that the patients with complete callosotomy do not compensate callosal disconnection by means of ipsilateral motor pathways for fingers. In the control experiment, in which the patient had to raise the same finger that is touched (e.g, the investigator touches the left index finger, and the participant raises the left index finger), the complete callosotomy patients showed normal performance.

We repeated an analogous task on the wrist, the elbow, and the shoulder. The same pattern of results are obtained for the wrist and the elbow. However, for the shoulder, there is evidence for ipsilateral control in the complete callosotomy patients.

The insufficient compensation by the ipsilateral motor control substantiates the basis for future evaluation of gestural behaviors. It is unlikely that split-brain patients will spontaneously, e.g., in a semi-structured interview, use deficient motor pathways to express themselves. Thus, when a patient with complete callosotomy uses the limb for a gesture, we can conclude that the gesture is generated by the contralateral hemisphere of the brain. This finding prepares the ground for addressing the key questions in this subproject - which hemisphere generates which types of gesture.

5.4   Influence of the Ghanaian left-hand taboo on gesture

In Ghana, a set of conventions restrict the use of the left hand. Virtually all Ghanaians consider giving, receiving and eating with the left hand to be rude. Furthermore, a significant portion of Ghanaians considers direction-indicating gestures with the left hand to be rude. In collaboration with Essegbey (Leiden U.) Kita investigated the consequence of this taboo on

Ghanaian gestural behavior. Twenty-six persons were first asked to give route directions in a town in Ghana; and were subsequently interviewed with respect to their view on the gesture taboo. All acknowledged the general left-hand taboo, and 16 subjects also acknowledged the taboo for direction-indicating gestures with the left hand.

This gesture taboo leads to several characteristic features of Ghanaian nonverbal behavior:

(i)   Although those who acknowledge the gesture taboo sometimes do indicate direction with the left hand, they do so significantly less often than people who do not acknowledge the taboo.

(ii)   When a direction-indicating gesture is performed with the left hand, it is often reduced in size and performed on the periphery. Some left-hand gestures were made so inconspicuously that they could no longer be counted as gesture with respect to the taboo.

(iii)   There is a conventional respect position for the left hand, in which the hand is hidden behind the buttocks.

(iv)   The right hand is often used to indicate directions, such as left-back, for which the use of the left hand would be more convenient. Such right-hand gestures exhibit unusual form characteristics, such as the arm wrapping around the neck.

(v)   There are conventionalized bi-manual gestures for indicating direction.

As mentioned above, the taboo does not lead to the total inhibition of direction-indicating gestures with the left hand. For the taboo-acknowledging consultants who used the word "left" in their route directions, the planning to utter the word "left" seem to have triggered a left-hand gesture: slightly before the production of the word "left", the left hand becomes gesturally active, despite the fact that this is socially stigmatized. This is consistent with the view that direction-indicating gestures with the left hand facilitate the access to the concept LEFT, and that speakers are cognitively compelled to gesture with the left hand when they have to make the conceptually difficult choice between LEFT and RIGHT (see Annual Report 1998). It is concluded that the cognitive demand to move the left hand penetrates through the cultural norm, but only to the extent that the reduced gestural morphology minimizes the potentially damaging social effect.

5.5   Gesture and emerging sign language

Kita has been collaborating with Senghas (Barnard College) and Özyürek (Koç U.), both former members of the Gesture Project, on a study which researches whether characteristics of co-speech gestures are adopted into the grammar of an emerging sign language. In particular, the expression of motion events that involve a complex manner and path of movement has been examined to answer the question whether the means of expressing manner and path in a sign language are derived from the expression of manner and path in the local community's co-speech gestures.

Sign languages have emerged in different countries all over the globe, and all of them were surrounded by the local spoken languages. Previous work of the Gesture Project has shown that the representation of motion events in co-speech gesture varies crosslinguistically: path-only and manner-only gestures occur more often with some spoken languages than with others, and their combination is dependent on concurrent verbal packaging of information (see Annual Reports 1997, 1999). One might predict that sign languages emerging among these different co-speech gesture systems would differ accordingly: those sign languages surrounded by combined gestures would include combined or holistic signs, those surrounded by separate gestures would include separate signs.

To test this prediction, Kita and his collaborators examined an emerging sign language, the Nicaraguan Sign Language, with respect to how manner and path are packaged. The Nicaraguan Sign Language has emerged over the last two decades within the deaf community in Managua, Nicaragua. Throughout its emergence, the Nicaraguan Sign Language has been surrounded by spoken Spanish.

To investigate stages of its emergence one must differentiate and compare at least the following three language varieties:

(i) the variety of spoken Spanish in Nicaragua together with its co-speech gestures,

(ii) the sign language variety of the first group or "cohort" of signers (now adults), and

(iii) the sign language variety of the second cohort of signers (now adolescents), who had been exposed to the sign language variety of the first cohort of signers.

In this study, four adult signers, four adolescent signers, and four hearing, Spanish-speaking Nicaraguans watched an animated cartoon and narrated its story. Signs and co-speech gestures used to describe complex motion events (such as a cat rolling down a hill) were coded as:

(i) manner-only (e.g., a rotating hand),

(ii) path-only (e.g., a hand tracing a trajectory),

(iii) manner and path combined (e.g., a rotating hand tracing a trajectory).

In their elicited narratives, the Spanish-speakers' co-speech gestures and the adult signers' signs often combined manner and path into a single holistic movement. Adolescent signers, however, produced fewer combined movements. Instead, they tended to use multiple signs for the expression of complex motion events. The adolescent signers frequently produced first a manner and then a path sequence - a construction rarely found in adult signers and never produced by the Spanish-speaking gesturers. These data suggest that the reanalysis of gesture into sign involved the separation of holistic representations into sequential components. Processes of language acquisition and language change evidently prevent sign languages from mirroring the co-speech gestures of the local language community.

6 SPACE

The Space Project investigates the relation between linguistic categories and language-independent concepts in the spatial domain. Two main approaches have been employed over the duration of the project. One is to look at the process of language acquisition, during which children construct language-specific semantic categories, and the other focuses on crosslinguistic variation and its cognitive correlates. Where possible we have tried to combine both approaches. In this report we concentrate first on the study of crosslinguistic variation, turning back to acquisition at the end. As before, the aim has been to get a picture of the full extent of variation. Such a picture requires a level of detail not available from published sources, and consequently first-hand fieldwork has been conducted in many areas of the world, from the Amazon, to West Africa, to Papua New Guinea. By coordinating data collection through the use of the same tasks and stimuli, we have been able to build a comparative typology for many subdomains of spatial conception. As far as we know, this is the first time there has been this kind of systematic overview of semantic variation within a single complex domain across languages from over a dozen language families. We hope that this kind of work will contribute to the development of "semantic typology", a subfield of linguistics which has a special interest for the psycholinguistic study of the interface between language and other aspects of cognition.

During the year, three main subdomains of spatial language were pursued. The first is the study of demonstratives, concentrating on the more complex systems in languages with three or more opposed terms. The second is the study of "spatial topology", that is, the description of objects in propinquity or contiguity with their "ground" or landmark objects. Last year, we reported on the role of locative verbs in the semantics of such locative constructions, while this year we have concentrated on

adpositions and other related spatial words. The third domain has been the expression of motion events, a theme shared with the Argument Structure project and reported in that chapter.

6.1   Multi-term demonstrative systems

The analysis of *two-term* demonstrative systems as used in exophoric reference in seven languages was described in the 1999 Annual Report (pp. 54-58). It turned out that there is a much richer set of variants than had been expected. Four main subtypes were isolated: (i) speaker-anchored, with a proximal and a distal form (Ewe, Italian, Yukatek), (ii) speaker-anchored, with a proximal and a "neutral" (i.e., unmarked for distance) form (Dutch, English), (iii) speaker-anchored, with a distal and a "neutral" form (Russian), (iv) speaker-and-addressee-anchored, with a proximal and a distal form (Brazilian Portuguese). When we turn to languages where *three or more* demonstratives are in opposition, the possible variants increase still further. In this report we illustrate some of these systems, and draw generalizations about the likely typology. As before, the focus of research has been restricted to deictic elements which appear as modifiers in NPs, and which refer to an entity located in real space (see Annual Report 1999).

The main languages investigated are presented in table 6.1:

Language (affiliation)	Researcher	Location
Chukchi (Paleosiberian)	Dunn	Chukotka, Russian Federation
Japanese (isolate)	Kita	Japan
Lavukaleve (Papuan)	Terrill	Russell Islands, Central Province, Solomon Islands
Saliba (Austronesian)	Margetts	Milne Bay Province, Papua New Guinea
Tiriyó (Cariban)	Meira	Amazon, Brazil and Surinam
Trumai (isolate)	Guirardello	Brazil
Yélî Dnye (Papuan)	Levinson	Rossel Island, Papua New Guinea
Tzeltal (Mayan)	P. Brown	Chiapas, Mexico

Table 6.1: Languages under research for demonstrative systems

The literature on spatial demonstratives frequently refers to systems with unidimensional distance scales specifying three or more distances. However, deeper investigation shows that most, perhaps all, such systems are not unidimensional referring to distance alone. They may involve differences in markedness (for example, one term may be semantically neutral), or some terms may be nested under others as further semantic elaborations.

More complex multiple term demonstrative systems may subdivide the distance scale according to how it is anchored with respect to speaker and addressee, or there may be the addition of other independent dimensions, such as spatial categories like elevation and direction, or perceptual/ cognitive categories like visibility, attention shift, and anaphoricity. Thus, multiterm systems may involve either a minor extension of the types of demonstrative systems found in languages with two terms, or a significant semantic elaboration in the types of categories they express. The types observed will be described below.

6.1.1 Purely speaker-anchored systems

Fillmore (1982) suggests that there are never more than three contrasts on the distance scale in the demonstrative system of any language. Of the languages investigated, Chukchi, Lavukaleve, Yélî Dnye, and Tiriyó have demonstrative systems consisting of or including distance scales with three or more values. None of these languages has a three-value distance scale clearly consisting of a simple three-way split into proximal, medial, and distal terms, with the possible exception of Tiriyó, although a different analysis is preferred for this system as well.

Terrill proposed the following analysis of Lavukaleve demonstratives (diagrammed in figure 6.1): In Lavukaleve *hoga* and *heaga* are semantically specific terms, whereas *hoiga* is a default, semantically neutral term. Use of *hoiga* pragmatically implicates, but does not entail, "not close to S" and "not far from S". Lavukaleve has a further demonstrative, *hoaga,* which is used nonspatially (see 6.1.3):
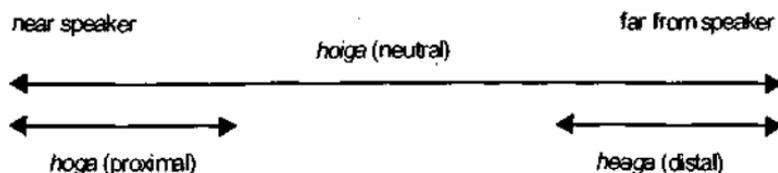

Figure 6.1: Application range of Lavukaleve spatial demonstratives

Similar analyses were proposed for the proximal, medial and distal elements of Chukchi and Yélî Dnye (although both these systems involve other terms as well; see below). Note that the distinction made in the two-term systems (discussed in the Annual Report 1999) is simply a subset of the distinctions made in three-term systems.
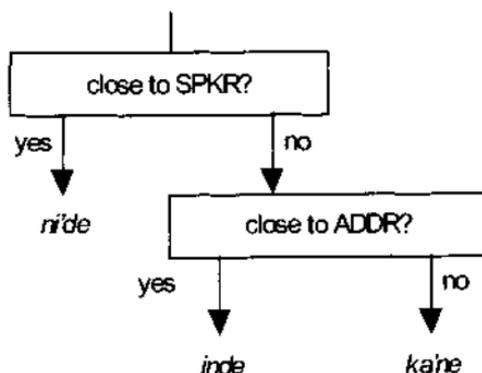
Meira proposed a different analysis for the three distance-based terms of the Tiriyó demonstrative system, according to which Tiriyó makes a contrast between a proximal term, *se(nï)/serë,* and two distals, *mere* (unmarked distal) and *ooni* (far-away distal). This account is preferred to an analysis of the system as consisting of proximal, medial, and distal or proximal, neutral, and distal terms for a number of reasons. The term *ooni* appears to be avoided in conservative speech. It is apparently a recent innovation, and is cognate with an adverb meaning "very far". In contrastive function, a two-way contrast in tabletop space was indicated by *se(nï')/sere* and *mere,* or by *mere* and *ooni,* but never by *se(nï)/serë* and *ooni,* suggesting that *se(nï)/serë* and *ooni* do not express the basic proximal-distal opposition.

Chukchi shows a related but different phenomenon. There are two distal terms, *naanqen* and *noonqen.* These are not extensionally distinct; both are appropriate for referents in the same spatial range. The term *naanqen* means "far from speaker" (and is in contrast with a proximal and a neutral term). The term *noonqen* is used emphatically, to signal the speaker's attitude towards the location of the referent as in some way surprising or problematic. This term is never spontaneously used in contrast with *naanqen* or with any of the other terms, and speakers rarely use the term when responding to elicitation tasks. Thus, despite the presence of four demonstrative terms which function exophorically to indicate distance from speaker, the distance scale indicated by Chukchi demonstratives is much simpler. It consists of a basic semantic opposition between proximal and distal (the terms *notqen* and *naanqen),* with the unmarked, neutral term *(enqen)* pragmatically implicating, but not entailing, medial. The fourth term *(noonqen)* is a marked variant of *naanqen,* and does not indicate a further value on the scale.

6.1.2 Systems with addressee-anchored terms

Saliba, Yélî Dnye, Japanese and Trumai have addressee-anchored demonstrative terms as well as speaker-anchored terms. It has been hypothesized that such systems are organized according to a single parameter of person-anchored space (Anderson and Keenan 1985); this has been investigated for the relevant languages using tools developed by Wilkins (see Annual Report 1999).
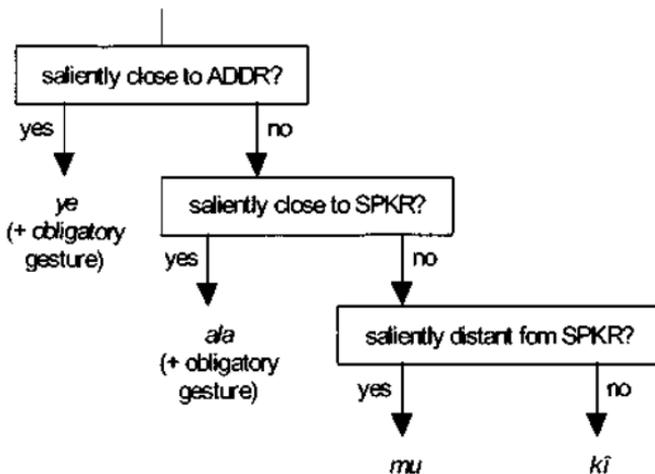
Languages with both speaker and addressee anchoring were found to differ in the degree to which this bipolar anchoring could be considered central to the system. Japanese, Saliba and Trumai can be contrasted with Yélî Dnye in this respect (see Annual Report 1998). The Trumai demonstrative system opposes a speaker-anchored proximal term, with both an addressee-anchored proximal term and a term indicating distal from both speaker and addressee. The speaker-anchored term pre-empts the addressee-anchored term; this is illustrated in figure 6.2 (note that figures 6.2 and 6.3 are not intended to represent online processing decisions, but only the information conveyed by the use of demonstratives):

Figure 6.2: Characterization of Trumai spatial demonstratives

Note that *ka'ne* is not a neutral term: use of *ka'ne* entails, and does not simply implicate, both "not close to SPKR" and "not close to ADDR".

The Yélî Dnye system contrasts with these, in that the addressee-anchored term *ye* (which is realized with an obligatory pointing gesture) is not integrated with the speaker-anchored terms (proximal *ala,* neutral *kî,* distal *mu)* in the same way. In any situation requiring a demonstrative for an object close to the addressee, the speaker can select either the addressee-anchored term or the appropriate speaker-anchored term. Neither term gives any information about the location of the referent with respect to the other participant. The term *ye* indicates that the referent is saliently close to the addressee; if the proximity to addressee is judged nonsalient by the speaker then the parameter can be ignored. Our characterization of these Yélî Dnye demonstratives is given in figure 6.3:

Figure 6.3: Description of Yélî Dnye spatial demonstratives

6.1.3   Additional distinctions

The multiple-term demonstrative systems investigated often include terms based on nondeictic parameters, such as perceptual accessibility, attention direction, and stereotypicality of spatial orientation.
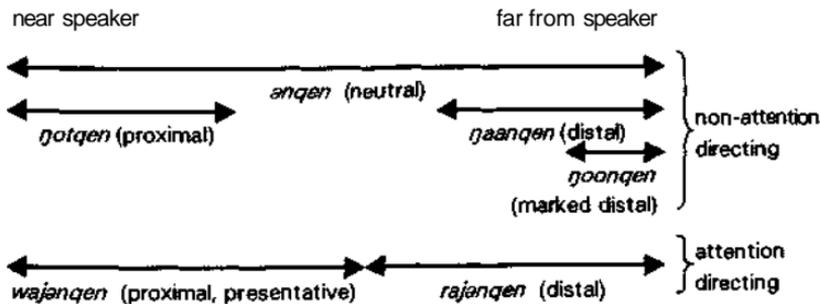
Yélî Dnye has a special demonstrative for anaphoric functions and a demonstrative indicating epistemic uncertainty. This may apply to an indirectly ascertained referent, one for which there is only auditory or tactile evidence, or evidence that is no longer current at the time of

speaking (e.g., a boat which had been seen but has now disappeared into the fog). Alternatively, the referent may be visible but not part of speaker-addressee common ground.

Tiriyó has an anaphoric demonstrative *ire* and a demonstrative *më(ni)* for referents which are inaccessible but still perceptible. The typical case of this would be something which is not visible but audible (such as a ticking clock in a box).

Lavukaleve has a special demonstrative, *hoaga,* which is used for hypothetical, nonexistent referents, or participants referred to generically rather than in a particular spatial setting.

Chukchi has two terms, *wajenqen* and *rajenqen* (derived from the neutral term e*nqen),* with attention-directing functions. *Wajenqen* is proximal and is obligatorily accompanied by a gesture. *Rajenqen* is distal, with a further sense of "beyond some boundary". These parameters cross-cut the distance parameters indicated by the other Chukchi demonstratives; see figure 6.4:

Figure 6.4: Important parameters for spatial demonstratives in Chukchi

Attention direction is a function of the SO-series of demonstratives in Japanese, although the SO-series demonstratives also have a spatial function (addressee-anchored). This was discussed for Japanese and Turkish in the 1998 Annual Report (pp. 65-66).

P. Brown found that earlier analyses (including her own) of the Tzeltal demonstrative system describing it as a three-levels-of-distance spatial system were simplistic. In fact there are three sets of morphemes involved in making demonstrative reference in Tzeltal, combining spatial semantics with other semantic elements. A member of the adjective set, *i(n)/me(n)*

precedes the noun phrase, and obligatorily cooccurs with one of a member of the terminal set *(-i, -e)* that follows the NP. In the absence of a noun these two elements together form the demonstrative pronouns *(ini, mene).* The *i(n)/me(n)* pair encodes spatial "distance" from speaker ("this"/"that"), and belongs to the same morphological class as the definite article *(te),* which also takes a terminal *(-e)* after the NP. Combinations of these two pairs *(i(n)/me(n)* and *-i/-e)* are used for demonstrative reference within interactional space; *men* is also the anaphoric term. *i(n)* + *-i* is for close, perceptually salient reference (e.g., *ja' i jun ini* "it's this book"), *me(n)* + *-(in)e* for farther away (yet still in interactional space) reference (e.g., *ja' me jun ine,* "it's that book"). Beyond interactional space, the adverb *lum* is combined with *ine* (e.g., *ja' i jun lum ine* "It's that book far away"). The third demonstrative set is adverbial *(/i', tey, lumine)* and cooccurs frequently with members of the other two sets. Combinations of elements from these three sets encode distinctions of (i) spatial distance, (ii) perceptual saliency, and (iii) degree of shared attention.

In some languages, the use of a demonstrative pragmatically implicates a "normal" position of the referent, and thus NP-modifying demonstratives were not always considered by speakers to be appropriate for all the situations proposed in the elicitation tool. Meira noted that in Tiriyó descriptive phrases were preferred in situations where the referent was in a nonobvious, unexpected place (e.g., a book hanging from the ceiling or behind the door), or where there were many possible referents (e.g., many books on a table). Dunn found that in Chukchi, the demonstrative NP modifiers were not possible for a distant, invisible referent; instead, a construction with a demonstrative adverb and a nominalized form of the positional verb *(-t)wa-* must be used:

ŋaanqen	jara-ŋə	
DISTAL.3sgABS	house-3sgABS	

"That house (visible)"

ŋenku	wa-lʔ-ən	jara-ŋə
DISTAL.ADV	be-NMZR-3sgABS	house-3sgABS

"That house (invisible)"

Similar phenomena were also observed in Saliba; an invisible referent may be indicated using a demonstrative adverb, but not a demonstrative adjective.

To summarize, multiple term demonstrative systems can be divided into two broad classes according to anchoring (purely speaker-anchored vs. speaker and addressee-anchored). Orthogonal to these distinctions is a large residue of other nondeictic parameters like visibility, attention direction, perceptual saliency, shared knowledge and so on.

6.2   The semantic encoding of static topological spatial relations

When we want to describe the location of one object, the figure, with respect to another, the ground, much depends on whether the figure and ground are close to one another. If they are not, we need to specify an angular search domain projected off the ground in which the figure can be found (e.g., "to the left of the tree", "in front of the cathedral", "north of the airport"). This constitutes the frame-of-reference subdomain, where the work of our project has shown there are only three main types of coordinate systems involved both in language and in higher-level cognition (Annual Reports 1996, 1997). But when figure and ground are contiguous, such information is usually superfluous, and languages generally offer a set of "topological" relators like the English prepositions at, *in,* and *on.* Topological relators specify that the positions of figure and ground coincide, and often give additional information about the relationship.

On the basis of European languages it has often been assumed that topological relators are usually adpositions (prepositions and postpositions). In wider crosslinguistic perspective, however, it is clear that this information may be encoded in relational nominate, adverbial nominate, locative predicates, case affixes, and constructional alternates, and in any one language it is often distributed across the clause. Compare, for example, the English sentence "The bird is on the roof." with the Ewe sentence (Ameka 1995):

Xeví-   lá   le   xo-   á   ta-me
bird   DEF   be-at:PRES   house   DEF   head-containing region of
[the bird is at the apex of the house]   "The bird is on top of the roof."

In the English sentence, the spatial information is all in the preposition (note that the predicate, *is,* is not specialized for spatial relationships). But in the Ewe sentence, the information in what had seemed like a unitary concept, "on", is broken into components expressed in different parts of the sentence - the fact of spatial relationship itself is encoded in the predicate *le* "be at", while the part of the ground with respect to which the

figure is located is expressed by the combination of two postpositions (historically derived from nominals): *ta* "head" and me "containing region of. A further aspect of the meaning of this Ewe sentence is expressed not by any overt element of the sentence itself, but by the implicit contrast between the construction it exemplifies and another related construction, as shown in this next Ewe example:

Xeví- lá le   xo-   á   fé   ta-me
bird   DEF be-at:PRES   house DEF POSS   head-containing region of
[the bird is at the area of the apex of the house] "The bird is above the roof."

The two Ewe sentences are constructional alternates that contain exactly the same spatial morphemes, but are distinguished by the absence (first Ewe sentence) vs. presence (second Ewe sentence) of fé, a possessive connective: when the connective is absent, the figure is in contact with the named part of the ground, whereas when it is present, the figure is in a region projected from the part but not touching it.

The languages represented in our sample differ in the extent to which they rely on adpositions or adposition-based phrases (on top of, *in the middle of,* etc.) to express topological (or other) spatial information; this is shown informally in table 6.2. At one extreme there is Tiriyó, which uses 30 or more adpositions to make fine spatial distinctions. (Notice, however, that languages with large adposition systems do not necessarily use them primarily for space - Japanese has about 35 adpositions, but only two are used for spatial description). At the other extreme are Trumai and Tzeltal. Trumai has several adpositions but apparently none that conveys topological information. A locative case suffix is used to express the general idea that two entities are spatially related, and finer spatial semantic distinctions are made with nominals and adverbials. Tzeltal has only one adposition, a semantically very general preposition that is used for expressing virtually any kind of spatial relationship, as well as other kinds of relationships (temporal, instrumental, etc.). Spatial information is encoded primarily in verbs, supplemented by spatial nominals. Ranging between these extremes we find Yélî Dnye and Dutch, both with rich topological adpositional systems, Lavukaleve with an intermediate number, and Hindi, Tidore, Yukatek, Kilivila, and Chukchi, with only one or two topological adpositions each, supplemented by spatial nominals, adverbials, and verb participles (along the lines of *tied, stuck, wrapped,* etc.).

Language	Resources in the topological domain
Tiriyó (Meira)	-30 topological adpositions (of ~100 adpositions), few nominals, fine distinctions (2 "in's", 3 "on's", etc.)
Yélî Dnye (Levinson)	~25 topological adpositions (of a large set of adpositions), few nominals, fine distinctions (2 "in's", 4 "on's", etc.) topological relation information also contained in positional verbs.
Ewe (Ameka)	-25 locative postpositions (2 "in's", 2 "on's", etc.) topological relation information also contained in positional verbs.
Dutch (Bowerman Van Staden)	~15 basic topological prepositions + many derived propositions, topological relation information also contained in positionals, adjectives and nouns, fine distinctions (2 "in's", 2 "on's", etc.)
Lavukaleve (Terrill)	~4 topological adpositions (of ~12 adpositions), nominals, 2 cases (case = general locative), positionals
Japanese (Kita)	2 topological adpositions (of -35 adpositions), nominals
Hindi (Narasimhan)	2 topological adpositions (of ~8 adpositions), complex postpositions, adverbials, participials, 2 general locatives
Tidore (Van Staden)	2 general locative adpositions - one preceding humans, one preceding nonhumans (of 4 adpositions), nominals, directional verbs used for static situations
Yukatek (Bohnemeyer)	1 topological adposition (of 2 adpositions), nominals (generic ti + nominals), positionals
Kilivila (Senft)	1 topological adposition, locatives (generic adposition + noun), locative adverbs
Chukchi (Dunn)	1 topological adposition (of 2 adpositions), 3 static topological case suffixes (of 13), 6+ spatial derivational suffixes, 10+ adverbs
Tzeltal (P. Brown)	0 topological adpositions (1 adposition), non-spatial generic preposition ta + spatial nominals (-24), positional verbs(~300)
Trumai (Guirardello)	0 topological adpositions (5 adpositions), 2 cases (1 general locative, 1 dispersed locative - also dative), nominals, adverbials

Table 6.2: Languages investigated and their resources for encoding static topological spatial relations

As the English and the two Ewe example sentences and table 6.2 make clear, it is inadvisable, when studying spatial relators in a language, to concentrate solely on adpositions: we need to work out the whole interlocking system of morphemes and constructions. Our goal, therefore, has been to provisionally delimit the *semantic area* encompassed by the term "topological relations" and then to explore whatever means the languages in our sample use to encode this area (also bearing in mind the connections between these means and the other subsystems of the grammar of each language).

Earlier work in the Space Project by Bowerman & Pederson (Annual Reports 1992, 1993) concentrated on containment and contact-and-support relationships such as support from beneath, hanging, adhesion or other attachment, and encirclement. To this set we add properties such as "configuration types" (e.g., in the middle of, between, among), figure shape and orientation (e.g., point-like, surface-like, vertically extended, horizontally extended, not extended), figure consistency (e.g., particulate, jointed, multiple), and ground shape or identity (e.g., location with respect to a projecting part of ground, location in water; cf. Tiriyó postpositions *pohtë* "at tip of, *hkao* "in water"). We look also at the encoding of certain relationships not (necessarily) involving contact between figure and ground, such as vertical orientation "above" and "below", and distance specifications such as "next to", "beside", "near", "far from", with the goal of determining whether and how languages distinguish such notions from related topological ones.

In ongoing research we are analyzing the semantics of forms within a language, and comparing forms across languages to assess the extent and nature of crosslinguistic variation. Do similar meanings or meaning clusters keep recurring? Are different form classes consistently associated with different types of meanings?

A pilot comparison of the semantics of topological adpositions has been carried out for the three languages in our sample that are rich in such forms: Tiriyó, Yélî Dnye and Dutch. All three languages mark subtle topological differences, but not always in the same way. Thus, Yélî Dnye has more forms for both "adhesion" and "vertical support" than Tiriyó, marking finer nuances, but it lacks a form comparable to the Tiriyó postposition for a figure that "straddles" the ground (e.g., clothes on line, necklace around neck). Tiriyó makes a strong distinction between relationships in which the figure adheres to or is otherwise attached to a

ground oriented in any direction (e.g., plaster on leg, telephone on wall, apple on twig), and those in which the ground supports the fgure from below (e.g., cup on table). In contrast, Dutch does not distinguish between "contact involving flat, surface adhesion" vs. "support from below" in its system of adpositions, but does draw a contrast between these and other kinds of attachment.

Even when the three languages mark what seem to be the same distinctions, details of the categories may differ. Thus, all three languages have two forms for "containment" relations, a more specific one and a more general one (analogous to English adpositional *inside* vs. *in:* note that *in* can be used wherever *inside* can be used, but the reverse is often not true: cf. *the ball is in/inside the box; the candle is in/*inside the candlestick).* But the languages differ in what kinds of situations "count" as specific vs. general (as inferred from differences in the extension of the forms to the stimuli in the Topological Relations Picture Series developed by Bowerman and Pederson, see Annual Report 1998). For example, the more specific containment term in Tiriyó, *awë,* is less constrained in its application than the more specific Yélî Dnye term *u mene;* in fact it has an extensional range similar to that of the more general Yélî Dnye term *k:oo.* The relationship between the adposition pairs in the two languages is suggested schematically in figure 6.5.

Form is applicable to stimuli: a b c d e f g h   i

Tiriyó   *awe* (more specific "in") _____

                tao (less specific "in") _____

Yélî Dnye: *u mene* (more specific "in")

                k:oo (less specific "in") _____

Figure 6.5: Tiriyó and Yélî Dnye "containment" adpositions

As figure 6.5. suggests, there may be an underlying "semantic space" that all languages respect in mapping spatial relators to meanings, even though the boundaries between forms may be drawn in different places. An initial proposal along these lines was made by Bowerman and Pederson (Annual Report 1993), who identified a pathway through

semantic space, linking (mental representations of) situations of "prototypical containment" (e.g., apple in bowl) and "prototypical support" (e.g., cup on table). Situation types can be ordered along this pathway in such a way that, although languages differ in how many forms they use to encode the domain, and where the boundaries between the forms fall, each form picks out a continuous segment of the pathway - i.e., forms do not "jump" from one segment to another over an intermediate segment representing situations to which the form cannot be applied. Thus, for example, English *on* covers situations of (a) support from beneath (cup on table), (b) adhesion (stamp on envelope, plaster on leg), (c) "fixed to" attachment (telephone on wall) and (d) point-to-point attachment (apple on twig). Dutch *op* "on" covers (a) and (b), but another adposition, *aan* "on", is needed for (c) and (d). Bowerman and Pederson found no language with a form that applies to, say, (a) and (d) but not to (b) and (c).

The information from the Space Project's studies of topological relators is now being analyzed to see whether a more comprehensive model of the nature of "semantic space" in the topological domain can be constructed. This semantic space can be thought of as structured by specific semantic parameters (relations holding over Figure [F] or Ground [G] or both) such as *contact (F,G), adhesion (F,G), superadjacency (F,G), inclusion (G,F), partial inclusion (G,F), horizontal plane (G), vertical plane (G), plane-to-plane contact (F,G),* and *long axis (F).* Into this space we attempt to map all the topological relators of different languages, whether adpositions, cases, spatial nominals or verbs. Our hypothesis is that there is just a single organization of this semantic space for all languages which will allow the intensional range of any given spatial relator to cover a contiguous area. Preliminary work suggests that the same space that accommodates adpositions is also compatible with the distinctions made in spatial predicates.

6.3   Acquisition of topological spatial relations in language and cognition.

Language diversity in semantic categorization signals an important challenge for language learners: to discover how space is conventionally partitioned in the language they are exposed to. In work together with Choi (San Diego State U.) and other colleagues, Bowerman has demonstrated that this process begins remarkably early: before two years of age children use spatial words productively in accordance with language-specific

categories (see Annual Reports 1988, 1989, 1993, 1995). In one series of studies a crosslinguistic adaptation of the preferential looking paradigm was used to test the comprehension of children learning English vs. Korean. The child sits on a parent's lap before two TV monitors which show pairs of action scenes: one member of a pair "matches" a simultaneously presented target word (embedded in short sentences) and the other does not. Assuming appropriate controls, longer looking time of the matching scene indicates that children comprehend the word; the "shape" of their category is tested by varying category instances systematically. In one study the targets were two early-learned words that pick out cross-cutting categories of topological relationships: *(put) in* for English and *kkita* "interlock, fit tightly" for Korean. *(Put) in* denotes "containment" and is indifferent to whether the relation is tight or loose (e.g., cassette into cassette case vs. block into pan), whereas *kkita* denotes the joining of objects with complementary shapes, regardless of whether there is containment (e.g., cassette into case vs. one Lego piece onto another). Patterns of gaze behavior showed that children grasp these language-specific principles of categorization by as early as 18-23 months, often even before they produce the words (Choi et al. 1999).

How is such early language-specificity possible? Are the needed categories prelinguistically "ready to go" (whether or not needed in the local language), or do children actively construct them on the basis of the linguistic input? Preliminary work by Choi and Bowerman, together with McDonough (City U. of New York) and Mandler (UC San Diego), showed that a *nonverbal* version of the preferential looking technique can be used effectively to explore this question (Annual Report 1996). Work in 2000 has used this technique to explore sensitivity to a distinction needed for Korean, but not for English: putting something into a snugly fitting container ("tight in") vs. into a loose container ("loose in"). ("Tight in" and "loose in" are subclasses of the Korean categories of *kkita* "interlock" and *nehta* "put loosely in/around", respectively; both fall under *(put) in* in English). Participants were 24 English-environment infants of 9, 11, and 14 months. Half were familiarized with 6 trial pairs showing only "tight-in" actions. The actions involved a variety of objects and were perceptually dissimilar (e.g., nesting cups into each other, shapes into matching holes, corks into bottles). The other half were familiarized with pairs showing only "loose in" actions (e.g., blocks into bag, wooden shapes into long basket). Music but no verbal input accompanied the scenes. Children were then shown two new test pairs in short succession, the same for both

familiarization conditions: these paired yet another novel instance of the familiarized category with a (necessarily novel) member of the other category. In test trials babies of all ages looked longer at the familiar than the novel relation, thereby showing an ability to differentiate between two categories that are not systematically distinguished in their language.

A further experiment used the same preferential looking task with *adult* speakers of both English (N=32) and Korean (N=20). Participants were simply asked to watch the video scenes. Intriguingly, the English speakers did *not* distinguish between the two categories (as inferred from their looking behavior on the test trials), while the Korean speakers strongly did. After this task the adults were shown four of the actions they had just seen on the video - three of the actions they had been familiarized with, plus one of the "new category" test scenes - and asked to pick out the action that was different. Eighty percent of the Korean speakers based their choice on tightness of fit, whereas only 37% of the English speakers did so; most of their choices focused on object properties like texture, size, or function.

Taken together, these findings are reminiscent of those from studies of early speech perception (e.g., by Werker), which show that infants under a year can often discriminate categories of sounds that are not functional in their language, but older infants and adults sometimes can no longer do so. Infants may, then, start out with sensitivity to a wide variety of spatial distinctions, but over time distinctions that are not relevant to their language may become less salient or available.

7 SCOPE

As in the previous years the Scope Project continued its investigations of the acquisition of scope phenomena in natural language, concentrating on scope phenomena that arise with focus particles, nominal and temporal expressions, and finiteness. In addition, the project aims to make theoretical contributions related to scope aspects of natural language. The project had some personnel changes: Swift and Krämer successfully completed their thesis work and left the research group.

7.1   Focus particles

Bergsma reports that Dutch children above the age of 4;6 perform nearly as well as adults in interpreting sentences with the focus particle *alleen* "only". In particular, their interpretation of sentences in which *alleen* immediately precedes or follows its domain of application marked by intonational prominence is almost adult-like.

In order to investigate whether children use the syntactic position of *alleen* or intonational prominence for the identification of the domain of application of the particle, Bergsma conducted a follow-up experiment. In this experiment, she investigated how children interpret ditransitive sentences in which *alleen* occurs between the indirect object and direct object as in (1):

(1a)   Bert heeft ERNIE alleen een boek gegeven.

"Bert gave only Ernie a book."

(1b)   Bert heeft Ernie alleen een BOEK gegeven.

"Bert gave Ernie only a book."

The contrast between (1a) and (1b) concerns which constituent is marked by intonational prominence, namely, the indirect object in (1a) and the direct object in (1b). Children's interpretations of these sentences can provide an answer to the question of whether children utilize syntax or intonational prominence to identify the domain of application of *alleen.* If children use intonational prominence, it is expected that they associate *alleen* with the constituent marked by intonational prominence in both types of sentences, that is, with the indirect object in sentences like (1a) and with the direct object in sentences like (1b). If children ignore intonational prominence, then it is expected that they associate *alleen* with the direct object, regardless of whether the direct object is marked by intonational prominence or not. Preliminary results of this experiment confirm the latter expectation and indicate that children use syntax and not intonational prominence for the identification of the domain of application of *alleen.*

Nederstigt (nee Heinzel) pursued her dissertation project on the acquisition of *auch* "also" and *noch* "still/another" in German. In general, the child's use of these particles is like that in spoken adult language, but there are also a number of differences, in particular with respect to the use of *noch.* Similar differences were found in a follow-up study that compared the use of *auch* and *noch* in language among adults and adult language directed to children. In the adult-child variety, we find that in 30% of the noch-utterances the particle follows its domain of application as in (2):

(2)   nur   wir   und [die OMI]   noch

       only   we   and the   Granny also

       "Only we and Granny too."

In contrast, we find that only 7% of the utterances in the adult-adult variety are of this type. Moreover, utterances in which the particle is located within its domain of application, as in (3), are relatively frequent in language among adults, namely 53%, but less frequent in child-directed speech where they occur in 29% of the noch-utterances.

(3)   so   [dann ziehn]   wir   [den   TISCH]   noch   [ein bißchen her]

       so   then pull   we   the   table   still   a bit closer

       "So we pull the table a little bit closer (before we can start)."

The differences between the language used among adults and the language directed to children seem to be able to account for the differences between the child's use of *noch* and that among adults. As shown above, one of the main findings indicates that for children, too, the frequency of *noch* in postposition is much higher than that in adult language, whereas the *noch* within its domain of application is less frequent than in the adult variety.

7.2   The interpretation of nominals

Krämer finished her dissertation work on children's interpretation of indefinite NPs. In a series of experiments she found that children under age 7 do not relate the interpretation of indefinite NPs to the context to the extent that adults do. In sentences like (4), adult speakers of Dutch will select a referent for *een meisje* "a girl" that is salient in the context, e.g., a character of a story that is being told.

(4) Een   meisje plukt een   bloem.

  a   girl   picks a   flower.

  "A girl is picking a flower."

65% of the children younger than 6 will allow any girl to be selected as a referent for *een meisje* "a girl". Krämer argues that this finding is expected if we take into account the development of (the production of) discourse. It is a well-established fact that many children do not or only to a limited extent mark discourse cohesion until about age 6. Krämer argues that this lack of discourse cohesion is also likely to have a counterpart in children's language comprehension, and that this view will explain a number of other findings in child language comprehension she presents in her dissertation. These other findings include nonadult-like interpretations of sentences including negation or the frequency adverbial twee *keer* "twice".

Van Geenhoven studied the scope interactions between so-called pluractional marking, durative adverbials, and verbal arguments. Her investigation starts out from the following well-known contrast:

(5)   ? Bill discovered a flea on his dog for an hour.

(6)   Bill discovered fleas on his dog for an hour.

Whereas (5) only has the odd reading that Bill discovered the same flea again and again, (6) does not have such a odd reading. In the literature,

we find two approaches that try to account for this contrast, namely, Dowty's (1979) quantificational approach and Krifka's (1989) event predicate approach. However, neither approach presents a satisfying account for frequentative readings in for-adverbial contexts. For example, although in the Vendlerian view achievement/accomplishment verbs cannot combine with for-adverbials, Dowty gives the following well-formed counterexample:

(7)   John found his son's tricycle in the driveway for six weeks.

The most likely interpretation of (7) is that John found the tricycle repeatedly or frequently over a period of six weeks. Moreover, Krifka points out that the unexpected combination of the accomplishment predicate *read the letter* with *for an hour* in (8) can be explained by appealing to some notion of iterativity, given that (8) means that John read the same letter again and again for an hour.

(8)   John read the letter for an hour.

If for the semantic representation of (7) and (8) we appeal to some notion of iterativity or frequency, Van Geenhoven raises the question of why we cannot do the same with respect to (6). The most likely understanding of (6) is that John discovered a flea and he discovered another flea and ..., that is, we assign it a frequentative interpretation. Starting from this observation, Van Geenhoven argues that in English the interaction of for-adverbials with indefinites and bare plurals is guided by silent pluractional operators, namely nonstop and frequentative pluractional operators. These operators distribute the event-time argument of a verb over the time interval measured by the for-adverbial. Depending on the semantics of the nominal argument(s) of a verb, these operators can also distribute event participants over that interval.

Linguistic support for the existence of silent pluractional operators on English verbs is drawn from the presence of the overt frequentative pluractional markers *-(sa)qattaar -* "again and again" and *-tar-* "once in a while" that are found on West Greenlandic verbs in durative contexts. With these so-called "pluractionality markers", "we seem to have an analog in the domain of events to the more familiar phenomenon of plurality in the domain of individuals (Lasersohn 1995)." Interestingly, only accomplishment /achievement verbs seem to combine obligatorily with *-(sa)qattaar-l-tar-* in durative contexts, as illustrated by the contrast between (9) and (10).

(9) "Nuka went for the whole morning (moving very slowly) to get past."

?? Nuka ullaap tungaa tamaat sanioqquppoq.

Nuka   ullaa-p   tunga-a   tama-at   saniuqqut-p-u-q
N.ABS   morning-ERG   direction-3SG.SG.ABS   all-3SG go   past-IND-[-tr]-3sG

(10) "Nuka went past again and again for the whole morning."

Nuka ullaap   tungaa tamaat sanioqquteqattaarpoq.

Nuka ullaa-p   tunga-a   tama-at   saniuqqu(t)-taqattaar-p-u-q
N.AB morning-ERG direction-3SG.SG.ABS all-3SG go past-again&again-IND-[-tr]-3sG

This leads Van Geenhoven to assume that crosslinguistically state/activity verbs are inherently nonstop pluractional, whereas accomplishments/ achievements never come with a built-in nonstop pluractional operator. (This assumption is a version of Dowty's view that states/activities have the subinterval property while accomplishments/achievements do not). Accomplishments/achievements can be pluractionalized by means of (silent) frequency operators whereby frequency is interpreted as pluractionalized iterativity. Moreover, a durative adverbial provides a measured time interval and selects for a (silently) pluractionalized VP. It follows, first, that a silent pluractional marker on the verbs *find* in (7) and *read* in (8) is responsible for the frequentative readings of both. Second, since frequency becomes an integrated part in the account of the distribution of for-adverbials, we also make use of it in the semantic representation of (6). In this respect, Van Geenhoven shows that if a pluractional operatoer applies to the bound argument of a semantically incorporating verb (see Van Geenhoven 1998, 2000), this verb can take only property arguments that do not have a maximal element in their meaning, e.g., the English bare plural in (6). Finally, the apparent broad scope of the indefinite in (5) is a matter of it never being a property that is distributable over time.

7.3   Temporality

Swift completed her dissertation research on the development of temporal reference in Inuktitut, a polysynthetic language spoken by the Inuit of arctic Quebec. The Inuktitut temporal system has several features that have not been a focus of acquisition research to date. Inuktitut has a

future-nonfuture opposition (subsumed under a realis-irrealis opposition), which contrasts with the past-nonpast opposition characteristic of languages previously studied. In addition, the temporal interpretation of verbs with no overt marking for tense, aspect, or modality depends on event-structure properties, such as telicity. Inuktitut also has a rich morphological system for the expression of degrees of temporal remoteness. This study analyzes formal and functional aspects of temporal-reference mechanisms in the speech of eight Inuit children acquiring Inuktitut as a first language between ages 1;0 and 3;6.

The results indicate that Inuit children first develop competence with future rather than past-time marking, and their first overt past markers tend to occur with atelic verbs. Both of these findings contrast with findings reported for other languages. Inuit children also demonstrate sensitivity to the temporal contrast between telic and atelic verbal expressions in their use of temporally unmarked verbs, a finding consistent with the early patterning of overt tense-aspect marking reported crosslinguistically. This is the first examination of the development of a morphological temporal remoteness system in child speech. Suffixes encoding the shortest time span in both past and future are the first remoteness markers to appear with frequency, while suffixes encoding the greatest temporal distance are late to develop. However, development of these suffixes is not strictly linear as measured in temporal distance. Factors such as salient degree of granularity and pragmatic context also play a role. Lexical temporal adverbials and temporal clause coordination are just beginning to appear in the speech of some of the children.

Matsuo carried out two different studies on children's acquisition of a past tense in complement clauses (CPs). The first study was concerned with a contrast between languages that exhibit sequence of tense and languages that do not. The second study was concerned with the relationship between tense and lexical aspect of the predicates.

Matsuo's first study discusses whether an embedded past tense is more difficult to interpret for children in Sequence of Tense (SOT) versus non-SOT languages. In SOT languages (English and Dutch), an embedded past tense is ambiguous.

(11) John said that Bill was happy.

(12) Jan zei dat Bill gelukkig was.

In (11) and (12), there is a reading where Bill was happy at the time of John's saying so (overlapping) or Bill was happy before John said so (shifted past). Non-SOT languages (Japanese and Polish), however, do not have an overlapping reading as indicated by (13) and (14):

(13) John-wa   Bill-ga   shiawase-datta   to   itta

     John-Top   Bill-Nom   happy-was   that   said

(14) Jan   powiedzial   ze   Bill   byl   szczesliwy

     John   said   that   Bill   was   happy

(13) and (14) only mean that John said that Bill was happy before John said so.

Ogihara proposes that non-SOT languages have a past-tense deletion rule. An overlapping reading is expressed using a present tense as in (15):

(15) John-wa   Bill-ga   shiawase-da   to   itta (simultaneous)

     John-Top   Bill-Nom   happy-be-Pres   that   said

Stowell argues that English past tense is ambiguous between "real" and "null" Past. However, Japanese past is a real past. Between these two proposals, Ogihara's theory would support the idea that Japanese and Polish children take longer to have an adult usage of an embedded tense because of the additional rule. Stowell's theory, on the other hand, would allow the view that Japanese and Polish children use an embedded tense correctly before English/Dutch kids do. This is supported by Crain's Semantic Subset Principle. Japanese and Polish past tense has a more restricted interpretation compared to English and Dutch.

Besides SOT, Matsuo carried out an independent test on complementation to see if there is a correlation between passing a complementation test and giving adult interpretations of embedded tense, which was already observed in English and Dutch. Thirty-two Polish children (3;3-6;11) plus 12 controls were tested using complementation and SOT tests. Although children with an adult-like CP failed to interpret an embedded tense correctly in Japanese, the Polish results reveal that having an adult complementation system is a significant factor in giving correct answers. Three-way ANOVA ($p = 0.0004$) suggests the difference between Polish and Japanese to be significant. Matsuo observes that Polish, Dutch and English contrast with Japanese. This outcome is not what Ogihara's and Stowell's theories predict. She suggests that what is responsible for this classification could be an embedded and matrix verb order.

As discussed above, in Matsuo's first study it was found that children have difficulties in providing adult interpretations of a complement tense. This led to the question of whether the lexical aspect of verbs influences children's performance. In a second study she investigated the same construction further focusing on different types of predicates. She conducted this experiment with 26 Dutch-speaking children with ages ranging from 3;09 to 6;08. Matsuo used a production elicitation task in which a puppet forgets the last word of a sentence. She exploited Dutch word order where an embedded verb comes at the end of a sentence. Children were asked to help the puppet finish the sentence with the accomplishment verb *afmaakte* for (16). The test sentences distinguished four classical verb types (states, activities accomplishments, and achievements).

(16) De aap zei, dat de man een hek *afmaakte.*

"The monkey said that the man finished a fence."

If having an adult-like Complementizer Phrase (CP) is a necessary condition for children to succeed in SOT experiments, failers should provide verbs with present tense markings across the board. However, if there is an influence of certain lexical aspects, children might succeed only with certain types of predicates. The results show that a clear asymmetry between telic and atelic verbs is found in the results from children who failed in a complementation test. The failers (4-year-olds) produced correct markings in 72.2 % of telic trials but only in 44% of the atelic trials. Matsuo concludes that telicity is an additional property to be acquired before the children give correct tense markings in embedded clauses.

7.4   Finiteness

Klein resumed earlier work on the important but poorly-understood notion of finiteness. The distinction between finite and nonfinite verb forms has been well-established since the days of the Greek grammarians; but it is not particularly well defined. In general, verb forms that are inflected for tense, mood, person, number, and perhaps other categories are considered to be finite, all others are considered as nonfinite. From this point of view, finiteness seems to be simply an epiphenomenon of inflectional morphology. This view, however, is unsatisfactory for at least two reasons. First, the distinction between finite and nonfinite forms is also made when there is hardly any morphological distinction on the verb. Thus, by far most English verb forms can be finite as well as nonfinite.

Second, there are numerous structural phenomena which are clearly associated with the presence or absence of finiteness:

-   In syntax, these include basic word order rules, the licensing of a grammatical subject, the licensing of expletive elements, and gapping (ellipsis of an identical verb on second occurrence). In German, for example, the finite element must be in second position (i.e., after the first major constitutent) in declarative main clauses, in final position in subordinate clauses, and in initial position in yes-no questions and imperatives. These positional constraints have nothing to do with the lexical verb, they reflect the way in which finiteness is integrated into the utterance. Similarly, gapping is not related to the lexical verb but rather to finiteness. If the carrier of finiteness is identical, it can be omitted on the second occurrence, as in *Hans ist gestern abgereist und Peter (ist) heute angekommen* "H. left yesterday and P. arrived today". If, however, the lexical verb is identical, then it cannot be omitted: Hans war gestern abgereist und *Peter ist heute *(abgereist).* It is possible, though, if the finite element is omitted too: *Hans ist gestern abgereist und Peter (ist) heute (abgereist).* Hence, if finiteness falls, so can everything else given the appropriate context.

-   In semantics, the specific interpretation of indefinite noun phrases is crucially linked to the presence of a finite element. Thus, *John sought a unicorn* has a specific and a nonspecific reading, whereas *John found a unicorn* has only a specific reading. This distinction is usually related to the difference between opaque and transparent verbs, an idea first advanced by Quine and subsequently elaborated by many formal semanticists. But the distinction disappears when the verb is nonfinite, as in *Finding a unicorn is an exceptional experience.* Here, the object noun phrase has a nonspecific reading as well; in fact, this reading seems preferred.

It appears, therefore, that many syntactic and semantic facts traditionally related to the verb have nothing to do with the verb as such but are a consequence of finiteness, which may, but need not, go with the lexical verb. In language acquisition, both first and second learners regularly start with nonfinite forms and only then acquire finiteness, a process which leads to substantial reorganisation of their sentence structure. In first language acquisition research, this phenomenon has been extensively discussed under the label of root infinitives. In second language research, it is less known because most research so far deals with classroom

learning in which finite forms are explicitly taught. In untutored acquisition, however, there is a clear progress from nominal utterance organisation (i.e., hardly any productive use of verbs at all) to infinite utterance organisation. The structural contribution of lexical verbs is exploited to finite utterance organisation. Hence, finiteness is not a mere issue of verb morphology but a grammatical category in its own right. Resuming and elaborating an earlier analysis, Klein shows that finiteness (a) relates the descriptive content of a sentence to its topic component, in particular to the time span (topic time) about which an assertion is made, and (b) marks this relation as positive, in other words, it functions as the carrier of assertion - or, more generally speaking, of a "validity claim" - in an utterance. It can be shown that most of the finiteness effects noted above naturally follow from this structural assumption on the one hand, and from some familiar assumptions about the integration of an utterance into ongoing discourse on the other.

Gretsch broadened her research interests in two distinct but related areas. Besides the acquisition of the finiteness element, which was the earlier focus of attention (see Annual Report 1998 and 1999), the acquisition of topic time and topics in general were examined.

With respect to finiteness, the question of the default characterization of form-function relations has been more closely investigated on the basis of crosslinguistic data on root infinitives from Dutch, English, German, Greek, Icelandic, Russian, and Swedish. One of the main empirical findings consists of a major split in tense-oriented vs. aspect-oriented languages, indicating that the form-function development of the infinitival form reverses with respect to its functional potential. Whereas in Dutch and German, for example, root infinitives narrow down towards the category of "requests/wishes", aspectual languages like Russian exhibit an opposite behavior. Root infinitives expand their functional coverage to comprise the categories "comments on ongoing events", "narratives with reference to past events" and "requests/wishes".

To capture the crosslinguistic and interindividual variability of early form-function relations a cell-partitioning perspective of early form-function relations has been proposed defining the first fission in development as one between a default interpretation (here-and-now) and a nondefault interpretation (distant from the here-and-now). This first fission is associated with the most salient morphological opposition available in the respective target language. In a second fission, temporal directionality is

introduced. Up to now only two temporal parameters are involved: the time of utterance, which is set to the here-and-now by necessity and a yet unanalyzed conglomerate of topic time (roughly reference time) and situation time. The emergence of the third parameter leads to a major reorganization of the temporal system, which is reflected in a radical shift in form-function correlations. It is only after the separation of topic time and situation time that the target-specific aspect and tense category is applicable to child language.

In Gretsch's second line of research, a comparison of child-language acquisition data with untutored adult second-language acquisition data showed interesting results concerning the development of topic-time markers. In the literature on second language acquisition, it has been claimed that L2 learners follow an adverbial option whereas the L1 learner favors the morphological option of acquiring a target-adequate topic time setting. As indicated by the label "adverbial option" L2 learners should have a wide range of temporal adverbials at their disposal to anchor an utterance in time (e.g., *today headache),* whereas L1 learners are said to entertain exclusively morphological forms (e.g., *goes* vs. *going* vs. *went)* to point to the intended topic time of an utterance. This coarse picture does not adequately reflect the developmental patterns found in L1 and L2.

Depending on the individual developmental sequencing, children will tend toward the adverbial option if they integrate verbal elements and especially verbal morphology late into their grammatical system. As a result, utterances like *Hause Oma - Suppe auch* "house grandma - soup also" are used to express the temporal relation between a topic time described as "when we were at grandma's house" and a situation time of the event "we had soup" which is linked to a here-and-now ongoing soup-eating event with the aid of *also* but without any morphological tense-marking. On the other hand, the range of adverbials in adult second-learners was shown to be restricted by their morphological development. Temporal adverbs of contrast (e.g., *already, still)* will appear only in L2 varieties that exhibit a grammaticalised finiteness element as indicated by (productively) inflected verbs (see Perdue et al. 2000). Moreover, the transparency of form-function correlations in the target language has been demonstrated to have an influence on the adverbial vs. morphological bias of adult learners.

Again, it is the abstract finiteness element that plays a crucial role not only in the acquisition of a first language, but in second-language acquisition as well. If learners need to acquire a full set of temporal and aspectual distinctions, an intertwined development of lexical elements, morphological oppositions, and topological requirements seems to be indispensable. This integrative approach allows us eventually to reach a more complete picture of acquisition than the limited one-way model "L1=morphological" and "L2=adverbial" ever would.

8 ARGUMENT STRUCTURE

8.1   Introduction

Language portrays events as having an internal relational structure consisting of a set of participants and the roles they play in the event, such as causing or instigating the event, changing state or location in the course of the event, etc. The Argument Structure Project is dedicated to the crosslinguistic study of the coding of events and their participants, and of how children acquire these structures in the course of language acquisition. Its members investigate how languages differ in construing events for encoding and in mapping event participants onto syntactic clause structure. They explore language-particular and universal constraints on this variation, and examine how children master lexical meanings, syntactic structures and their interactions. Questions about predicate semantics and the within-clause mapping of participants onto syntactic arguments have long been central to the project. In 1999 research also began to extend to broader questions about event encoding, e.g., how different languages segment and sequence the information in complex motion scenarios (cf. Annual Report 1999). This new focus has continued in the subproject on Event Representation.

In pursuing the issues mentioned above, the members of the project have collected child and/or adult language data from two dozen typologically diverse languages. They have worked in a wide range of settings - e.g., the Institute's child lab, family homes in Germany and India, field sites in subarctic Siberia, Oceania, and the tropical rain forests of Africa and South and Central America - and applied methods ranging from the recording of naturally occurring discourse to elicited descriptions of non-verbal stimuli. Particularly worth mentioning is the ongoing effort by

several members to create a unique crosslinguistic corpus of child data collected under comparable circumstances and coded and transcribed according to common standards. Collection started last year of extensive longitudinal corpora from three German children (Eisenbeiß), and four Hindi and four Tamil children (Narasimhan). Eisenbeiß has also started collecting a cross-sectional corpus of German child language, and has developed a set of 30 elicitation stimuli for use in both corpora. Below, studies focusing on argument structure issues are reported first, followed by work carried out within the Event Representation subproject.

8.2   Argument structure issues

Events are typically lexicalized in verbs, and (a subset of) their participants are encoded as the verb's arguments, realized by the syntactic constituents of verb phrases or clauses. Argument structure can be viewed as an information structure that defines, roughly, what syntactic arguments a verb can occur with, what the formal properties of these arguments are in the clause, and which participant - as defined by its role in the event - is "linked" to which syntactic argument. The first four studies discussed in this section address problems in argument linking. The remaining two studies deal with the formal properties of syntactic arguments.

8.2.1   Argument linking

Eisenbeiß continued her research on the relation between argument structure, case-marking, and agreement. Previous research in collabo- ration with Clahsen (U. of Essex) and Bartke (U. Marburg) showed that both normal and specific-language-impaired learners of German correctly case-mark arguments with structural case, i.e., case that can be predicted from the structural position of the argument (e.g., nominative for subjects, accusative for direct objects). But they make many errors with lexical case, i.e., case that is determined by the identity of governing lexical items, such as the distinction between prepositions that take objects in the accusative case vs. in the dative case. Against this background, Eisenbeiß asked how children learn the language-particular and lexeme-specific ways events are construed, and NPs for their participants are mapped onto syntactic positions and assigned case and agreement markers.

In answer, she argued for a relation-preservation approach to the acquisition of case. First children determine the referents of nouns in

sentences like *Jack tickles John.* Then they establish the asymmetric relations between them, based on causal relations and the amount of situation control the referents have. These relations are mapped onto asymmetric relations between semantic arguments in hierarchical representations, according to the Relation-Preservation Principle, which requires that asymmetric relations between elements of cognitive representations are preserved in the mapping to linguistic representations. Thus, if an event participant P_1 (e.g., *Jack)* precedes another participant P_2 (e.g., *John)* in the causal chain and controls the situation, the semantic argument referring to P_1 must occupy a higher position than the argument referring to P_2. The relative argument position is then correlated with the morphological markers (Wunderlich 1997). Dative marks arguments that are intermediate between higher and lower arguments, ergative occurs on arguments dominating lower arguments, accusative is restricted to arguments dominated by higher arguments, and nominative/absolutive markers are underspecified - they are not correlated with a specific position and occur only if no other marker is appropriate.

To evaluate this approach, Eisenbeiß started a study of existing corpora, and also created a set of 30 stimuli (picture books, puzzles, memory games, and video clips) to elicit various verb types in her ongoing longitudinal and cross-sectional studies with German preschool children. Preliminary results suggest that children show no case errors with verbs expressing unambiguous asymmetrical relations, including nonagentive verbs like *hören* "hear". In contrast, they do make errors with verbs that do not express causal relations and that have subjects low on the control hierarchy (e.g., inanimate subjects), e.g., *gehören* "to belong to". Specifically, children initially treat a possessor, who has more control over the situation than the possessum, as the higher argument, and mark it with the nominative, even if - like the possessor argument of *gehören* "to belong to" - it requires the dative. Children also make errors with verbs for which the causality hierarchy is in conflict with the control hierarchy; e.g., they overgeneralize the nominative to experiencer arguments of psych-verbs like *schmecken* "to taste good to", which describe situations in which a stimulus causes a perception or emotion but the experiencer is in control of the experience. These findings support the relation-preservation approach and provide evidence against Pinker's (1984) claim that possessum/stimulus-subject verbs involve a canonical linking pattern and are acquired earlier and with fewer errors than verbs with possessor/experiencer-subjects.

Narasimhan and Budwig (Clark U.) continued their research on transitivity and argument ellipsis in Hindi child-caregiver discourse. The presence of verbal arguments in the input plays a crucial role in enabling children to determine the correct correspondence between the meaning of a verb and the number of arguments it can take. However, in a language such as Hindi, the possibility of argument ellipsis allows transitive verbs to frequently appear in the same environments as intransitive verbs, viz. either with no arguments at all (PREDICATE frame), or with a single (subject or object) Nominative argument (NOM-PREDICATE frame). How do language learners establish syntax-semantics correspondences in Hindi? In order to investigate this issue, Narasimhan and Budwig examined the use of intransitive and transitive (nonlight "simplex") verbs in overlapping case-frames in Hindi caregiver-child speech. The study is based on videotaped interactions of twelve 3-4 year-old children collected as part of a study of 40 families (Budwig, 1996).

Transitive verbs occur frequently in zero-argument and single-argument environments in caregivers' speech (80%). While transitive verbs do occur in unambiguous contexts (e.g., with non-Nominative case on single argument or two overt arguments), their use in ambiguous contexts could still lead to errors from which recovery might not be easy:

(i) Some transitive verbs might initially be assigned to the intransitive class. Since the syntactic frames in which intransitive verbs appear is a subset of the environments in which (most) transitive verbs appear, children's errors in production would not be readily detectable. Further, unambiguous contexts for transitive verbs are relatively rare in the input (e.g., non-Nominative case on single overt arguments: 5% ; two overt arguments: 15%), potentially causing delay in the child's learning the correct transitivity requirements of these verbs.

(ii) Even if clear evidence regarding transitivity were (eventually) forth-coming, children might not expunge the intransitive entry, but assume the verb to be compatible with both transitive and intransitive frames with corresponding differences in meaning (e.g., the causative and inchoative uses of the English verb "break"). In such cases, no syntactic frame exists which would rule out the intransitive alternant.

(iii) Intransitive verbs might be wrongly assigned to the transitive class, even by conservative learners misled by the frequency of transitive verb use in intransitive contexts. Again, no positive evidence in the form of subcategorization frames is available to trigger a revision of the assumption.

One way to avoid such recovery-from-error problems is not to make the error in the first place. In principle, distinctive verb inflection, discourse-pragmatic factors (Rispoli 1991, 1995) and nonlinguistic context (Pinker 1989) could help the child distinguish intransitive verbs from transitive ones even in ambiguous surface syntactic environments. However, further information might be available in the form of differences in the frequency distributions of intransitive versus transitive verbs in the same contexts (cf. Wilkins 1998). Preliminary studies which test this hypothesis suggest that frequency-related cues are present in the input, but only in restricted contexts. Transitive and intransitive verbs are found in differing frequencies in caregivers' speech in imperative constructions (42% vs. 10% in the NOM-PREDICATE frame; 58% vs. 90% in the PREDICATE frame). However, there is no difference in *nonimperative* constructions (68% vs. 64% in the NOM-PREDICATE frame; 32% vs. 36% in the PREDICATE frame). These patterns suggest that, despite the massive ellipsis of arguments in adult speech, differences in the frequencies of use of transitive and intransitive verbs in identical frames (in imperative contexts) are available in the input as cues which might help the child avoid verb transitivity errors. Do children acquiring Hindi make use of these cues? Although 3-4-year-olds do not (yet) exhibit adult-like patterns in their own production, this is inconclusive. Further (experimental) research is needed to determine whether and how frequency-based information in the input is used to infer verb transitivity.

Levinson investigated the mapping of semantic participant structure to syntactic clause structure in Yélî Dnye, the complex Papuan language of Rossel Island in Papua New Guinea. Yélî Dnye raises a number of interesting problems for the acquisition of argument structure. Like many Papuan languages, it has no passive or antipassive and hardly any other valence-changing operations. Instead of applying morphosyntactic operations to verbs to derive semantically related verbs with an alternative mapping of arguments onto clause structure, Yélî Dnye simply lexicalizes the alternate mappings. There are thus many lexical doublets, e.g., *pwââ* "break (transitive)" vs. *pwópu* "break (intransitive)". One exceptional valence-changing operation is object-incorporation, which brings an object into the verbal complex between the preverbal clitic and the verb. The verb is then inflected as an intransitive. Unlike many kinds of object-incorporation, full noun phrases of arbitrary complexity can be so incorporated, but in line with general crosslinguistic patterns they cannot contain quantifiers, deictics, possessives, or proper names as heads.

Certain intransitive verbs also permit the incorporation of their subcategorized oblique arguments, which bring their oblique postpositions with them.

There appears to be a relationship between the lexical realization of argument structure alternations and certain other traits of lexical and grammatical morphology in Yélî Dnye, pointing to an overarching pattern of morphological opacity. In Yélî Dnye, cross-referencing of S, A and O functions is marked by clitics on either side of the verb in complex patterns. The preverbal clitics mark subjects (S/A functions) but also code six tenses, two aspects, five moods, and three persons in three numbers in unanalyzable portmanteaux form - 540 distinctions collapsed onto 144 items. The postverbal clitics mark both subject and object person/number, transitivity, and (redundantly) many of the same tense/aspect/mood distinctions. The patterns of conflation here follow a pattern found in other Papuan languages, whereby first person all numbers is conflated with second and third person singular, the second and third dual/plural references being conflated in another category. On top of this impenetrability, the preverbal clitics are often unrecognizably fused with deictics, negation, conditional markers, etc., yielding literally over a thousand unanalyzable forms. How children master such a cross-cutting system of grammatical categories fused into unanalyzable morphemes is quite remarkable.

In addition to the use of lexical alternates for what in other languages would be argument structure alternations, and the fusion of cross-cutting grammatical categories into myriads of distinct morphemes, Yélî Dnye shows a third kind of lexical hypertrophy: normal verbs exhibit massive suppletion. Lexical work so far suggests that 77% of all verbs are irregular in some way, with nearly two thirds suppleting over any of the categories of tense, aspect, person, negation, or when the postverbal clitic is a zero-morph. A quarter of the verbs have four or more roots, and the verb "give" has nine! This makes it quite hard for the analyst to reassemble what we would like to think of as a single verb from its many parts. Worse, many of the individual parts are homophonous with parts of another verb, so that e.g., *y.eemî* means "be giving to 3rd person", "be feeling presence of sorcery", or "left yesterday", while the other parts of "give to 3rd person" are *y:oo* (proximate past tense), *y:ee* (form used with zero-postverbal clitic), and *y:ângo* (remote past), each homophonous with parts of yet other verbs. To add insult to the analyst's injury, one third of verbs take

irregular inflections of some kind (e.g., "go towards" takes the dual for singular subjects).

From the perspective of the child learner, a language of this kind seems to present maximal lexical opacity just where transparency would be highly desirable for learning argument structure. The child cannot easily discern the grammatical categories underlying the portmanteaux inflectional clitics which are (given noun phrase ellipsis) often the only clue to the arguments. Nor can the child easily find a single verb on which to hang a subcategorization frame or canonical array of arguments. The viability of such a natural language suggests that handling massive irregularity is no real hurdle to the child, and that models of acquisition may often overemphasize the role of rule and underestimate the role of rote.

Van Geenhoven finished her investigation of so-called "raised possessors" in West Greenlandic noun-incorporating constructions (see Annual Report 1998). Her study addresses the general question of whether noun incorporation is a base-generated or a derived construction from the perspective of a semanticist who is interested in interpreting the output of syntax. By focusing on what have been treated as raised possessors in West Greenlandic noun-incorporating constructions and presenting some new data, she discusses some problems that arise if one uses the derivational syntactic framework to analyze them. As an alternative, she presents a base-generated syntactic analysis enriched with a coindexation system that makes overt the predication structure of noun-incorporating constructions in the sense of Williams (1980). She rejects the view that "raised possessors" are real possessors. Rather, these elements are simply third arguments of the incorporating verbal affix. Finally, she shows that by adopting a dynamic approach to meaning (Groenendijk & Stokhof 1990; Heim 1982), this kind of syntactic input is all that is needed to arrive at an adequate semantic interpretation of these constructions.

8.2.2 Argument marking

Ameka investigated the nature of grammatical relations in multiverb constructions in Ewe. The aim was to explore the behavior of arguments with the functions of subject and object in different kinds of multiverb constructions and to use findings to propose a typology of multiverb constructions in the language. Ameka shows that in Ewe, an isolating language, the prime indicator of intraclausal grammatical relations is

constituent order. The order in a pragmatically unmarked clausal construction is:

NP -   V   -   NP   -   NP   -   Other

Subject   Object1   Object 2

Other features that converge on the identification and definition of grammatical relations in the language are:

(i) the existence of distinct sets of pronouns for the expression of the argument functioning as subject and for the arguments functioning as direct object or second object or prepositional object;

(ii) distinctions in the way arguments with different syntactic functions are nominalized: subject nominalization employs an alienable genitive strategy while direct object nominalization involves preposing the NP to the reduplicated verb (the second object always occurs postposed in a nominalization structure);

(iii)use of the focus marker: ye is obligatory for focusing arguments in subject function but optional for arguments that bear other relations to the verb.

Differences in the expression of arguments bearing core (subject and object) grammatical relations in multiverb constructions point to at least two major types of such constructions in Ewe: the serial verb construction and the overlapping clause. In a serial verb construction, each verb in the series has the same subject. This is overtly expressed only with the first verb. In one subtype of the serial verb construction - the concomitant subject construction - the subject and the object of the first verb together are understood as the semantic subject of the second verb. Even in this subtype of the serial verb construction, the subject is expressed only with the first verb (see example below). By contrast, in an overlapping clause the subject argument must be expressed for each verb. The subject NP of the second verb is usually coreferential with a nonsubject argument expression, or with the entire event expressed in the first clause. Compare:

(1) Concomitant subject serial verb construction

Kofi   nya-e   dzó

NAME   chase-3SG   leave

"Kofi chased him/her away" (and also moved together with him/her, i.e., both left).

(2) Overlapping clause

Kofi	nya-e	wò-dzó
NAME	chase-3SG	3SG-leave

"Kofi chased her and she left" (Kofi did not follow or leave with her).

The two multiverb construction types are rather similar in the expression of the argument that functions as the object. Coreferential NPs in object function need to be expressed only once, as illustrated in the examples below:

(3) Serial verb construction (the three verbs share the same object, expressed once).

É-ku	te	da	du
3SG-scoop	yam	cook	eat

"He dug yams cooked and ate"

(4) Overlapping clause (the two verbs share the same object, expressed once).

É-ku	te	ná	Áma	wò-da
3SG-scoop	yam	for	A.	3SG-cook

"He dug yams for Ama and she cooked"

However, both construction types allow the object of each verb to be expressed separately, for example, when the first verb is semantically monovalent but the others are multivalent, or when the verbs have obligatory complements (see Essegbey 1999, Annual Report 1999).

In sum, coreferential arguments in object function can be omitted in both kinds of multiverb construction, but coreferential arguments in subject function can be omitted only in serial verb constructions. Thus, the behavior of arguments with various grammatical relations can serve as one parameter for a typology of multiverb constructions in Ewe.

Meira studied the pattern of argument marking in the Cariban language Tiriyó, spoken in Brazil and Surinam. Four independent morphosyntactic parameters converge in identifying two classes of intransitive verb stems: person-marking prefix sets, imperative affixes, nominalization morphology, and causativization (both the causativizing morphology and the syntactic and semantic properties of the resulting derived causative stem). At first sight this seems to present a paradigm case of a "split-intransitive" (active-stative, agent-patient) marking system: a pattern that groups the single

argument, S, of intransitive verbs together with the "A-argument" of transitives under certain conditions and with the "O-argument" under others. Consistent with this, one of the two intransitive classes takes transitive A-marking prefixes while the other takes transitive O-marking prefixes. Puzzlingly for the split-S analysis, however, there is no synchronic semantic basis for class membership: Tiriyó's two classes of intransitive verbs cannot be distinguished according to any of the kinds of semantic distinctions that typically play a role in split-intransitive systems, such as "verb specifies an activity vs. nonactivity", "verb specifies a controlled vs. noncontrolled event", or "subject is animate vs. inanimate".

Close inspection suggests that the Tiriyó pattern did not in fact develop as an effort to express semantic case roles transparently, but is an epiphenomenal consequence of the evolution of reflexivizing (detransitivizing) morphology. Almost all the members of the A-marking intransitive class (the putatively "active" verbs) are derived from transitive stems, either synchronically or diachronically, by means of detransitivization. The detransitivizing prefix is quite old (with several morphologically conditioned allomorphs). The semantics of the resulting intransitive stem conform to that of a "middle marker" in Kemmer's 1993 study of the middle voice (most of her middle situation types are attested in Tiriyó). It thus seems that, for some historical reason, the four identifying morphological parameters (including the person-marking prefix sets and their parallelism to transitive A- and O-marking prefixes) became at some point "linked" to the detransitivizing prefix, in a "symbiotic" relationship. When formerly detransitivized verb stems began to lexicalize, they became formally definable by these parameters. Thus, the parallelisms between the new "A class" of intransitive stems and the class of transitive stems are not semantically motivated, but instead are incidental byproducts of the evolution of the detransitivizing prefix, given its (apparently accidental) historical connection with transitive A-marking prefixes.
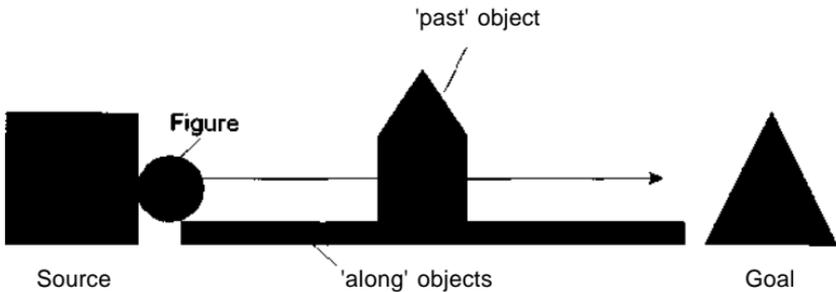
8.3   Event Representation

The members of the Event Representation subproject have studied the impact of language structure on the semantic segmentation of complex motion scenarios across languages, based on the responses collected with the Event Integration Questionnaire and the Event Complexity (ECOM) animations (see Annual Report 1999). Table 8.1 lists the individual contributions that have been made to these studies so far.

Language	Researcher	Quest-ionnaire	ECOM clips
Dutch (Germanic; Netherlands)	Caelen	**-**	**+**
Ewe (Kwa; Ghana, Togo)	Ameka & Essegbey	**+**	**-**
Farsi (Indo-Iranian; Iran)	Seyfeddinipur	**-**	**+**
Hindi (Indo-Iranian; India)	Narasimhan	**+**	**+**
Japanese (isolate; Japan)	Kita	**+**	**+**
Lao (Tai; Laos)	Enfield	**-**	**+**
Marquesan (Oceanic; French Polynesia)	Cablitz	**-**	**+**
Mparntwe Arrernte (Pama-Nyungan; Australia)	Wilkins	**+**	**-**
Nederlandse Gebarentaal (Deaf Sign Language; Netherlands)	Wilkins		**+**
Russian (Slavic; Russia)	Dunn	**-**	**+**
Saliba (Oceanic; PNG)	Margetts	**-**	**+**
Tenejapa Tzeltal (Mayan; Mexico)	P. Brown	**+**	**+**
Tiriyó (Carib; Brazil, Surinam)	Meira	**+**	**+**
Trumai (isolate; Brazil)	Guirardello	**+**	**+**
Yélî Dnye (East Papuan; PNG)	Levinson	**+**	**+**
Yukatek (Mayan; Mexico)	Bohnemeyer	**+**	**+**
Zoogocho Zapotec (Otomangean; Mexico)	Sonnenschein	**+**	**+**

Table 8.1: Languages in the Event Representation sample

The guiding question in this investigation is how complex journeys - those that proceed along a path that is defined by a series of locations or objects in space ("ground objects") - are packaged in units of discourse. Of particular interest are structural units (e.g., clauses or verb phrases) that, as constructions, have the semantic properties of simple event expressions. The properties that are taken here as defining for descriptions of simple events include a single location in time, a single event structure ("lexical aspect", "Aktionsart"), and a single argument structure. For example, in English, the scenario depicted in figure 8.1 may be described in a single clause: *The circle rolled from the square along the bar past the house-shaped object to the triangle.* This description entails a number of "subevents" (leaving the square, passing the house-shaped object, etc.) which are presented as located in time together, in that the clause maximally takes one time-positional adverbial (e.g., a *moment ago)* which then has scope over all the subevents. Thus, the description has the properties of a simple event description. This is captured by saying that the description represents the scenario as a single "macroevent" (a term adopted from Talmy 2000).
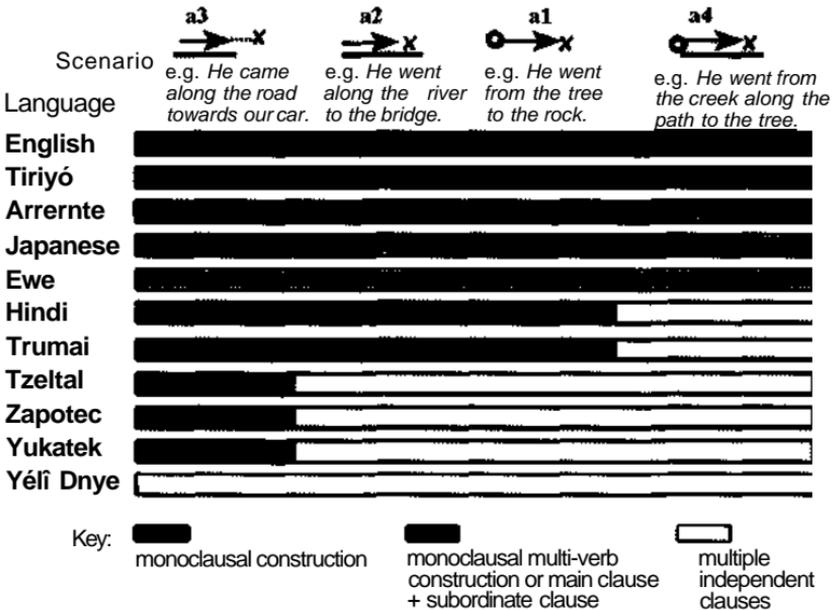

Figure 8.1: A schematic representation of the motion path in the ECOM B5 clip

In contrast, many languages (e.g., Saliba, Tzeltal, Yélî Dnye, Yukatek, Zapotec) require a separate clause for the coding of each of these location-change subevents, yielding something like *The circle left the square, it went along the bar, it passed the house-shaped object, and it arrived at the triangle.* In this type of description, each clause or verb phrase can take a separate time-positional adverbial (e.g., *and then).* Hence, the scenario is presented as a sequence of multiple macroevents.

The linguistic segmentation of motion scenarios into macroevents is controlled not only by cognitive, cultural, and pragmatic factors, but also by principles of language structure. Bohnemeyer, who has led the group in this study, has found evidence suggesting two types of design principles of linguistic coding that jointly determine the segmentation of motion scenarios: (i) typological patterns of lexical packaging, and (ii) crosslinguistic constraints on form-to-meaning mapping at the syntax-semantics interface.

An illustration of the impact of lexicalization patterns was given above: a language that does not have "path-neutral" verbs compatible with multiple ground-denoting phrases (such as English *go (from X to Y)* or Spanish *ir (de X a Y))* has to break down the description of a source-to-goal trip into multiple macroevent expressions. The languages studied by the Event Representation group actually form a cline in terms of the types of location-change subevent s they allow to be integrated into single clauses or verb phrases. Figure 8.2 illustrates this cline with respect to the scenarios a1 - a4 of the Event Integration Questionnaire.

Figure 8.2: Distribution of construction types across the scenarios a1-a4 of the Event Integration Questionnaire

In contrast to patterns of lexical packaging, crosslinguistic constraints on form-to-meaning mapping appear to be shared across the languages in the Event Representation sample. Three of these constraints, the Argument Uniqueness Constraint (AUC), the Macroevent Linking Principle (MLP), and the Referential Uniqueness Constraint (RUC), seem to fall out from more general principles of macroevent coding in language, while the fourth principle, the Unique Vector Constraint (UVC), is specific to the motion domain.

The AUC requires the semantic roles ("source", "goal", etc.) assigned to ground-denoting phrases in a macroevent expression to be assigned uniquely: no such role can be assigned more than once, and no ground-denoting phrase can be assigned more than one role. This rules out expressions such as (5a), where the source role is assigned twice:

(5a) *Sally walked out of the library from the cafeteria to the desk.

(5b) Sally walked out of the library and (then) from the cafeteria to the desk.

Coordination may be introduced to fix the expression, as in (5b), but this segments the scenario into two macroevents, as shown by the possibility of inserting the time adverbial *then.* The AUC has been known to syntacticians under various labels since Fillmore's (1968) Case Grammar, but it is usually considered only with respect to core arguments. This constraint limits the maximal content of a macroevent description in the domain of motion to a leaving subevent, an arriving subevent, and various passing subevent s in between.

A macroevent expression entails not only a set of subevents, but also relations of temporal order and causality obtaining among them. The MLP restricts the subevents referred to in a macroevent expression to the set of events among which the relations entailed by the macroevent expression obtain. For example, a passing subevent must precede an arriving sub-event entailed by the same macroevent expression. This ensures that (6a) can only be interpreted like (6b). In order to obtain the reading that Sally first reaches the mill and then passes the barn, coordination must be introduced, as in (6c):

(6a) Sally walked to the mill past the barn.

(6b) Sally walked past the barn to the mill.

(6c) Sally walked to the mill and then past the barn.

The RUC rules out multiple references to the same ground in a single macroevent expression, even if the ground-denoting phrases are assigned different semantic roles, as in (7).

(7)   ??Sally walked from the hill (back) to the hill.

However, "ground" must be construed here as whatever part of the physical ground object is selected by the semantic argument of the motion-event description. References to different parts of the same physical object do not violate the RUC:

(8)   Sally climbed from the foot of the hill to the top of the hill.

The UVC requires the directional information coded or entailed in a macro-event description to project onto a single vector. This principle was discovered by analyzing the responses to a subset of the ECOM stimuli: clips portraying direction-change scenarios. Figure 8.3 gives a schematic sketch of one of these scenarios.

Figure 8.3: A schematic representation of the motion path in the ECOM C6 clip
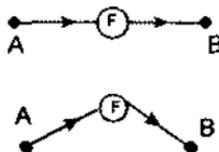
Across all the languages in the sample, no more than one of the vectors in figure 8.3 was covered by a single macroevent expression. For an elaboration of the analysis, consider the scenarios in figure 8.4. The motion event depicted by the diagram in the upper left corner of figure 8.4 can be described as a single macroevent in English if directional change is not specified and assertion is restricted to change of location; e.g., *It went from A via B to C.* However, unless the locations of A, B, and C are actually known, such a description would fail to distinguish between this scenario and those depicted in the lower diagrams of figure 8.4. An un-ambiguous description requires the assertion of directional information;

e.g., *It went from A north to B and then east to C.* In order to package the subevents entailed by such a description into a single macroevent expression, a language would require a vector-change operator that would translate e.g., "north-and-then-east". So far, no such vector-change morpheme has been attested in the languages of the Event representation sample.

Figure 8.4: The impact of directionality on motion event

It might be thought that the segmentation observed with respect to the scenarios in figures 8.3 and 8.4 can be accounted for in terms of the AUC alone. If one assumes, with Jackendoff (1983), that there are only two semantic roles of direction, AWAY-FROM and TOWARD, a packaging of these scenarios in a single macroevent expression would be ruled out because the description would assign multiple instances of the TOWARD role. However, the UVC is not fully derivable from the AUC, because the AUC does not explain why the scenario depicted by the upper diagram in figure 8.5 can be described as a single macroevent (e.g., *It went away from A towards B)* whereas the scenario portrayed by the lower schema cannot.

Figure 8.5: The relationship between the AUC and the UVC

The four principles of motion event segmentation discussed here are neither purely formal nor purely semantic. That is, they determine neither the syntactic wellformedness of particular combinations of adjuncts nor the wellformedness of particular semantic representations. They are, instead, constraints on what semantic representations can be expressed by particular syntactic structures (clauses, verb phrases, or, more generally, macroevent expressions), and in this sense, they are principles of the syntax-semantics interface under a broad construal.

In a separate study on the expression of motion, Narasimhan investigated the linguistic encoding of (manner of) motion events in Hindi. English and other Germanic languages allow constructions such as *The bottle floated into the cave,* whereas languages such as Spanish, French, and Hindi tightly constrain reoccurrence of manner of motion verbs with path phrases. This typological observation has been accounted for by reference to different patterns of conflating complex meanings in verb roots, or to the presence vs. absence in a language's lexicon of path "satellites" with special grammatical properties (cf. Talmy 1985, 1991). However, data from Hindi challenge these claims: the restrictions obtain despite the availability of both verbs with suitable meanings and path "satellites". Alternative proposals that stress aspectual constraints on manner verb + path, phrase combination in Spanish-type languages (Aske 1989) fare no better in accounting for the full range of data in Hindi. However, an empirically adequate account is provided, argues Narasimhan, by positing a general mapping constraint that specifies whether the lexical requirements of the verbs of a language constrain the verbs' syntactic privileges of occurrence strictly, or only weakly. In Hindi, path phrases can combine with manner-of-motion verbs only to the degree that they are compatible with the lexical meaning of the verb. In contrast, in English, path phrases can extend the verb's lexical meaning, subject to certain constraints. This suggests that path phrases are licensed in English by the semantic requirements of the construction in which they appear rather than by selectional requirements of the verb alone (Jackendoff 1990; Goldberg 1995).

A new two-year project on Serial Verb Constructions (SVCs) initiated by Senft took off in April 2000 under funding from DFG (German Research Society). Entitled "Serial Verb Constructions, Event Conceptualization and Event Report in Austronesian and Papuan Languages", this project is run by Senft and Van Staden, together with Dukers. The aim of the research is

to answer the following general questions: What characterises SVCs in Austronesian and Papuan languages? Can we set up a typology of SVCs for these languages? What types of SVCs do we find? What functions do SVCs fulfill? What kinds of verb complexes constitute SVCs? Can we find unified ways to describe the syntax of these constructions? What kinds of lexicalization processes can we observe in SVCs? Does all this enable us to give a comprehensive definition of SVCs, at least for these languages? The project will also focus on event construal and event report in relation to SVCs, asking what "a single event" is in an SVC, and whether we can infer language- and/or culture-specific conceptualizations of events from the SVCs found in these languages. To answer at least the first set of questions, an initial data base on SVCs in Austronesian and Papuan languages has been set up and a first questionnaire on SVCs has been sent out to colleagues on the internet to obtain additional data. To explore event construal issues, elicitation tools will be developed and field tested in the course of 2001.

9 THE DYNAMICS OF LEARNER VARIETIES

This project differs from other Institute projects in that only a small fraction of the actual work is done at the Institute itself. Its role is rather to co-ordinate the joint research of a group of European research centers, in particular the universities of Aix-en-Provence, Amsterdam, Bergamo, Berlin (Freie U. and Humboldt U.), Cambridge, Heidelberg, Paris (U. III, U. VIII, and U. X), Pavia and Tilburg. Since its beginning the project has been concerned with the comparative analysis of untutored adult language acquisition from a crosslinguistic and longitudinal perspective. Its research is in many ways based on work done in the European Science Foundation's project "Second Language Acquisition by Adult Immigrants" (Perdue 1993) and some other contemporary projects with a closely related setup.

The core idea of the project is not just to investigate the process of language acquisition, its course, and the reasons that often bring it to a premature end, but also to contribute to an understanding of the human language faculty itself. The project thereby focuses on the dynamics of language acquisition, the key question being "What pushes the learner to go beyond the so-called basic variety (Klein and Perdue 1997)"? A common research interest is the construction of coherent discourse, where for any given utterance, the discourse context defines an informational structure - what is maintained and what is developed in a given conceptual domain, which parts are affected by scope-bearing elements, and so on. The learner has to learn how to reconcile this informational structure with the linguistic means available and, if this is not possible, to acquire further means. The assumption that it is between information structure and the available linguistic means that one finds the dynamics of adult language

acquisition determines the choice of the main research topics. The following empirical domains seem most sustainable for testing the causal factors mentioned:

(i)   The scope of "optional elements" (e.g., adverbials, particles, negation)

(ii)   Finiteness

(iii)   Complex structural devices (e.g., reference to space and time)

(iv)   Discourse cohesion

The first of these factors exists in the basic variety, but the way optional elements are integrated in the structure of utterance is much simpler than in source and target languages. The second one is strikingly absent from the basic variety, and it will be interesting to see what its structural precursors are and how they evolve in later stages of acquisition. The third point refers to the acquisition of more complex structures, in particular the acquisition of means for the expression of temporality, of devices for clause combination and of items that violate certain basic variety-level semantic constraints. A fourth question is how the development of further means at the three above-mentioned focal points enhances discourse cohesion (anaphor, reconciling utterance structure and the informational organization of text types).

In the following report, we will give examples ofr research done in these four sections (the contributions of Dimroth and Benazzo cover points (i) and (ii)). The work of Dimroth (9.1), Starren (9.3) and Schmiedtová (9.4) was done at the Institute itself. The work of Benazzo (9.2) and Murcia-Serra (9.5) has been carried out at other centers.

9.1   From information structure to target language syntax: the acquisition of scope-bearing elements

Dimroth studied the untutored acquisition of scope-bearing elements (particles like *also* and *another,* and temporal adverbials like *still* and *again)* in German L2. The stressed forms of the additive particles and adverbials investigated share an interesting behavior. They affect topical information and express that a given state of affairs holds for one topic time, place or entity in addition to a different topic time, place or entity (which is often mentioned earlier or contextually given).

For basic learners it could be shown that in the absence of finiteness marking only one position for topic related additive words was available,

namely the position between the topic element in the scope of the additive word and the expression of the state of affairs that is claimed to be true for this topic element. In the next stage of acquisition, finiteness seems to compete with additive words for this position. At this stage, due to their role as mediators between a repeated state of affairs and a (contrastive) topic, additive words can even comprise assertion marking and appear in complementary distribution with finiteness. Additive words can have distant scope over a topic element only at a stage with stable finiteness marking.

The observed development is shaped by the interaction between utterance-level and discourse-level constraints. At utterance level, the integration of topic related additive words in the unfolding utterance structure was researched from the perspective of a developmental picture created in collaboration with Gretsch, Jordens (U. of Amsterdam), Perdue (U. Paris VIM), and Starren. This framework tries to capture the basic form - function relations of relatively simple utterances that are common to both first and second language acquisition at two subsequent decisive stages.

The first of these is the so-called "adjunction stage" corresponding to the basic variety as described in earlier L2 work (Klein and Perdue 1997). It is characterized by a one-to-one mapping from conceptual organization to formal arrangement. At that stage, utterance structure basically consists of three positions that are to be filled by juxtaposed elements without marking for grammatical relations (no agreement). The first position is typically filled by a nominal or adverbial element that refers to the topic of the utterance. The rightmost part of the structure is filled by elements referring to some state of affairs that is claimed to hold true for the topic. The position in the center is the position for a structural link between state of affairs and topical information. The information about the link is typically left implicit when it has its default value of a simple assertion, i.e., only negation, addition, and some modal relations deserve overt expression at that stage. As shown in example (1), logical relationships like the scope of particles or adverbs can only be marked by topological relations; distant scope as used in target language German whenever topical information is to be affected by additive words is therefore impossible at that stage.

(1) das rot laufen (...) und eine axt und [blau mann] **auch** eine kaufen

   the red walk (...) and a hatchet and blue man also one buy

   "Red was walking along the street. (...) He bought a hatchet and Blue also bought one."

The following grammatical linkage stage is characterized by a more hierarchical organization of utterance structure. The filling of the position for the link between state of affairs and topic and the marking of agreement become obligatory (i.e., finiteness is acquired). With that step, the number of insertion slots for scope-bearing elements increases and the available positions become more specialized with respect to scope marking. Due to the growing syntactic hierarchy, scope particles and adverbs can affect distant topic constituents as in (2).

(2)   [er] hat auch axt gekauft

        he has also hatchet bought

        "he also bought a hatchet"

In order to investigate discourse level constraints on the functioning of topic-related additive words, Dimroth designed a discourse elicitation task that has obligatory contexts for topic related particles and adverbs, natural conditions for topic management in discourse and a high degree of control over the underlying information structure of each utterance. The data (see example 3) show that reference to topical information which is affected by some additive word can be left implicit under the same discourse-dependent conditions as topical information that is not in the scope of some particle or adverb.

(3) dann kommt auf dem bus ein blaues mann (...) und [0] geht auch zum waffenladen

    then comes on the bus a blue man (...) and goes also to the armourer's shop

    "Then Blue arrives by bus (...) and he also goes to the armourer's shop."

In cases of empty elements referring to contrastive topics in the scope of additive words, terms like *bridge accent* (i.e., a raising tone on the topical element and a falling tone on the particle (Büring 1995) or *I(ntonation)-topics* (Jacobs 1997) that were used to describe the German accent pattern for this informational configuration are in fact misnomers.

9.2   The interaction between verb morphology and temporal adverbs of contrast

Benazzo (U. Paris VIII) continued her study on the acquisition of temporal adverbs of contrast (TACs) such as *again, already, still, yet,* in the longitudinal data of French, English and German L2 (ESF).

Previous studies have shown the important role of temporal adverbs at early stages of L2 acquisition, but it has been hypothesized that TACs, because of their structural complexity, only appear in postbasic varieties (Dietrich et al. 1995), that is at a stage when utterances are organized around a finite verb.

The results of Benazzo's analysis lead to modification of this hypothesis: actually items expressing the reiteration of an event (such as *again) are* used in the nonfinite basic variety while others (such as *already, yet, still)* are attested only at more advanced stages of acquisition, usually when the verb is (more or less) functionally marked for tense oppositions.

Benazzo claims that the reasons for this asymmetry are to be found in the interaction between the discourse functioning of the relative items and the development of verb morphology in the learners' variety:

> Items such as *again* quantify over events referred to by V and its complements. To be repeated, an event has to be bounded (perfectly presented), and the expressive means for temporality at the basic variety allow this.

> The other TACs *(still, already* and their negative counterparts) relate and contrast different time intervals (phases) of the same event which are usually encoded by the finite component of the verb. To make use of TACs, learners have to master the relevant verb morphology signaling for which time interval the predicate holds; this happens at postbasic stages.

On the basis of these remarks it seems that the integration of TACs in the learner's repertoire is not constrained by their cognitive structural complexity, but is related to their compatibility with the global functioning of the learner variety at a given time.

9.3   The acquisition of temporal relations in Dutch and French

Starren finished her Ph.D. research on the development of temporal reference in the untutored acquisition of Dutch and French by Turkish and Moroccan learners. She had shown in previous analysis (Starren 1997) that learners first mark temporal reference lexically (e.g., with temporal adverbials) before proceeding to a gradual and often slow acquisition of morphosyntactic devices. In fact, few learners ever attain the morphosyntactic tense and aspect system of their target language and

most of them fossilize at a stage where they manage to create temporal and aspectual reference on the basis of temporal adverbials. The optimalization of this basic lexical reference system has been considered as a serious blocking factor in the grammaticalization process (Starren 1997).

In the competition of cues that could determine this morphologization process for those learners who pass this basic temporal reference system, Starren, on the basis of a combination of quantitative and fine-grained discourse analyses, has found that:

> learners of Dutch and French both start with auxiliary-like elements (proto-AUX) in the focus constituent of the utterance in the preverbal area as in *die man is brief schrijven, en dan is hij heeft werk aanvragen* - "the man is letter write and then he has work apply-for";

> these various proto-AUX are first used in order to contrast aspectual viewpoints (grammatical aspect before grammatical tense);

> only later in the morphologization process past tense marking does emerge, which is spelled out by a past proto-AUX *(was* and [sete]) and a main verb;

> verbs which have a clear poststate (achievements and accomplishments) are shown to attract first the perfect aspectual viewpoint construction; the semantic features of a particular semantic category of verbs attract a particular morphosyntactic coding;

> in actual use, all verbal categories take all types of (pre)-morphosyntactic marking if it was needed in a particular discourse context. This means that in the ongoing debate of the so-called "lexical aspect hypothesis" versus the discourse hypothesis in SLA-literature, Starren has found supporting evidence for the discourse hypothesis.

9.4   The acquisition of simultaneity

In her dissertation project Schmiedtová is interested in how untutored second-language learners describe simultaneous events in time. Based on preliminary analysis of some of the data from the ESF data base, second language learners in the basic variety phase tend to evade the description of simultaneous events in narrative discourse (retelling a movie). It seems

that they either ignore scenes involving simultaneity completely or describe them as if they were sequential. A similar phenomenon has been observed in L1: before age 5 children can not capture simultaneity but rather describe events sequentially (Piaget 1969). Although observations in L1 and L2 are quite similar they may have different causes.

In discourse, native speakers usually do not overtly mark simultaneity at all. Rather, they infer information regarding simultaneity from other sources than the temporal properties of a sentence. Two very important factors here are the given situational context and the shared world knowledge. At the same time, simultaneity can be overtly marked by various linguistic means in situations where two or more events are simultaneously salient enough. This happens, for example, when the speaker is "forced" to mark simultaneity explicitly. In other words, since overt marking of simultaneity in narrative context is not the default case, it is necessary to elicit this kind of data. For this purpose, Schmiedtová is using a series of 10 commercials which are highly salient with regard to simultaneity.

The languages currently being examined in this project are Czech, English and German. The reason for this choice is that the explicit devices for expressing simultaneity in Czech, English and German differ significantly: German relies mostly on lexical means, whereas Czech and English can make use of morphological means as well. As Czech is a heavily aspect-based language compared to English, it uses morphological means for expressing simultaneity more extensively than English does.

9.5 Acquiring the linking of syntactic, semantic, and informational roles and relations in narratives

Murcia-Serra (U. Heidelberg) studied the acquisition of the linking of syntactic, semantic, and informational roles and relations in narratives. The study is based on a group of 15 very advanced learners of L2 German with L1 Spanish and two groups of 20 native speakers per language. The analysis of the latter shows that speakers of German use basically the grammatical role of subject to package topic information, which in narratives corresponds with the protagonist of the events being related. This is clearly shown by the extensive use of passive constructions whenever the protagonist happens to play the role of a patient in the event at hand *(er wird von einem Blatt Papier umgeworfen* - "he gets by a sheet of paper knocked down").

In Spanish on the other hand, information structure is encoded via word order, with topic information typically placed in preverbal position while the subject category is systematically accorded with the actor entity of the different events under narration. In the case of inanimate actors the prototypical linking of subject, topic, and actor establishes the setting of the actor entity as a local topic at utterance level *(una hoja de papel* to *tira -* "a sheet of paper him knocks down") (Murcia-Serra 2000).

The advanced learners of German have serious difficulties to recognize the importance of the protagonist of a narration for topicality in their target language, since on the whole they show the source-like linking of the actor entity with topic status *(die Wände zerquetschen ihn -* "the walls squash him"). Only a small subset of speakers attain the target-like linking of subject and topic information (demotion of the actor entity, *er wird von einer Maschine zerquetscht -* "he gets by a machine squashed"). This shows that the entanglement of language dependent constraints for the production of a coherent text and the assumption of a determined form-meaning cluster lead to serious acquisition problems even at a very advanced level.

10 OTHER RESEARCH

10.1 East Papuan Project

In 2000 Levinson, Reesink (Leiden U.), Terrill (MPI for Evolutionary Anthropology, Leipzig) and Dunn launched the "East Papuan Project", involving descriptive, typological and historical research on the little-known East Papuan outlier languages of Insular Melanesia.

The East Papuan outliers are surrounded, and to a greater or lesser extent influenced, by Oceanic Austronesian languages. Compared with the closely related Oceanic Austronesian languages in the area, the East Papuan outliers are almost entirely unknown and underdescribed, and the relationships between them are also unclear. The East Papuan Outliers, through their proximity with the well-researched Oceanic languages, provide linguists with a laboratory for investigating questions of retention versus borrowing. There are also language and cognition implications, as prolonged cultural contact between speakers of Papuan and Austronesian languages has led to underlying convergence in linguistic construals between languages with very different grammatical resources.

This project is run jointly by the Typology Group at the Max Planck Institute for Evolutionary Anthropology and the Language and Culture Group at the Max Planck Institute for Psycholinguistics, maintaining links with the Spinoza Project on Lexicon and Syntax at the University of Leiden. Research tools under development by the Language and Culture Group will be used to approach the comparative typological questions posed by the Typology Group, and it is envisaged that a profitable dialogue will result. Apart from the project members within the two MPIs, other researchers with interests in the Papuan Outliers will be invited to participate.

10.1.1 Color words

The color domain has been one of the best examples of strong universals in semantics. Levinson (2000) published a paper on the color term system of Yélî Dnye, the language of Rossel Island. Berlin and Kay's celebrated universals include an assumption that every language exhaustively partitions the color domain with a set of basic color terms. Using the standard procedures, Yélî Dnye turns out to be an exception. It has three terms, formed by reduplicating object names, for white, red and black, but unexpectedly, these are not extended beyond the range of the corresponding English terms, and for other colors there are only metaphors, which leave most of the color area unnamed. In retrospect, other color systems in the Pacific look similar, forming a type of language that escapes the Berlin and Kay model, not having crystallized out color as a systematic domain to be exhaustively named. This in turn shows that color universals lie more on a perceptual than a linguistic level. Kay and Maffi have now developed a broader framework for color universals partially in response to Levinson (2000).

Meira collected data in the field on color terms in Tiriyó, a Cariban language of Brazil and Surinam. Color terms were collected using the Berlin & Kay procedures from 10 speakers (7 men and 3 women, aged 17-60). Most of the terms used are metaphorical phrases (e.g., "like the egg of the /suuwi/ bird"); even the few synchronically monomorphemic terms (which are also the best candidates for the status of "basic" color terms due to their frequency and consistency) show signs of having been historically derived from nouns that no longer exist. Preliminary results suggest that a yellow-green ("yeen") category exists for older, but not for younger, speakers. The analysis of Meira's data is still ongoing.

10.2   Variable-free semantics

In 2000 Böttner continued his project on variable-free semantics by extending relational grammar to capture a certain type of ambiguity and by introducing multigrade relations to relational algebra.

10.2.1 Pronominal ambiguity

In a first project, Böttner investigated pronominal ambiguity. In the sentence "Ann likes Helen and her sisters" the pronoun "her" may refer at least to Ann or to Helen. Many languages reflect this difference by different types of pronoun. In relational grammar this difference is reflected

by different trees. The advantage over rival accounts is that it is variable-free and does not require the introduction of additional operations.

10.2.2 Multigrade relations

In a second project, Böttner examined multigrade relations, considered by Leonard and Goodman in the early forties. Whereas standard ("unigrade") relations are restricted to sequences of a fixed length, multigrade relations are not. Böttner's interest in multigrade relations is based on the observation that natural language terms rarely fit the categories of fixed valencies but exhibit some flexibility with respect to valencies. It is shown that the interpretation of terms by multigrade relations leads to a more fine-grained classification of terms. The approach has the advantage that certain types of logical consequence can be explained on a basis that is motivated semantically.

10.3 Multifunctionality and scope evasion in Vietnamese clause structure

Duffield examined the interactions among a set of "multifunctional" grammatical elements in Vietnamese, that is, elements whose interpretation is determined by their clausal distribution. He argues that a restrictive explanation of multifunctionality can be given by assuming that the interpretive features expressed by these elements are inherently syntactic rather than lexical properties. Specifically, it is proposed that the syntax of Vietnamese (and of English) involves a sentence-medial functional projection (Assertion) and that this projection hosts interpretive features, independent of the lexical elements that may instantiate them. A corollary of this analysis is the notion of "scope evasion": elements may appear in a noncanonical position above A, not to check features, but rather to evade scope. Two instances of scope evasion are presented; it is also suggested that this notion offers a plausible semantic alternative to the purely formal requirements of the Extended Projection Principle (EPP).

10.4 Representation of morphological relationships between German inflected forms

In collaboration with Clahsen (U. of Essex), Sonnenstuhl, and Hadler (U. Düsseldorf), Eisenbeiß investigated the representation of morphological relationships between inflected forms in the German mental lexicon. In a series of visual lexical decision experiments (word/non-word discrimination), participants responded faster to regularly inflected words

with high frequency stems than to regularly inflected words with low frequency stems. This effect was independent of the frequency of the inflected word form and the status of the stem (marked vs. unmarked). These results suggest that both marked and unmarked stems of regularly inflected word forms are stored separately from their affixes. Moreover, a set of cross-modal priming experiments revealed asymmetries in the priming patterns between morphologically related word forms: the prior presentation of a morphologically related inflected word form facilitated the recognition of an inflected form but the size of the facilitation effect was determined by the morphological relation between the two forms involved, specifically by the structure of the respective paradigms and the structure of lexical entries for marked stems.

10.5   Comprehension in discourse

10.5.1 Semantic/pragmatic and syntactic integration processes

In the processing of sentences with relative clauses such as (1) and (2), it has been established for several Germanic languages that readers initially prefer a subject relative (SR) reading over an object relative (OR) reading. In Dutch, the reading times of the syntactically disambiguating auxiliary and/or the words following the auxiliary were longer in the OR clause than in the SR clause.

(1)   ... de professor, die de Studenten gezien heeft,...   [SR]

         "the professor, who the students seen has "

(2)   ... de professor, die de Studenten gezien hebben,   [OR]

         "the professor, whom the students seen have"

However, in earlier self-paced reading and eye-movement research (see Annual Report 1999), in which the animacy of the antecedent NP and the NP in the relative clause was varied, this preference disappeared when the object of the relative clause was inanimate, as in (3) and (4). Animacy can affect the processing of the relative clause.

(3)   ... de wandelaars, die de rots weggerold hebben, ...   [SR]

         "the hikers, who the rock rolled away have"

(4)   ... de rots, die de wandelaars weggerold hebben, ...   [OR]

          "the rock, that the hikers rolled away have"

In an experiment in which both NPs were inanimate, Vonk, in collaboration with Mak and Schriefers (both U. Nijmegen), could rule out the difference in animacy of the antecedent NP as the only explaining factor, because when both NPs were inanimate, as in (5) and (6), the SR preference was again established.

(5)   ... de gel, die de lekkages verhelpt, ...   [SR]

     "the gel, that the leakages remedies"

(6)   ... de lekkages, die de gel verhelpt, ...   [OR]

     "the leakages, that the gel remedies"

This finding may be explained on the basis of pragmatic principles: since the referent of the antecedent of the relative clause is the topic of the relative clause, the relative pronoun may preferably be seen as the subject of the relative clause. If both antecedent NP and NP in the relative clause do not differ in factors that affect syntactic subjecthood, the preference may be established on the basis of topichood of the relative clause, that is an SR preference. This is in accordance with their earlier finding that for relative clauses in which the NPs differ in animacy, the OR reading was very difficult when the subject of the relative clauses was inanimate, as in (8) compared to (7): both animacy and topichood of the antecedent bias toward an SR reading.

(7)   ... de rots, die de wandelaars verpletterd heeft, ... [SR]

     "the rock, that the hikers crushed has"

(8)   ... de wandelaars, die de rots verpletterd heeft, ... [OR]

     "the hikers, who the rock crushed has"

The influence of topichood was also studied with the use of pronouns. In general, the use of a pronoun is connected to topichood. When the NP in the relative clause is a pronoun, readers may interpret it as the subject of the relative clause. If the pronoun is not case marked, this should lead to a longer reading time at the auxiliary in (9) than in (10).

(9)   ..., de hardloper, die jullie in het park gegroet heeft,...   [SR]

     "the jogger whom you (pl.) in the park greeted has"

(10)   ..., de hardloper, die jullie in het park gegroet hebben....[OR]

     "the jogger, whom you (pl.) in the park greeted have"

Indeed, an OR preference was found at that position (see Annual Report 1999). The question now is when the commitment toward an SR or OR

reading can be made. It is possible that readers initially parse the relative clause as an SR clause and reanalyze it only as an OR clause when they encounter the pronoun *you* (pl) in the relative clause. However, if the pronoun were marked as an object, as in (11), there would be no need for reanalysis. Only the pronoun marked as the subject, as in (12), would force reanalysis.

(11) De huisbaas sprak met de huurders die hem bij het conflict misleid
     hebben.   [SR]

     "The landlord spoke with the tenants, who him in the conflict misled
     have".

(12) De huisbaas sprak met de huurders, die hij bij het conflict misleid
     heeft.   [OR]

     "The landlord spoke with the tenants, who he in the conflict misled
     has".

However, the opposite was found: in a self-paced reading study the reading times were shorter at the word following the pronoun in the OR clause (12) than in the SR clause (11). This is consistent with the topic-hood hypothesis: the personal pronoun is preferred as the subject of the relative clause. The accusative case marking on the pronoun in (11) blocks this preferred analysis, which leads to longer reading times.

10.5.2 Inference processes

Together with Frank, Koppen (both U. Nijmegen) and Noordman (Tilburg U), Vonk continued a project that aims at the development of a discourse comprehension model that accounts, for the dynamic character of the representation, and for on-line inference processes. The dynamic character of the representation includes to the processes of reactivation of earlier information that is referred to and the decay of earlier information that is not referred to. The inference processes comrise to the interaction of the information in the text and the reader's knowledge. The first step in this project was to implement a number of models in the literature and to evaluate them with respect to both mathematical soundness and psycho-logical plausibility. The models included the Construction-Integration, Predication, Resonance, Landscape and Competitive Cohort models, as well as the Golden and Rumelhart, and Langston and Trabasso models. The investigation of these models pointed out a number of important mathematical requirements (convergence and control of activation, sensitivity to input, robustness with respect to parameter variation) and

psychological requirements (reinstatement, inference, recency, decay). These requirements provide challenges for subsequent research.

Several kinds of representations have been implemented: network models in which propositions and their connections correspond to nodes and links; models in which propositions are represented by vectors as in Latent Semantic Analysis; models in which propositions are represented as activations of a set of elementary units in Self Organizing Maps. In addition to the text propositions, the knowledge of everyday activities as reported in an elementary children's book is implemented in the same formats. Several simulations have been performed with these models. Some promising results were obtained in the simulation of temporal inferences. For instance, when shown incoherent stories in the form of temporal sequences of propositions, one of the models was able to infer the intermediate steps necessary to make the stories coherent.

11 OTHER ACTIVITIES

11.1 Activities of the Technical Group

11.1.1 Overview

During the year 2000 the Technical Group received a number of grants for further developing key technologies such as the "European Distributed Corpus Project" (EUDICO) and the "Browsable Corpus" and for making them available to internal and external users. The European Community was already funding the "MultiMedia Indexing and Searching project" (MUMIS) and the "International Standards for Language Engineering project" (ISLE) (see Annual Report 1999). Other grants were received from the Netherlands Organisation for Scientific Research (NWO) for developing the "Corpus Exploration Tool" (COREX) and from the German "Volkswagen-Foundation" (VW-Stiftung) for the "Tools and Infra-Structure for the Documentation of Endangered Languages" project (TIDEL). The MUMIS project is to develop technology to automatically index multimedia recordings. This indexing allows direct access to media fragments via a query interface and networks. The ISLE project will deliver a standard for the coding of metadata for multimedia/multimodal language resources and will propose annotation and encoding schemes for such resources. The purpose of the COREX project is developing exploitation software for the Dutch National Corpus project and the TIDEL project will set up an online archive for endangered languages; moreover, it will also develop annotation and analysis software for the documentation of such languages.

As a result of additional external funding the TG was also able to continue further development of the "Nijmegen Experiment Setup" (NESU2). The TG is currently developing a completely new NESU system to run on Windows 2000 with the same degree of timing accuracy as the current NESU version, which is still DOS-based.

The means provided by these external funds allowed the TG to secure the positions of highly qualified IT personnel and to attract additional young IT specialists. The number of development staff members was more than doubled. The TG also hired an expert for professional support of MAC computers and employed student assistants for the creation of metadata descriptions for the processing of the enormous amount of audio- and video-tape material, and for supporting the MPI scientists in dealing with new technology.

11.1.2 Computer systems and networks

After having transferred the server infrastructure to modern SPARC-based SMP servers and completing the integration of the heterogeneous platforms in 1999, the focus in 2000 was to prepare the server infrastructure for housing the extensive multimedia archive. An additional media server provides media streams to outside users. Essential initial components of a Storage Area Network were integrated so that a large 2TB RAID system is now available and can even be expanded in the years to come. This RAID system is connected to all major SUN and NT servers by means of Fibre Channel components. As the use of good storage management tools is very important from a system management point of view, components from Veritas will be tested to facilitate storage management. The TG expects that the integration of this storage architecture will lead to a more scalable solution capable of meeting the continuously increasing demand for storage capacity from all departments. For data-security reasons it will be necessary to integrate a larger tape library into the Storage Area Network in 2001, since the existing 3 TB library is now fully occupied. In 2001 it will also be necessary to establish a remote copy of archived data. To support media streaming on MACs the DAVE SAMBA client was tested and installed.

Outdated old NT-servers were replaced by new and more powerful machines. Testing of the Windows 2000 server edition was begun with the aim of verifying whether this new operating system version can be used in the future to offer smooth server capacity.

Netscape Messenger was chosen as the common default e-mail client for the future and a separate server was set up as an e-mail server running the IMAP protocol. In general this combination has turned out to be fairly robust, i.e., the e-mail system, which has become so crucial for scientific communication, operated fairly smoothly throughout the year.

Media serving via the network is now a very common procedure. Although the existing central 100 Mbps allowed us to send media streams to clients in a jitter-free mode, it turned out to be insufficiently powerful. Therefore, it was necessary to replace the 100 Mbps switching backbone with Gbps technology since natural presentation of the video and audio material has become essential. This move was performed without disturbing service to users.

Due to a new type of connection to the Dutch Scientific Network, another more powerful router was integrated as well. This provides the Institute with a connection to the scientific network with a 155 Mbps bandwidth.

The increasing demand for Linux led to Linux being tested and adapted to our configuration. The TG now offers Linux support. However, system privileges remain very restricted. Only systems managers are allowed to install system software and carry out changes at the system level. To limit the number of platforms being supported, the last SGI computers were deactivated.

11.1.3 Information systems

After the entire server infrastructure had been transferred to SUN machines, major information systems such as the scientific and administration databases and the library software had to be transferred to the new operating system as well. Since Intranet and Extranet services are partly related, i.e., both interface with some tables of the database, the move had to be planned very carefully. The Apache web server was installed on the SUN machines and all Oracle database applications were moved to the SUN platform as well. This move was also used to upgrade to Oracle version 8i. These transfers and upgradings demanded considerable manpower due to the many tests necessary for guaranteeing smooth service.

A real milestone for the Institute was the delivery of the archive client. This client was written in Java and installed on all machines that support Java 1.2. It allows users to easily browse through their directory structures and

indicate which files should be archived. Users may associate descriptions on the archive set and file level very easily as well as retrieve archive sets in a simple way. The TG is responsible for the actual storage. The archive tool guarantees that only those authorized to do so may access individual archive sets.

Another important step was the development and installation of a preprint server. The preprint server is set up so that every scientist can easily add new items and Internet users can carry out searches along several dimensions. All information is stored in an Oracle database; CGI programs couple this to the web server.

11.1.4 Linguistic applications

Due to the external grants mentioned above extra personnel could be integrated and thus a considerable amount of work was carried out in the year 2000. Space restrictions do not allow a detailed account of the EUDICO and BrowsableCorpus projects. For this we refer the reader to the following website: http://www.mpi.nl/world/tg/lappy/lapp.html.

In cooperation with the Department of Computer Science at the U. of Sheffield a connection to the GATE package was realized. The GATE package is a software framework for language engineering components. This connection allows one to access Tipster-formatted files and to view, for example, syntax trees in the synchronized fashion that is typical for the EUDICO package. EUDICO has acquired three new synchronized viewers, all of which are available: an enhanced speech viewer, a synchronized text viewer, which presents the text of a tier in a compact form, and a synchronized time-line viewer, which is especially important for the visualization of overlap in activities. A preliminary search tool was integrated into the EUDICO tool set, which allows the search for certain textual patterns. It will be expanded to a full-fledged search tool. EUDICO has been extended such that the RMI-based interaction can now pass through firewalls solely by opening one specific port. Finally, the first fully functional version of EUDICO was burned to CDROM and handed over to the Dutch Spoken Language project as deliverable to users. Other versions will follow in 2001.

Moreover, the Abstract Corpus Model, the nucleus of EUDICO, was extended such that EUDICO can now be integrated into Browsable Corpus technology. EUDICO now also delivers metadata from the gesture corpus. This allows BC users to scan through the gesture corpus, which in

itself has metadata included in its database. A developers' workshop of the Talkbank project in Pittsburgh discussed the requirements for annotation structures for multimedia language resources. Based on this discussion the TG decided to adopt the ATLAS Interchange Format as a general XML-based file format. The Abstract Corpus Model was extended to cope with some phenomena not yet included (e.g., hierarchies in annotation structures). Requirements from the EUDICO framework for the AIF were formulated. In connection with the project for archiving data on endangered languages, it was investigated in detail how UNICODE can be integrated into the EUDICO tool set. Several software packages written in Java were evaluated. It seems that the TG has found solutions even for the archiving of Chinese, Bengali, and Arabic languages, which have very special requirements as far as the editing and the rendering of complex script characters are concerned. Finally, a workshop on problems of lexicon structure was organized. On the basis of this workshop the TG began sketching an Abstract Lexicon Model, which will serve as the basis for developing a lexicon component for the EUDICO tools set.

The Browsable Corpus technology was also extended considerably. Metadata editor copies are now installed on all field notebooks so that users can create metadescriptions in the field. The browser has been ported to Java and is now also functioning as an applet. A number of corpora used within the Institute such as the ESF Second Learner Corpus, the PMOL corpus, and the TIMIT corpus were described with the help of metadata. Existing field data from researchers in the Language and Cognition Group is being processed as well.

In parallel an overview of existing metadata descriptions and formats was compiled. This overview covers a large number of existing standards from other fields (such as the TEI header format), of existing catalogues (such as the one from the Helsinki University corpus description), and header formats (such as the one from the Childes corpus). On the basis of this overview a preliminary draft for a general metadata standard (IMDI set) for language resources was extracted and distributed. This draft will be discussed in the upcoming months. All this work was carried out within the EAGLES/ISLE project. For the "Dokumentation bedrohter Sprachen" (Documentation of Endangered Languages, DOBES) archive project a core metadata set was defined as a subset of the IMDI set for which the editor and browser are being adapted.

The metadata concepts have been presented at several workshops and meetings. At a meeting on Open Archives for Endangered Languages in Philadelphia the LDC (Linguistic Data Consortium) presented the OLAC (Open Language Archive Centers) concept. It includes a slightly extended metadata set derived from the Dublin Core set, and adopts the metadata harvesting protocol proposed by the Open Archives Initiative. The IMDI concept includes, among other things, browsable metadata hierarchies and fine-grained metadata elements to assist linguists, anthropologists, speech engineers and others in locating certain resources more easily. The OLAC concept addresses a more general public not interested in too much detail. The TG will develop a mapping from the IMDI set to the extended Dublin Core set within the ISLE project so that parts of the fine-grained IMDI-based metadescriptions can be searched via OLAC/OAI interfaces.

It should be mentioned here that the metadata concept is now one of the pillars of corpus creation work within the Institute and the DOBES project. Media data recorded in the field will only be processed if they are provided with the corresponding metadescriptions. The Institute's corpus committee has discussed a workflow scheme, which should serve as a guideline for both field researchers and members of the TG.

Some enhancements were added to the existing MAC-based multimedia annotation and analysis tool, MediaTagger (MT). MT can now also work with MPEG1-encoded video data. Many tests were carried out to check which video and audio formats (mpg, mpv, mpa, aiff) offer optimally synchronized audio/video streaming and allow access to the audio waveform (for example for the calculation of pitch contours).

11.1.5 Computer-based video handling

Much time was invested in the installation and testing of professional audio and video digitization setups for efficient media processing and for creating media formats that can be processed by MT (Quicktime-based player) and EUDICO (JavaMediaFramework-based player). Currently, only MPEG1 can be decoded and played by state-of-the-art processors in PCs and notebooks. However, it is clear that the next generation CPUs will be fast enough to process MPEG2 in real time. Since it is known that MPEG1 resolution is less than SVHS quality, it can be expected that scientists will want to use MPEG2 as soon as possible. The changeover can be expected to take place within the next two years when the relevant media

players (Quicktime, JMF) are capable of supporting MPEG2. Therefore, in digitizing data we should create both MPEG1 and MPEG2 for the time being. All time linking must guarantee that MPEG 1-based annotations will work for MPEG2 media as well.

On average MPEG2 requires roughly double the capacity of MPEG1. Therefore, network and storage architecture must consider these changes as well. For the time being MPEG2 files will have to be stored on external tapes. However, for external users with connections of smaller capacity MPEG1 will remain a valuable option. Thus, for several years to come both media files must continue to be supported.

To allow for redundancy and the necessary throughput of video tapes, three video digitization setups have been installed using Optibase boards. Two setups produce MPEG1 streams and one MPEG2. Scripts have been developed allowing us to automatically segment the tape into separate video files when exact time boundaries are provided. This is possible for DV video, which has become the Institute standard for fieldworkers. With old formats such as Hi-8, the procedure is often inverse: First the whole tape must be digitized, then, with the help of cutting software, the file is split up into sessions - the units of analysis. For audio a special setup was installed, which allows one to directly copy the digital format from DAT recorders.

With respect to the formats we decided to create the normal "mpg" streams that also contain "mp3" compressed audio information. To make the audio information accessible for drawing waveforms and for applying the typical speech analysis operations such as LPC, the audio information is extracted immediately after digitization and converted into the "wav" format. Tests must still be carried out to indicate whether mp3 compression does not lead to undesirable effects when applying speech analysis algorithms.

Tests conducted during the past year indicated that NTSC tapes can be digitized in exactly the same way as PAL tapes and can be embedded in the workflow scheme mentioned above. Under the supervision of the TG, users are required to process their tapes and to make adequate metadescriptions of their data, enabling the responsible persons to then digitize and cut the material, integrate the metadescriptions into the linked hierarchy and store the media data in the appropriate place. It is hoped that this scheme will lead to better and more manageable corpus data.

11.1.6 Experimental facilities

In 2000 several new labs were set up: the Baby Lab, a second Eye-Tracking Lab using the second EyeLink system, and an Eye-Tracking Lab using the Remote EyeView system. With respect to the lab using the first EyeLink system, new analysis software was integrated allowing easier operation of static and dynamic objects. The Baby Lab was equipped with a very large screen capable of showing large-sized animated objects (132 cm/52").

The existing DOS-based NESU version was extended in order to smoothly connect the new NESU-Box2. Until recently, the existing NESU version had been extended through the installation of new drivers that could directly operate with the sound chips on notebooks. Thus, it was possible to use notebooks for experiments with online sound generation. However, since these sound chips frequently changed and since there was virtually no documentation and assistance available for developers, we ceased this type of adaptation. The new NESU version relies on Direct X Technologies and will support online sound generation on notebooks. The TG started developing a special graphic server to play video sequences and to show animations on notebooks. This server is constructed in such a manner that it can later be integrated into the new NESU environment.

Since the existing NESU version is mature and runs smoothly in our labs, most development time was dedicated to the new Windows2000-based version. The new *experiment builder* has already reached a very advanced stage and the graphics user interface will give the user wide flexibility. The design has been streamlined in such a way that only one file needs to be maintained instead of two, something which had always created problems. It contains the executable Smalltalk code to be integrated into the runtime environment and all information necessary to graphically present the experimental layout. The tests and developments made with the *experiment runner* have greatly progressed. By using DirectX components it is possible to present audio and visual stimuli within the specified timing accuracy. We expect the NESU version to be operational in the summer of 2001.

11.1.7 Electronics and audio/video facilities

As in previous years many field researchers were equipped for their field research and all equipment was serviced and tested before their departures to the field. For audio recordings we currently offer three

technologies: traditional cassette, DAT, and MiniDisk. The MiniDisk technology has many advantages but relies on compressed audio formats. It is not yet clear whether compression will introduce artefacts when standard speech-analysis algorithms are applied. The DAT technology creates problems in environments with high temperature and high humidity, therefore, traditional cassettes must still be used in some areas. For video recordings the TG offers DigitalVideo technology. This has many advantages and post processing is easily possible.

Guidelines on how to make high-quality video recordings in the field were compiled and discussed together with field researchers.

11.1.8 Other activities of the Technical Group

The TG continued to create high-quality 3D animations for experimental purposes. A special machine was set up not only to play the existing videos but to enable the production of video clips for experimental use as well. In general, AVI files, which can also be played on notebooks, are generated by this process.

For the analysis of infant word-segmentation skills a flexible script was developed. With the help of this script hypotheses of infants' speech segmentation strategies can be tested. The script operates on databases of transcriptions of infants' behavior and allows the user to combine various probability measures to operate on the database.

There was a considerable amount of graphic and artwork completed this past year to include the creation of web sites for projects, conferences and other events as well as the preparation of conference posters.

Again the TG gave considerable support to external researchers especially in the area of experiments and computer-based video analysis: for the F.C. Donders Centre for Cognitive Neuroimaging the planning of the data center facilities was carried out; Lund University was advised on the set up of various labs, on the design of network and data-center facilities, and on computer-based video handling.

The head of the TG remained a member of the Central Computer Committee of the Max Planck Society. In this function support was provided for several activities important for the society as a whole and advice was given to a number of other institutes within the MPG.

11.2   Honors/Awards

- Bastiaansen (Tiburg U.) and Schultze-Berndt (U. Nijmegen) received a cum laude doctorate.

- Van Berkum received a *Vernieuwingsimpuls-award* from the Netherlands Organisation for Scientific Research (NWO) and the Royal Dutch Academy of Sciences (KNAW) to establish a research group and ERP laboratory at the University of Amsterdam. He has also been appointed as a Research Fellow at the F.C. Donders Centre for Cognitive Neuroimaging.

- Broersma won the AVT/Anéla prize, which is annually awarded by an independent jury on behalf of the Dutch Linguistics Association (AVT). the Dutch Association of Applied Linguistics (Anéla) and the National Dutch Graduate School of Linguistics (LOT) to the best undergraduate thesis in linguistics at a Dutch university during the previous year.

- Cutler was elected to membership of the Royal Dutch Academy of Sciences (KNAW).

- Dahan received the New Investigator Award in Experimental Psychology: General 2000 of the American Psychological Association Division of Experimental Psychology.

- Hagoort and Van Turennout, in collaboration with 11 European research groups, received an award from the European Union in the context of the EU 5th Framework Programme.

- Indefrey received a Human Frontier Science Program Research Grant.

- Klein obtained a grant from the DFG for a "Digital Dictionary of the German Language", to be compiled at the Berlin-Brandenburgische Akademie der Wissenschaften in Berlin.

- Levelt was appointed member of the Bayerische Akademie der Wissenschaften, and foreign associate of the National Academy of Sciences (USA). The University of Maastricht awarded him an honorary doctorate.

- Meira won the Mary Haas award of SSILA.

- Seuren was elected President of "Societas Linguistica Europea".

- Van Turennout received a *Vernieuwingsimpuls-award* from the Netherlands Organisation for Scientific Research (NWO) and the Royal Dutch Academy of Sciences (KNAW) to establish a research group at the F.C. Donders Centre for Cognitive Neuroimaging at the University of Nijmegen.

- Vonk was appointed full professor in psycholinguistics in the Faculty of Arts at the University of Nijmegen.

11.3 Nijmegen Lectures

This year's Nijmegen Lectures were given by Terrence W. Deacon. The title of the series was "Beneath linguistics: Language as a complex coevolutionary phenomenon". The series included three morning lectures: "The neurodevelopmental mechanisms implicated in hominid brain evolution and their relevance to language adaptations", "The primacy of symbolic reference", and "Coevolutionary mechanisms: How language shaped human brain evolution". In the afternoons three seminars were given, with invited discussants: "Interpreting the hominid brain evolution record" (discussants: Aiello, U. College London, and Hurford, U. of Edinburgh), "The origins of syntactic regularities" (discussants: Geurts, U. Nijmegen, and Steels, Free U. Brussels), and "Language change as an evolutionary process: towards a science of cultural evolution" (discussants: Aunger, Cambridge U., and Klein, MPI Nijmegen). The lectures were organized in cooperation with the Interfaculty Research Unit for Language and Speech (IWTS) of the U. Nijmegen. The series was organized by Bohnemeyer, Van Turennout and Kolk (U. Nijmegen) with assistance from Jonas.

11.4 The F.C. Donders Lectures on Cognitive Neuroscience

This lecture series was organized by Hagoort, in collaboration with the Nijmegen Institute of Cognition and Information (NICI). Speakers in the 2000 series were: Logothetis (MPI for Biological Cybernetics, Tübingen), Güntürkün (Ruhr-U. Bochum), Marsel Mesulam (Northwestern U., Chicago), Arbib (UCLA), and Dolan (Wellcome Department of Cognitive Neurology, London).

11.5   Internal lectures

During 2000, nine speakers gave lectures in the Institute's Formal Colloquium series. The speakers were Corbett (U. Surrey), Karmiloff-Smith (Institute of Child Health, London), Jackendoff (Brandeis U.), Ochs (UCLA), Budwig (Clark U.), Zuberbühler (MPI for Evolutionary Anthropology, Leipzig), Hadar (Tel Aviv U.), Berman (Tel Aviv U.), and Plaut (Carnegie Mellon U.). These lectures were organized by P. Brown, Matsuo, Narashimhan, and Warner, the Institute's colloquium committee. Many informal lectures were also presented by long-term and occasional visitors to the Institute.

11.6   Teaching

Members of the Institute taught at the following institutions:

Berkum, van (U. of Geneva; Leiden U.)

Bohnemeyer (Summer school of the National Dutch Graduate School of Linguistics [LOT], Tilburg)

Bowerman (Summer school on New Theoretical Perspectives on Syntax and Semantics in Cognitive Science, Dubrovnik)

Brown C. (Winter school of the Dutch Graduate School of Linguistics [LOT], Leiden)

Gullberg (Summer school of the Behavioral and Cognitive Neurosciences, U. Groningen; U. Nijmegen)

Hagoort (U. Nijmegen)

Indefrey (U. Düsseldorf, Maastricht U., U. Nijmegen)

Kempen (Leiden U.)

- Klein (U. Heidelberg, HU Berlin)

Kita (Australian Linguistic Institute, Melbourne)

McQueen (Winter school of the Dutch Graduate School of Linguistics [LOT], Leiden; U. Padova)

- Schiller (Maastricht U.)

- Senft (U. Bielefeld; U. Köln)

Van Geenhoven (Summer school of the National Dutch Graduate School of Linguistics [LOT], Tilburg; U. Frankfurt)

Vonk (Summer school of the National Dutch Graduate School of Linguistics (LOT), Tilburg; U. Nijmegen)

Warner (U. of Minnesota)

11.7 Colloquia presented

The following members of the Institute presented colloquia at various institutions:

Berkum, van (U. of Amsterdam)

Bohnemeyer (Amsterdam Center for Language and Cognition)

- Brown, P. (Utrecht Institute of Linguistics, OTS; U. Utrecht)

Brugman (U. Enschede)

Broeder (U. Enschede)

- Cutler (UCLA; U. of Colorado; MRC CBU, Cambridge; U. Nijmegen; U. Marburg; MacArthur Auditory Research Centre, Sydney)

- Dahan(U. of York)

Gretsch (U. Mannheim; MPI for Evolutionary Anthropology, Leipzig)

Hagoort (Heinrich Heine U. Düsseldorf; CNRS, Paris)

Indefrey (U. Ulm; U. Marburg)

Irwin (Rutgers U.; U. of Chicago)

Kita (Japan Women's U. Tokyo; Keio U. Tokyo; U. of Rochester; U. of Chicago; Northwestern U.)

Levelt (Duke U., Durham)

Matsuo, (U. Groningen; Duke U., Durham, U. of Essex)

Meulen, van der (Graduierten Kolleg, Leipzig; U. of Exeter)

- Roelofs (U. of Glasgow, U. Bielefeld).

Schiller (U. de Bourgogne; U. of Birmingham)

Schmiedtová, (U. Nijmegen)

Senft (Keio U. Tokyo; Advanced Telecommunications Research Institute International Kyoto; Japan Women's U. Tokyo)

Turennout, van (National Institute on Deafness and other Communication Disorders, Bethesda, USA; Maastricht U.)

Warner (Arizona U.; UCLA; U. of Minnesota)

Van Geenhoven (U. of Amsterdam; U. Tübingen; Leiden U.; U. Frankfurt)

Vigliocco (Bristol U.; U. College London; MPI Nijmegen; U. de Louvain, Leiden U.)

Wittenburg (Lund U., U. Tübingen)

11.8   Workshops organized:

Bastiaansen, in collaboration with Pfurtscheller (TU Graz), organized a symposium at the 4th European Conference of the Federation of European Psychophysiology Societies, Amsterdam, 24 - 27 May. The title of the symposium was "Combining EEG and MEG in the study of the desynchronization of cortical rhythmic activity".

In collaboration with Brunia (U. Tilburg), Bastiaansen organized a symposium entitled "Thalamocortical relations", held at Tilburg U. on October 5th.

In collaboration with Lasser (U. Potsdam), Dimroth organized a workshop entitled "The Notion of Finiteness" at the Annual Conference of the "Deutsche Gesellschaft für Sprachwissenschaft" (DGfS), held in Marburg, March 1-3. Participants were Becker (Humboldt U. Berlin), Blom (U. Utrecht), R. Dietrich and Fries (Humboldt U. Berlin), Gretsch (MPI Nijmegen), Jordens (U. of Amsterdam). Lindner (U. München), Maas (U. Osnabrück), Perdue (U. Paris VIII), Schaner-Wolles (U. Wien), Tracy (U. Mannheim), and Ziegler (U. Fukushima, Japan).

Dunn ran a training course on computerized lexical database building for the members of Chukchi Dictionary Project, at the Laboratory for Subsistence Studies and Social-Ethnographic Research at the Chukotka Branch of the Far Eastern Division of the Russian Academy of Science in Anadyr.

Kempen, in collaboration with Olsthoorn (Leiden U.), organized the 6th International Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000), which took place in Leiden from 20-23 September.

Levinson organized a workshop on February 8th at the Institute under the title "Sahul" to discuss possible connections or typological parallels between Papuan and Australian languages in the context of prehistoric links between the continents. Participants included Evans (U. Melbourne), McGregor (MPI/Aarhus), Reesink (Leiden U.), Dol (Leiden U.), Terrill (MPI for Evolutionary Anthropology, Leipzig), and MPI staff.

On behalf of the Dynamics of Learner Varieties project Perdue (U. Paris VIII) and Dimroth organized the third of a series of four international conferences under the aegis of the European Science Foundation and the High-Level Scientific Conferences program of the European Commission. The conference was held in Sant Feliù de Guixols, Spain, 7-12 October, and was entitled "Information structure, linguistic structure and the dynamics of acquisition". The conference heard 32 plenary addresses, half presented by members of the project, half presented by outside scientists, and there was a poster session. Plenary speakers from the Institute were: Dimroth, Gretsch, Gullberg, Hagoort, and Starren.

McQueen and Cutler organized the Spoken Word Access Processes (SWAP) workshop, held in Nijmegen on 29-31 May. SWAP was financially supported by the MPG, and was an International Speech Communication Association (ISCA) Tutorial and Research Workshop. There were 23 oral and 22 poster presentations. Talks were given by the following invited speakers: Bard (U. of Edinburgh), Content (Free U. Brussels), Cutler (MPI Nijmegen), Fowler (Haskins Laboratories, New Haven), Frauenfelder (U. of Geneva), Gaskell (York U.), Goldinger (Arizona State U.), Kingston (U. of Massachusetts, Amherst), Luce (SUNY Buffalo), Marslen-Wilson (MRC Cognition and Brain Sciences Unit, Cambridge), Miller (Northeastern U.), Nearey (U. of Alberta), Nooteboom (U. Utrecht), Norris (MRC Cognition and Brain Sciences Unit, Cambridge), Pallier (LSCP, EHESS-CNRS, Paris), Pierrehumbert (Northwestern U.), Pitt (Ohio State U.), Samuel (SUNY Stony Brook), Shillcock (U. of Edinburgh), Tanenhaus (U. of Rochester), Vroomen (Tilburg U.), Whalen (Haskins Laboratories, New Haven), and Zwitserlood (U. Münster). Poster presentations were by submission; they were given by: Van Alphen (MPI Nijmegen), Amano (NTT Communication Science Laboratories, Atsugi), Bölte & Coenen (U. Münster), Boudelaa (MRC Cognition and Brain Sciences Unit, Cambridge), Van den Brink (MPI Nijmegen), Cooper (MPI Nijmegen), Dahan & Magnuson (MPI Nijmegen & U. of Rochester), Davis (MRC Cognition and Brain Sciences Unit, Cambridge), Dumay (Free U.

Brussels), Goswami (Institute of Child Health, London), Nguyen (U. de Aix-en-Provence), Kirk (U. of Massachusetts, Amherst), Van der Lugt (U. of Exeter), Mauth (MPI Nijmegen), McQueen (MPI Nijmegen), Meunier & Ford (MRC Cognition and Brain Sciences Unit, Cambridge), Reid (MRC Cognition and Brain Sciences Unit, Cambridge), Rodd (MRC Cognition and Brain Sciences Unit, Cambridge), Sereno & Quene (U. of Kansas, Lawrence & U. Utrecht), Smith (Cambridge U.), Tao (Ohio U., Athens), and Weber (MPI Nijmegen).

Van Geenhoven organized the workshop "Semantics Meets Acquisition", March 31 - April 2. The aim of the workshop was to bring together linguists who work in the field of formal semantics with language acquisition researchers. The participants were: Bergsma (MPI Nijmegen), Carlson (U. of Rochester), Crain (U. of Maryland, College Park), Dimroth (MPI Nijmegen), Drozd (U. of Aarhus), Gleitman (U. of Pennsylvania), Gretsch (MPI Nijmegen), Gualmini (U. of Maryland, College Park), Heinzel (MPI Nijmegen), Hollebrandse (U. Groningen), Hun-tak Lee (City U. of Hong Kong), Kamp (U. Stuttgart), Klein (MPI Nijmegen), Matsuo (MPI Nijmegen), Li Ping (U. of Richmond), Roeper (U. of Massachusetts, Amherst), Schwarzschild (Rutgers U.), Starren (Tilburg U.), Von Stechow (U. Tübingen), Van Geenhoven (MPI Nijmegen), and Swift (MPI Nijmegen).

Van Geenhoven together with Van der Sandt (U. Nijmegen) organized the Semantics Colloquium at the Philosophy Department of the University of Nijmegen (since Sept. 1998).

Vigliocco organized a workshop on the Meaning and Syntax of Words (MASOW), September 8th, held at the MPI Nijmegen. Contributors were Bock (U. of Illinois), Cutler (MPI Nijmegen), Garrett (U. of Arizona), Hagoort (MPI Nijmegen), Indefrey (MPI Nijmegen), Kita (MPI Nijmegen), Özyürek (Koç U.), Roelofs, (MPI. Nijmegen), Sanz (Georgetown U.) Tabossi (U. of Trieste), and Vigliocco (U. of Wisconsin).

Warner, together with Gussenhoven and Rietveld (U. Nijmegen), organized the 7th Conference on Laboratory Phonology, held at the University of Nijmegen from 29 June - 1 July. Invited speakers were Clements (CNRS, Paris), Demolin (Free U. Brussels), Keating (UCLA), Lahiri (U. Konstanz), and Ohala (U. California, Berkeley). Discussants were Boves (U. Nijmegen), Cutler (MPI Nijmegen), Hayes (UCLA), Levelt (MPI Nijmegen), Pierrehumbert (Northwestern U.), and Wetzeis (Free U.

Amsterdam). 14 additional talks and approximately 45 posters were presented.

Wittenburg, Roy (Odense U.), and Cunningham (U. of Sheffield) organized an international workshop on "Metadescriptions for Multimodal/ Multimedia Language resources", which was held in Athens on May 29th at the LREC Conference. For details see www.mpi.nl/ISLE.

Wittenburg, Roy (Odense U.), and Cunningham (U. of Sheffield) organized an international workshop on "Annotation Schemes for Multimodal/ Multimedia Language resources", which was held in Athens on May 30th at the LREC Conference. For details see www.mpi.nl/ISLE.

Wittenburg organized an international symposium on "Measurement Methodologies in Gesture and Sign Language", which was held during the Measurement Behavior 2000 Conference at the Institute on August 17th. For details see www.noldus.com/events/mb2000.

Wittenburg, Brugman, and Broeder organized a workshop about "Architectures for Linguistic Annotation and Exploitation Tools and Browsable Corpus Tools and Infrastructure", which was held in Kleve on September 6th.

Wittenburg and Brugman organized the first DOBES Workshop about "Documenting Endangered Languages", which was held at the Institute on September 15/16th . For details see www.mpi.nl/DOBES.

Wittenburg and Brugman organized a workshop on Lexical Architectures and Structures, which was held at the Institute on December 4th. Papers were presented by Behrens (U. Köln), Hinrichs (U. Tübingen), Peters (U. of Sheffield), Sasse (U. Köln), Schultze-Berndt (U. Bochum), and Wittenburg (MPI Nijmegen).

11.9 Presentations at conferences, congresses, and workshops:

Ameka, F. "From dying to intensifying: The grammar and semantics of Die in Ewe in crosslinguistic perspective" [invited talk]. Institute of African Studies. Leipzig, May.

Ameka, F. "When I die, don't cry: The ethnopragmatics and typology of strategies of gratitude expression in West African languages" [invited talk]. Institute of African Studies. Leipzig, May.

Ameka, F. "The grammaticalization of triadic mode of communication in West African languages: A study in ethno-syntax". 22nd West African Languages Congress. U. of Ghana. Legon, August.

Ameka, F., & Schultze-Berndt, E. "Adverbialiser or predicate(ion) marker? Ewe -i and its relatives in a typological perspective". 3rd World Congress of African Linguistics. U. du Benin. Lome, Togo, August.

Ameka, F. "Towards a typology of the grammaticization of triadic mode of communication in West African languages". International Symposium on Areal Typology of West African Languages at the Linguistics Department of the MPI for Evolutionary Anthropology and the Institute of African Studies. Leipzig, September.

Ameka, F. "Multiverb constructions in Kwa languages: A typological study" [invited talk]. Institute of Linguistics. Leipzig, October.

Bastiaansen, M.C.M. "Desynchronisatie in het MEG: Methodologische ontwikkelingen". Landelijke werkgroep neuronale bronkarakteri-sering. Utrecht, March.

Bastiaansen, M.C.M. "ERD as a tool for studing cognitive functions". CHRU Hospital. Lille, August.

Bastiaansen, M.C.M. "Anticipatory attention: An event-related desyn-chronization approach". Symposium on Thalamocortical Relations. Tilburg, October.

Bastiaansen, M.C.M. "Using ERD in cognitive paradigms: Methodological advances". Advanced Source Analysis User Meeting. Brussels, December.

Berkum, J.J.A. van, Hagoort, P., Brown, CM., & Zwitserlood, P. "Relating spoken sentences to prior discourse: Evidence from the N400". 7th Annual Meeting of the Cognitive Neuroscience Society (CNS-2000). San Francisco, April.

Berkum, J.J.A. van, Zwitserlood, P., Brown, CM., & Hagoort, P. "Processing gender and number agreement in parsing: An ERP-based comparison". 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000/ Leiden, September.

Bielamowicz, L, Turennout, M. van, & Martin, A. "Time-dependent modulation of the object-naming system: An event-related fMRI analysis of long-term repetition priming". 30th Annual Meeting Society for Neuroscience. New Orleans, November.

Bock, J. K. "The persistence of structural priming in language production". Colloquium presented to the Department of Psychology, U. of Chicago. Chicago, January.

Bock, J. K. "Collective agreement in British and American English". Workshop on Language and Thought, Department of Psychology, U. of Chicago. Chicago, January.

Bock, J. K. "When mind meets mouth". Beckman Institute Director's Seminar, Beckman Institute. U. of Illinois. Urbana, February.

Bock, J. K., & Griffin, Z. M. "What the eyes say about speaking". International Workshop on Processes of Conceptualization in Language Production: The Role of Perspectivization. U. Heidelberg. Heidelberg, February.

Bock, J. K. "The persistence of structural priming in language production" [plenary lecture]. 5th Annual Conference on Conceptual Structure, Discourse, and Language. Santa Barbara, California, May.

Bock, J. K. "Number meaning and number marking in English". Workshop on Meaning and Syntax of Words (MASOW). MPI for Psycholinguistics. Nijmegen, September.

Bock, J. K. "What the eyes say about speaking". Workshop on Perception and Production, U. Bielefeld. Bielefeld, December.

Bohnemeyer, J. "Inferring from what? The impact of the grammaticalization of aspectual operators on the derivation of temporal inferences in discourse". Workshop on Temporal Reasoning in Discourse: Linguistic Variation and Cognitive Structure. Lyon, February.

Bohnemeyer, J. "Constraints on motion event coding: Vectors or path shapes"? Workshop on Axes and Vectors in Language and Space. Lincoln, UK, July.

Böttner, M. "Multigrade extension of relational grammar". Conference on Relational Methods in Computer Science (RelMiCS 5). Quebec, January.

Bowerman, M. "Session on Early Production" [discussant]. Workshop on Building Linguistic Structure in Ontogeny. MPI for Evolutionary Anthropology. Leipzig, May.

Bowers, J.S., Havelka, J., & Damian, M.F. "Facilitatory and inhibitory long-term form priming". 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Breugel, C. van, & Kempen, G. "SPREEKBUIS: Automatische taal- en spraakgeneratie in het Nederlands". Computer demonstration during the National Dutch ICT Congress. The Hague, June.

Brink, D. van den, Brown, C.M., & Hagoort, P. "Electrophysiological evidence for early contextual influences during spoken word recognition: The N200". 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Brockmole, J.R., Wang, R.F., & Irwin, D.E. "Temporal integration between visual memory and perception". 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Brown, C M, "The interaction of prosodic, syntactic, and semantic information during spoken sentence understanding: An electrophysiological investigation". 13th Annual CUNY Sentence Processing Conference. La Jolla, San Diego, March.

Brown, C M. "Mapping sound onto meaning: Electrophysiological activity during spoken language understanding". Satellite Symposium on the Cognitive and Cortical Organization of Concepts at the 7th Annual Meeting of the Cognitive Neuroscience Society (CNS-2000). San Francisco, April.

Brown, C M. "Brain-imaging studies of language comprehension and production: A focus on Broca's region." Conference on Mirror Neurons and the Evolution of Brain and Language. Hanse Institute for Advanced Studies. Delmenhorst, July.

Brown, P. "Semantics and child language acquisition in Tenejapan Tzeltal". College de France Symposium on Categorizations, Classifications, Nomenclatures. Un debat autour de l'oeuvre de Brent Berlin. Paris, March.

Brown, P. "The concept of culture in cognitive science: Universals and particulars revisited". Wenner-Gren Conference on Culture and the Cultural: New Tasks for an Old Concept? Morelia, Mexico, September.

Brugman, H., & Wittenburg, P. "MPI tools and software architectures". Talkbank Technical Workshop. Pittsburgh, October.

Brugman, H., Wittenburg, P., & Breeder, D. "COREX - Corpus Exploitation Software for the Dutch Spoken Corpus". CNG Workshop/ Studiedag, RUB. Tilburg, December.

Budwig, N., & Narasimhan, B. "Transitive and Intransitive Constructions in Hindi Child-Caregiver Discourse." 5th Annual Conference on Conceptual Structure, Discourse, and Language. Santa Barbara, California, May.

Choi, S., McDonough, L, Mandler, J., & Bowerman, M. "Development of language-specific categorization of spatial relations from the prelinguistic period to the one-word stage". Workshop on Finding the Words. Stanford, April.

Clahsen, H., Eisenbeiß, S., Hadler, M., & Sonnenstuhl, I. "How regular affixes are represented in the mental lexicon: A study of German adjective inflection." 2nd International Conference on the Mental Lexicon. Montreal, October.

Cutler, A., Norris, D.G., & McQueen, J.M. "Tracking TRACE'S troubles", [poster]. 5th Australasian Cognitive Science Conference. Melbourne, February.

Cutler, A., Norris, D.G., McQueen, J.M., & Butterfield, S. "Cross-modal associative priming which disappears in sentence context" [poster]. 13th Annual CUNY Conference on Human Sentence Processing. La Jolla, San Diego, March.

Cutler, A. Recognizing words in continuous speech. NWO/NSC Joint Workshop on Cognitive Science. Arnhem, April.

Cutler, A. Introduction: Phonological processing. 7th Conference on Laboratory Phonology (LabPhon7). Nijmegen, June - July.

Cutler, A. "Activation of lexical candidates". Workshop on the Nature of Speech Perception: The Psychophysics of Speech Perception III. Utrecht, July.

Cutler, A., & McQueen, J.M. "Cross-modal associative priming in isolation, in word context and in sentence context". Workshop on Meaning and Syntax of Words (MASOW). MPI for Psycholinguistics. Nijmegen, September.

Cutler, A. "Prosody in sentence comprehension"[plenary lecture]. 6th Conference on Architecture and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Dahan, D., Tanenhaus, M.K., & Chambers, CG. "Interaction of thematic role and accent in the interpretation of referential noun phrases". 6th Conference on Architecture and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Dahan, D., Magnuson, J.S., Tanenhaus, M.K., & Hogan, E.M. "Tracking the time course of subcategorical mismatches on lexical access". 41th Annual Meeting of the Psychonomics Society. New Orleans, November.

Damian, M.F. "Kongruenzeffekte unbewußt verarbeiteter Wörter: Semantische Kategorisierung oder automatische S-R-Assoziation?" 42. Tagung experimentell arbeitenden Psychologen (TeaP). Braunschweig, April.

Damian, M.F., Vigliocco, G., & Levelt, W.J.M. "Effects of semantic context in the naming of words" [poster]. 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Dimroth, C. "The untutored acquisition of scope items in German as a second language". 10th Annual Conference of the European Second Language Association. Krakow, September.

Dimroth, C. "Topic and focus particles". EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliü de Guixols, Spain, October.

Dimroth, C. "Additive particles and contrastive topics". International Conference on Particles. Brussels, December.

Dobel, C. "Event-related potentials as a method to investigate restitutional and substitutional processes in aphasia" [invited talk]. Stanford Medical School and VA. Palo Alto, CA, April.

Dobel, C, Pulvermüller, F., Härle, M., Cohen, R., Köbbel, P., Schönle, P.W., & Rockstroh, B. "Syntactic and semantic processing in the healthy and aphasic human brain". 7th Annual Meeting of the Cognitive Neuroscience Society (CNS-2000). San Francisco, April.

Dobel, C. "Eye movements during syntactic priming". Workshop on Eye Movements and Language. Birmingham, September.

Duffield, N., & Matsuo, A. "Converging methodologies, diverging results: What first and second languages learners (don't) know about VP-Ellipsis". 1st International Conference on Psycholinguistics. Keio U. Tokyo, March.

Duffield, N., & Matsuo, A. "Divergent outcomes in L2 acquisition of Ellipsis and Anaphora". Second Language Research Forum. U. of Wisconsin, Madison, September.

Dunn, M. "The word in Chukchi". Workshop on the Status of "Word": Its Phonological, Grammatical, Cultural and Cognitive Basis. La Trobe U. Melbourne, August.

Gretsch, P. "Funktionen früher Finitheitsmarkierung im Erstspracherwerb". 22. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft (DGfS). Marburg, March.

Gretsch, P. "On the similarities of L1 and L2 acquisition: How German children anchor utterances in time". EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliü de Guixols, Spain, October.

Guirardello, R. "Case system and grammatical relations in Trumai, an isolate Brazilian language". Friday Lectures (Vrijdagmiddag-lezingen). Leiden, March.

Gullberg, M. "Gestural anaphoric linkage in learner varieties". EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliü de Guixols, Spain, October.

Hagoort, P. "Bewustzijn in de randen van het onbewuste". 2nd Barendregt Lecture on Consciousness. Nijmegen, February.

Hagoort, P. "The uniquely human capacity for language communication". Symposium Sony Computer Science Laboratory on the ecological brain. Paris, April.

Hagoort, P. "What the human brain can tell us about language". Auftaktkongress: Das Jahrzehnt des menschlichen Gehirns. Bonn, April.

Hagoort, P. "How the brain solves the binding problem for language". NWO/NSC Joint Workshop on Cognitive Science. Arnhem, April.

Hagoort, P. "De toekomstige eeuw der cognitieve neurowetenschap". Rede uitgesproken bij de aanvaarding van het ambt van hoogleraar in de Neuropsychologie aan de Faculteit der Sociale Wetenschappen van de Katholieke Universiteit Nijmegen. Nijmegen, May.

Hagoort, P. "Electrocortical reflection on the binding problem for language". 4th European Conference of the Federation of European Psychophysiology Societies. Amsterdam, May.

Hagoort, P. "De Psychologie verdwijnt". Symposium van de Nederlandse Vereniging voor Wetenschapsfilosofie. Biologisering van de Psychologie en sociologie: Zegen of vloek? Utrecht, May.

Hagoort, P. "Language session"[chair]. 6th Annual Meeting of the Organization for Human Brain Mapping. San Antonio, Texas, June.

Hagoort, P. "Order out of chaos: An explicit account of ERP effects on the interface of lexicon, grammar and semantics". McDonnell-Pew Program in Cognitive Neuroscience Annual Meeting. Durham, North Carolina, June.

Hagoort, P. "The neurocognition of syntax". Workshop on the Nature of Speech Perception: The Psychophysics of Speech Perception III. Utrecht, July.

Hagoort, P. "Measuring what makes behavior possible". Measuring Behavior 2000. 3rd International Conference on Methods and Techniques in Behavioral Research. Nijmegen, August.

Hagoort, P. "Gagarin in de neurale kosmos: Taal, brein en bewustzijn". Lustrumconference Nederlandse Vereniging voor Audiologie.' Zutphen, October.

Hagoort, P. "Recente inzichten m.b.t. relatie taal en hersenen". Lustrum-symposium Nederlandse Vereniging voor Stem-, Spraak- en Taalpathologie. Utrecht, October.

Hagoort, P. "The structure of learner language". EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliti de Guixols, Spain, October.

Harbusch, K., & Kempen, G. "Complexity of linear order computation in Performance Grammar, TAG and HPSG". 5th International Workshop on Tree Adjoining Grammars and Related Formalisms (TAG+5). Paris, May.

Hauk, O., Eulitz, C, Dobel, C, & Rockstroh, B. "MEG correlates of grapheme monitoring in picture names". 12th International Conference on Biomagnetism (Biomag 2000). Helsinki, August.

Indefrey, P. "Neural correlates of regular and irregular inflection". 9th International Morphology Meeting. Vienna, February.

Indefrey, P., & Levelt, W.J.M. "Die Hirnaktivität bei der Produktion von Wörtern". 22. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft (DGfS). Marburg, March.

Indefey, P. "The neural architecture of speech production". 4th Dutch Endo-Neuro Meeting. Doorwerth, June.

Indefrey, P., Brown, CM., Hellwig, F., Herzog, H., Seitz, R.J., & Hagoort, P. "Two ways to meaning - a combined PET/ERP study". 6th International Conference on Functional Mapping of the Human Brain. San Antonio, Texas, June.

Indefrey, P., Hellwig, F., Posse, S., & Goebel, R. "Task- and stimulus-dependent differential activation during verbal and visuo-spatial short term memory". 6th International Conference on Functional Mapping of the Human Brain. San Antonio, Texas, June.

Indefrey, P. "The neural architecture of word production". Workshop on the Nature of Speech Perception: The Psychophysics of Speech Perception III. Utrecht, July.

Indefrey, P. "Two ways to meaning: A combined PET/ERP study". Workshop on Meaning and Syntax of Words (MASOW). MPI for Psycholinguistics. Nijmegen, September.

Indefrey, P. "Controversial issues in written word processing investigated with fMRI". Tweede landelijke fMRI dag Nederland. Amsterdam, October.

Indefrey, P. "The neurocognition of syntactic processing". Symposium Brain and Cognition. Nijmegen, October.

Irwin, D. E. "Attention and eye movements". Workshop on Eye Movements and Language. Birmingham, September.

Irwin, D. E. "Cognitive processing during saccadic eye movements". 1st Scientific Meeting on Perception and Action. Birmingham, October.

Jerger, S., Martin, R.C., & Damian, M.F. "Time course of semantic and phonological stages in picture naming for children and adults". 41th Annual Meeting of the Psychonomic Society. New Orleans, November.

Johnson, E.K., Jusczyk, P.W., Cutler, A., & Norris, D.G. "The development of word recognition: The use of the possible-word constraint by 12-month-olds". 22nd Annual Conference of the Cognitive Science Society (CogSci 2000). Philadelphia, August.

Johnson, E.K., Jusczyk, P.W., Cutler, A., & Norris, D.G. "12-month-olds show evidence of a possible-word constraint". 140th Meeting of the Acoustical Society of America. Newport Beach, CA, November.

Kempen, G. "Lezen: een topprestatie van ons brein". Flemish-Dutch symposium on Reading. Gent, March.

Kempen, G. "Automatische Taal- en Spraakgeneratie in het Nederlands". ToKeN2000 Workshop. Maastricht, June.

Kempen, G. "Human grammatical coding". DFG Workshop on Schwerpunkt Sprachproduktion. Schloss Dagstuhl, Germany, September.

Kempen, G. "Performance Grammar: Decomposing the complexity of grammar". Workshop on Language Evolution (BeNe-Evolang 2000). Brussels, November.

Kita, S., & Essegbey, J. "The effect of the Ghanaian left-hand taboo on pointing gestures". Conference on Gesture: Meaning and Use. Porto, April.

Kita. S. "Japanese ideology of conversation and its structural manifestations: A study of aiduchi and head nods". Workshop on Ethno-pragmatics. Melbourne, July.

Kita, S., & Özyürek, A. "Semantic coordination between speech and gesture crosslinguistically: Evidence for the 'interface represen-tation' of spatial thinking and speaking". Workshop on Meaning and Syntax of Words (MASOW). MPI for Psycholinguistics. Nijmegen, September.

Klein, W. "Das Ende vor Augen: Deutsch als Wissenschaftssprache". Internationales Symposion. Akademie der Wissenschaften und der Literatur. Mainz, January.

Klein, W. "On finiteness". Semantics Meets Acquisition Workshop. MPI for Psycholinguistics. Nijmegen, March.

Klein, W. "Inflectional morphology and second language acquisition". EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliü de Guixols, Spain, October.

Lauer, M., Vigliocco, G., & Damian, M.F. "Semantic and syntactic effects in producing phrases". 13th Annual CUNY Sentence Processing Conference. La Jolla, San Diego, March.

Levelt, W.J.M. "The brain's production of spoken words - A metaanalysis". 10th Biennial Winter Workshop on Schizophrenia. Davos, February.

Levelt, W.J.M. "Introduction and discussion to on session encoding". 7th Conference on Laboratory Phonology (LabPhon7). Nijmegen, June - July.

Levelt, W.J.M. "Met twee woorden spreken". Simon Dik Lezing 2000. Amsterdam, September.

Levelt, W.J.M., Irwin, D.E., & Elswijk, G. van "Producing three-digit number names in Dutch". Workshop on Eye Movements and Language. Birmingham, September.

Levelt, W.J.M. "The speaker's selection and preparation of words for articulation". ASHA 2000 Annual Convention. Washington, November.

Levelt, W.J.M. "On the architecture of spoken word production". ASHA 2000 Annual Convention. Washington, November.

Levelt, W.J.M. "Speaking: Accessing and preparing words for articulation". Studium Generale. Leiden, November.

Levelt, W.J.M. "Over de genese van woorden". Dertig jaar Kinderneurologie. Retirement Symposium for Prof. dr. F.J.M. Gabreels. Nijmegen, December.

Levinson, S.C. "Color and culture". Symposium at the College de France. Paris, March.

Mak, W.M., Vonk, W., & Schriefers, H. "Stuurt semantische en pragmatische informatie de syntactische analyse"? 23. Minisymposium Lezen. Nijmegen, April.

Matsuo, A. "The acquisition of a complement tense in SOT and non-SOT languages". Semantics Meets Acquisition Workshop. MPI for Psycholinguistics. Nijmegen, April.

Matsuo, A., & Feest, S. van der "What Dutch children know about telicity and tense". 25th Boston University Conference on Language Development. Boston, November.

Matsuo, A. "ACDs revisited: An alternative classification as an Asp-P deletion" [invited talk]. Semantics Colloquium. U. Nijmegen, November.

Mauth, K. "Morphological influences on phonetic categorization" [poster]. 22nd Annual Conference of the Cognitive Science Society (CogSci 2000). Philadelphia, August.

McQueen, J.M. "The architecture of the spoken word recognition system: Evidence from phonetic decision-making". Workshop on the Nature of Speech Perception: The Psychophysics of Speech Perception III. Utrecht, July.

McQueen, J.M. "Constraints on the recognition of words in continuous speech". 27th International Congress of Psychology. Stockholm, July.

McQueen, J.M., Otake, T., & Cutler, A. "The mora in Japanese: More a segmentation unit than a lexical access unit" [poster]. 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Meira, S. "Comparing the exophoric use of Demonstratives: Tiriyö (Cariban) and spoken Brazilian Portuguese (Romance). 23. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft (DGfS). Leipzig, February.

Meira, S. "The Demonstrative System of Tiriyö, and other Cariban languages". 50fh International Congress of Americanists. Warsaw, July.

Meira, S. "Constituintes em Tiriyö (Karib). Conferencia a Estrutura das Linguas Brasileiras. Petröpolis, Brazil, March.

Meulen, F., van der "Cognitive processes in the production of nouns and pronouns". 22. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft (DGfS). Marburg, March.

Meulen, F., van der "Eye movements and sentence production". 42. Tagung experimentell arbeitenden Psychologen. Braunschweig, April.

Meulen, F., van der "Coordination of eye gaze and speech in sentence production". 41th Annual Meeting of the Psychonomic Society. New Orleans, November.

Narasimhan, B. "Event encoding in Hindi and English". Symposium on Language, Culture, and Cognition. New Delhi, India, November.

Nederstigt, U. "Additive particles and scope marking via intonation in spoken child German". Semantics Meets Acquisition Workshop. MPI for Psycholinguistics. Nijmegen, April.

Nederstigt, U. "The acquisition of focus particles in German". Alternate, 25th Annual Boston U. Conference on Language Development. Boston, November.

Nederstigt, U. "Additive particles - Intonation and scope marking in spoken German". International Conference on Particles. Brussels, December.

Niedeggen-Bartke, S., Eisenbeiß, S., & Clahsen, H. "Case and agreement in SLI". 1st Tokyo Conference on Psycholinguistics. Tokyo, March.

Noordman, L.G.M., Blijzer, F. de, & Vonk, W. "On the processing of different kinds of causal relations" [poster]. 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Olsthoorn, N.M., & Kempen G. "Syntactic priming can be negative" [poster]. 13th CUNY Conference on Human Sentence Processing. La Jolla, San Diego, March.

Onishi, K.H., Murphy, G.L., & Bock, J.K. "Effects of typicality on word order in sentence production". Meeting of the Midwestern Psychological Association. Chicago, May.

Özyürek A., & Kita, S. "Attention manipulation in the situational use of Japanese and Turkish demonstratives". Annual Meeting of the Linguistic Society of America. Chicago, January.

Peterson, M.S., McCarley, J.S., Kramer, A.F., Irwin, D.E., & Wang, R.F. "Visual search has memory". 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Pringle, H.L., Kramer, A.F., & Irwin, D.E. "The roles of scene characteristics, memory, and attentional breadth on scene representation". 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Rockstroh, B., Dobel, C, Cohen, R., Köbbel, P., & Schönle, P.W. "Electrocortical reflections of language processing in aphasics and controls". 4th European Conference of the Federation of European Psychophysiology Societies. Amsterdam, May.

Roelofs, A. "Control of language: A computational account of the Stroop asymmetry". 3rd International Conference on Cognitive Modelling. Groningen, March.

Roelofs, A. "Control of spoken word production". NWO/NSC Joint Workshop on Cognitive Science. Arnhem, April.

Roelofs, A. "Meaning, syntax, and form in producing spoken numerals". Workshop on Meaning and Syntax of Words (MASOW). MPI for Psycholinguistics. Nijmegen, September.

Roelofs, A. "Intentional control of language use". 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Roelofs, A. "Intentional control of perception and action in language use". Munich Encounters in Cognition and Action (MECA), MPI for Psychological Research. Munich, December.

Rüssel, A., Brugman, H., Broeder, D., & Wittenburg, P. "EUDICO: An annotation and exploitation tool for multimedia corpora". International Measurement Behavior 2000 Conference. Nijmegen, August.

Schiller, N.O., & Caramazza, A. "Gender or determiner selection interference? Evidence from noun phrase production in German and Dutch". III Congreso de la Sociedad Espanola de Psicologia Experimental (SEPEX). Barcelona, March.

Schiller, N.O., & Caramazza, A. "Der Gender-Kongruenz-Effekt bei der Sprachproduktion: Evidenz aus dem Deutschen und Niederländischen". 42. Tagung experimentell arbeitender Psychologen (TeaP). Braunschweig, April.

Schiller, N.O., Costa, A., & Colome, A. "Phonological encoding: In search of the lost syllable". 7th Conference on Laboratory Phonology (LabPhon7). Nijmegen, June - July.

Schiller, N.O., & Caramazza, A. "The 'gender congruency effect' revisited: New evidence from German and Dutch". 27th International Congress of Psychology. Stockholm, July.

Schiller, N.O., & Caramazza, A. "The processing of gender information in language production". 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Schiller, N.O., & Caramazza, A. "The gender interference effect revisited: Evidence from noun phrase production in German and Dutch". 2nd International Conference on the Mental Lexicon. Montreal, October.

Schiller, N.O. "Die Verarbeitung von Genusinformation in der Sprachproduktion" [invited talk]. DFG-Workshop on Verarbeitung von syntaktischem Genus in der Sprachproduktion. Leipzig, December.

Schmiedtovä, B., & Schmiedtova, V. "The color spectrum in language: The case of Czech. Their cognitive concepts, new idioms and lexical meanings". 10th International Symposium on Lexicography. Copenhagen, May.

Schmiedtova, B. "Temporatlity in untutored adult second language-acquisiton: The case of simultaneity" [poster]. Tutorials in Behavioral and Brain Sciences (TuBBS 2000). Woerlitz, Germany, August.

Schmiedtovä, B. "Second language acquisition of temporality: The case of simultaneity" [poster]. EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliü de Guixols, Spain, October.

Senft, G. "What do we really know about nominal classification systems"? [invited talk]. Sponsored by the Japan Foundation's Foreign Researcher Exchange Programme. 18th National Conference of the English Linguistic Society of Japan, Konan U. Kobe, November.

Senghas, A., Ozyürek, A., & Kita, S. "Encoding motion event in an emerging sign language: From Nicaraguan gestures to Nicaraguan signs". Conference on Theoretical Issues in Sign Language Studies. Amsterdam, July.

Seyfeddinipur, M. "Gestures and speech dysfluencies". Conference on Gesture: Meaning and Use. Porto, April.

Seyfeddinipur, M., & Kita, S. "Monitoring and self-interruption in speech" [poster]. 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Sharp, D.J., Scott, S.K., Cutler, A., & Wise, R.J.S. "A functional imaging study of vowels and consonants". British Psychological Society. Colchester, September.

Smits, R., Sereno, J., & Jongman, A. "Learning to categorize sounds". Workshop on the Nature of Speech Perception: The Psychophysics of Speech Perception III. Utrecht, July.

Smits, R., Sereno, J., & Jongman, A. "Categorization of sounds". 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Sonnenstuhl, I., Hadler, M., Eisenbeiß, S., & Clahsen, H. "Morphological paradigms in the mental lexicon". 9th International Morphology Meeting. Vienna, February.

Spinelli, E., McQueen, J.M., & Cutler, A. "Lexical and acoustical factors in the resolution of liaison in French" [poster]. 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Sprenger, S.A., Levelt, W.J.M., & Kempen, G. "The production of fixed expressions: Idiom representation and access". 13th Annual CUNY Sentence Processing Conference. La Jolla, San Diegeo. USA, March.

Sprenger, S.A., Levelt, W.J.M., & Kempen, G. "Produktion idiomatischer Ausdrücke: Idiom-Repräsentation und lexikaler Zugriff". 42. Tagung experimentell arbeitender Psychologen (TeaP). Braunschweig, April.

Starren, M. "A crosslinguistic study on the acquisition of temporality in L2 Dutch and L2 French". Semantics Meets Acquisition Workshop. MPI for Psycholinguistics. Nijmegen, March.

Starren, M. "Anaphoric time-linkage in Dutch and French L2". EURESCO Conference on dynamique des lectes d'apprenants. Sant Feliü de Guixols, Spain, October.

Swingley, D. "Two kinds of robustness in early word recognition". Workshop Development and Interaction of Linguistic and Non-Linguistic Cognition in Infants. Berlin, February.

Swingley, D. "Do good neighbors make good fences"? Workshop on Finding the Words. Stanford, April.

Swingley, D. "Lexical representation in children's second year". Workshop pn Speech Perception Development in Early Infancy: Behavioral, Neural-Modeling and Brain-Imaging Data. Barcelona, July.

Swingley, D. "Mecanismes de reconnaissance des mots paries chez les
        tres jeunes enfants". 3emes Joumees de l'Ecole d'Orthophonie
        de Lyon: Acceder aux Langages. Lyon, November.

Swingley, D. "On the origins of infants' lexical parsing preferences". 25th
        Annual Boston University Conference on Language Development.
        Boston, November.

Tanenhaus, M.K., Dahan, D., & Chambers, C. "Use of accent during
        reference resolution in spoken-language comprehension". 13th
        Annual CUNY Sentence Processing Conference. La Jolla, San
        Diego, March.

Tanenhaus, M.K., Dahan, D., Magnuson, J.S., & Hogan, E.M. "Tracking
        the time course of subcategorical mismatches on lexical access".
        13th Annual CUNY Sentence Processing Conference. La Jolla,
        San Diego, March.

Turennout, M. van "Event-related fMRI studies on long-term repetition
        priming." Center for Cognitive Neuroscience. Duke U. Durham,
        March.

Turennout, M. van., & Martin, A. "Varieties of object repetition-related
        effects in the brain". INS 2000 Symposium Meeting. Thun,
        Switzerland, June.

Turennout, M. van., & Martin, A. "Long-lasting changes in cortical
        representations following object naming: An event-related fMRI
        study". 4th Dutch Endo-Neuro Meeting 2000. Doorwerth, June.

Turennout, M. van "Naming an object once produces long-lasting changes
        in neural activity". Symposium on Brain and Cognition. Nijmegen,
        October.

Turennout, M. van "Taal in de hersenen: Functioneel MRI onderzoek naar
        neurale activiteit tijdens spreken". Hogeschool Nijmegen,
        October.

Van Geenhoven, V. "Bare plurals, bare singulars and (inherent) narrow
        scope". International Conference on NP Syntax and Semantics.
        Antwerpen, February.

Van Geenhoven, V. "On (early) VP interpretation: The case of for-adver-bials". Semantics Meets Acquisition Workshop. MPI Nijmegen, April.

Van Geenhoven, V. "Pro properties, contra generalized kinds". 10th Conference on Semantics and Linguistics Theory. Ithaca, June.

Vigliocco, G., Collina, S., New, B., & Franck, J. "The interplay of sex and syntax in sentence production". 13th Annual CUNY Sentence Processing Conference. La Jolla, San Diego, March.

Vigliocco, G., Lauer, M., Damian, M.F., & Levelt, W.J.M. "Interface between lexico-semantic and lexico-syntactic information: Insights from production RT experiments in Dutch and German". 6th Conference on Architectures and Mechanisms of Language Processing (AMLaP-2000). Leiden, September.

Vigliocco, G., Vinson, D.P., Indefrey, P., & Levelt, W.J.M. "The interplay between meaning and syntax in speech errors: Evidence from meaning-related substitution errors". 41st Annual Meeting of the Psychonomic Society. New Orleans, November.

Vinson, D.P., Vigliocco, G., Indefrey, P., & Levelt, W.J.M. "Syntactic constraints on semantically related word substitution errors: A study in German". 13th Annual CUNY Sentence Processing Conference. La Jolla, San Diego, March.

Vonk, W., Mak, W.M., & Hoeks, J.C.J. "Information structure in the processing of sentences in text". 10th Annual Meeting of the Society for Text and Discourse. Lyon, July.

Vonk, W., & Noordman, L.G.M. "Inference processes as a component of the comprehension process". 27th International Congress of Psychology. Stockholm, July.

Warner, N., Jongman, A., Cutler, A., & Mücke, D. "The phonological status of Dutch epenthetic schwa: A challenge to articulatory phonology" [poster]. 7th Conference on Laboratory Phonology. Nijmegen, June

Warner, N. "Fast and slow acoustic changes and their usefulness in auditory processing". Workshop on the Nature of Speech Perception: The Psychophysics of Speech Perception III. Utrecht, July.

Wassenaar, M., Hagoort, P., & Brown, CM. "Syntactische ERP-effecten bij afasiepatienten". Stichting Afasie Nederland - Wetenschaps- dag. Amsterdam, March.

Weber, A. Sequential constraints in non-native listening, or why Germans recognize "John Lennon" easier than "Rush Limbaugh" [poster]. CUNY Science Day 2000. New York, USA.

Weber, A. Phonotactic constraints in native and non-native listening, [poster]. Tutorials in Behavioral and Brain Sciences (TuBBS 2000). Woerlitz, Germany, August.

Weisberg, J., Turennout, M. van, & Martin, A. "Effects of object form and task demands on repetition priming: An event-related fMRI study". 7th Annual Meeting of the Cognitive Neuroscience Society (CNS-2000). San Francisco, April.

Wittenburg, P. "Metadescription standard for multimedia LR". Dublin-Core Usage Workshop. Luxembourg, May.

Wittenburg, P. "Multimodality and crosslingual knowledge management". EC Expert Meeting on Emerging Issues in Crosslingual Knowledge Management. Brussels, June.

Wittenburg, P., Brugman, H., Broeder, D., & Rüssel, A. "Infrastructure to support gesture research". International Measurement Behavior 2000 Conference. Nijmegen, August.

Wittenburg, P. "Future mobile computing in scientific environments". EC Expert Meeting on Next-generation Mobile-Business Applications - Advanced Issues for R&D and Piloting. Brussels, November.

PUBLICATIONS

Angrilli, A., Dobel, C, Rockstroh, B., Stegagno, L., & Elbert, T. (2000). EEG brain mapping of phonological and semantic tasks in Italian and German languages. *Clinical Neurophysiology,* 111, 706-716.

Alibali, M.W., Kita, S., & Young, A.J. (2000). Gesture and the process of speech production: We think, therefore we gesture. *Language and Cognitive Processes,* 15, 593-613.

Alphen, P. van (2000). Does subcategorical variation influence lexical access? In A. Cutler, J. McQueen, & R. Zondervan (Eds.), *Proceedings of SWAP: Workshop on Spoken Word Access Processes* (pp. 55-58). Nijmegen: MPI for Psycholinguistics.

Baayen, R.H., & Schreuder R. (2000). Towards a psycholinguistic computational model for morphological parsing. *Philosophical Transactions of the Royal Society* [Series A: Mathematical, Physical and Engineering Sciences], 358, 1-13.

Baayen, R.H., Schreuder, R., & Sproat, R. (2000). Morphology in the mental lexicon: A computational model for visual word recognition. In F. van Eynde & D. Gibbon (Eds.), *Lexicon Development for Speech and Language Processing* (pp. 267-291). Dordrecht: Kluwer.

Bastiaansen, M.C.M., & Knösche, T.R. (2000). MEG tangential derivative mapping applied to Event-Related Desynchronization (ERD) research. *Clinical Neurophysiology,* 111, 1300-1305.

Barnett, R., Coda E., Eppler E., Forcadell M., Gardner-Chloros P., Hout, R. van, Moyer M.,Torras, M.,Turell, M., Sebba, M., Starren, M., & Wensing, S. (2000). The LIDES Coding Manual - A document for preparing and analyzing language interaction data. *International Journal of Bilingualism,* 4, 131-200.

Berkum, J.J.A. van, Hagoort, P., & Brown, CM. (2000). The use of referential context and grammatical gender in parsing: A reply to Brysbaert and Mitchell (2000). *Journal of Psycholinguistic Research,* 29, 467-481.

Bertram, R., Schreuder, R., & Baayen, R.H. (2000). The balance of storage and computation in morphological processing: The role of word formation type, affixal homonymy, and productivity. *Journal of Experimental Psychology: Memory, Learning, and Cognition,* 26,419-511.

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