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Max-Planck-Institut für Psycholinguistik

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## Preface

Undoubtedly the most notable event of 2001 in the life of the MPI for Psycholinguistics was the first visit, in October, of our new Fachbeirat. Visitors during those days saw the Institute walls bedecked with research posters, and demonstrations and other displays running apace. We were delighted that the Fachbeirat had high praise for our research achievements, and in particular that they commended the excellence of the Ph.D. students and the outstanding service achievements of the Technical Group.

The occasion of the Fachbeirat visit motivated a review of the Institute's projects; regular readers will already have noticed new project names in the table of contents, in some cases replacing projects that have been listed since the project structure was first incorporated in the Annual Report, in 1994. The changes reflect reorganization as a result of new lines of research developing, and new staff joining the Institute.

On the next page readers will also see that for the first time the Institute now has two External Scientific Members. Professor Pieter Muysken, since February 2001 professor of general linguistics at the University of Nijmegen, was appointed External Scientific Member of the Institute in the summer of 2001. Pieter Muysken is an internationally known specialist in bilingualism and Creole languages and the languages of South America; he will be actively involved in coming research projects in the Institute.

Also new in this year's Annual Report is that the work of the Technical Group is no longer grouped with "Other Activities", but is reported in a separate chapter. This reflects a steady line of development over recent years. The MPI for Psycholinguistics is unusual among Max Planck Institutes in having a single central technical group serving all groups and projects. Inevitably this has meant that the Technical Group has amassed a formidable amount of expertise, which in turn has enabled it to produce innovative solutions to technical problems in the Institute's research

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support. Not surprisingly, scientists outside the Institute have been keen to profit from these innovations. The Technical Group has been asked to contribute expertise in European projects, in particular regarding corpus data management in linguistics and related disciplines. The Institute is very proud of the service to science internationally which the Technical Group provides.

In fact the Institute is increasingly participating in European-funded projects; in 2001 the successful projects ISLE, DOBES, MUMIS and COREX to which the Technical Group contributes were joined by COMIC (a major project on Conversational Multimodal Interaction with Computers, together with the MPI for Biological Cybernetics, the German Artificial Intelligence Research Centre, and the Universities of Nijmegen, Sheffield and Edinburgh).

During 2001 the Neurocognition of Language Processing project (supported by NWO, and now in its final year) largely moved its activities to the F.C. Donders Centre for Cognitive Neuroimaging, further strengthening the ties between research at the Institute and in the F.C. Donders Centre. The Centre will have its official opening in September 2002.

Finally, we are delighted and honored to report that the Institute's founding director Willem Levelt will become the president of the Royal Netherlands Academy of Arts and Sciences (KNAW), an office which he will hold for three years (2002-2005) in conjunction with his directorial position in the Institute.

Anne Cutler

Nijmegen, March 2002

# Organization of the Institute in 2001

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# INSTITUTE PROJECTS



# 1 PHONOLOGICAL LEARNING FOR SPEECH PERCEPTION

The Phonological Learning for Speech Perception (PLSP) Project began in 2001 with the goal of understanding how phonological regularities in speech are learned, and of determining the consequences of this learning for the comprehension of language. The project has roots in the previous Phonological Structure in Comprehension (PCS) Project and the Spoken Word Recognition (SWR) Project, particularly in the PSC Project's studies of listening to second languages. PLSP also comprises most of the work conducted on the NWO-supported Spinoza award to Anne Cutler, which provides funding both for the Baby Research Center (BRC) work on the development of listening skills and for research on adult listening to native and non-native language. In addition to experimental work with infants and young children (section 1.1), the project includes studies on the computation of auditory categories in adulthood (1.2) and research assessing the role of native-language phonology in adults' listening to non-native languages (1.3).

## **1.1 Phonological categories in infants' speech processing and word learning**

Swingley oversaw the move of the Baby Research Center from within the Institute to a larger space in the Katholieke Universiteit Nijmegen. The BRC also hired a part-time laboratory coordinator, Khadar, to help in the administration of infant research at the MPI, KUN, and the F.C. Donders Centre. Over the course of the year the BRC was featured in several television and radio broadcasts, most notably the 4-part documentary "Oetsiekoetsie", which was shown nationally in December 2001 and January 2002.

Swingley and Cutler collaborated with phonologists Kager (U. Utrecht) and Fikkert (U. Nijmegen) on an NWO grant to study infants' learning of the word-final devoicing rule in Dutch. Postdoctoral researcher Zamuner and Ph.D. student Van der Feest (both U. Nijmegen) will carry out the grant's infant research at the BRC, while Ph.D. student Kerkhoff (Utrecht U.) will test older children in Utrecht.

### 1.1.1 Phonological detail in infants' word-form knowledge

Infants possess a remarkable amount of language-specific knowledge before they start making sound-meaning linkages. To ascertain to what extent this low-level knowledge is used in infants' treatment of fluent speech, Dietrich explored Dutch infants' similarity judgments of word forms in utterances in a new series of experiments, using the conditioned headturn method.

7.5- to 12-month-old infants were trained to make a head-turn response to isolated tokens of words containing the sound /a/. Then infants were tested for their responses to these words, and variants of them, in sentences. In place of /a/, variant target words contained either /a:/ (which contrasts with /a/ in Dutch; e.g., *lat* vs. *laat*), or /ʌ/ (which is not a Dutch sound, though it contrasts in North American English). The questions of interest were whether infants would respond to the trained words in sentences, and whether infants' generalization from the trained words would follow the phonology of Dutch, i.e., greater responding to targets containing the trained /a/ and the noncontrasting /ʌ/ and less responding to the target containing /a:/.

Response measures included the proportion of responses (how reliably infants turned their heads) and the response latency (how quickly). On both measures infants more readily generalized from the trained target word to the non-native word than to the native variant. This effect was significant for response latency and marginal for proportions. This pattern of generalization is expected if the infants had begun to learn the phonology of Dutch vowels and were able to use this knowledge in word recognition. However, an acoustic explanation is also possible: Irrespective of Dutch phonology, /a/ and /ʌ/ may simply be less discriminable to infants than /a/ and /a:/. To exclude an acoustic explanation of the current results, Dietrich is currently testing Canadian infants in Werker's laboratory (U. of British Columbia). If it were indeed native language phonology that shapes infants' word generalization, a

reversal of response latencies - in line with North American phonology - would be expected.

In collaboration with Aslin (U. of Rochester), Swingley completed a study of infants' knowledge of the sound-forms of familiar words. This work was motivated by past results suggesting that infants younger than 17 months do not encode phonetic detail in recently-learned words when those words are used in referential contexts. A previous study by Swingley and Aslin (2000) used a visual fixation task to evaluate 18-23 month-olds' knowledge of word forms (see Annual Report 2000). Infants saw two pictures on a large screen; one of these was named using either a correct pronunciation (e.g., "Where is the baby?") or a mispronunciation ("Where is the vaby?"). In the new study, 14- and 15-month-olds usually fixated the named picture in both conditions, but did so significantly more upon hearing a correct pronunciation than a mispronunciation. Infants' better performance on correct pronunciations held for words for which infants knew no phonological neighbors, contradicting accounts in which encoding of phonetic detail occurs only when infants need to distinguish neighboring words.

### 1.1.2 Word-form learning in infancy and early childhood

Swingley continued computational work assessing the lexical knowledge infants may gain through the interaction of perceptual grouping mechanisms and the statistical characteristics of the speech sequences infants hear (see Annual Report 2000). Previous results had shown that in speech to infants, bisyllable sequences having high frequency and *mutual information* (an information-theoretic measure of association) were usually words. New research examined the statistical characteristics of monosyllable and trisyllable sequences, using a similar set of algorithms, and tested another corpus, the Korman (1984) corpus of English infant-directed speech. The general conclusion remains: Statistically associated syllables tend to be words in infant-directed speech. However, trisyllable sequences are relatively less likely to be words even when they meet rigid statistical criteria. These broader analyses will be crucial for making cross-language comparisons with (for example) Spanish, in which the ratio of trisyllabic words to monosyllabic words is considerably higher than in the Germanic languages.

In collaboration with Aslin, Swingley completed a study of 18-month-olds' learning of new words. Children were taught two words: One a neighbor of

already known words (e.g., "tog", a neighbor of "dog"), and one not a neighbor of known words (e.g., "meb"). Then children's recognition of the novel words was tested in the visual fixation procedure described above. Children learned the no-neighbors word (meb), but did not learn the neighbor word (tog). It appeared that a word like "tog" activated competitors like "dog" enough to inhibit the association of "tog" and its referent. This result provided the first experimental evidence of competition in the lexicon at this age.

## 1.2 Computation of auditory categories in adulthood

McQueen and Cutler, in collaboration with Norris (MRC Cognition and Brain Sciences Unit, Cambridge), began a series of experiments examining whether listeners use their lexical knowledge to retune phonological categories when they encounter ambiguous sounds in the speech of a particular talker. Dutch subjects made lexical decisions on a list of words and nonwords. The final fricative of some words had been replaced by an ambiguous sound, midway between [f] and [s]. One group of listeners heard ambiguous [f]-final Dutch words like *kara?* (based on *karaf* "carafe") and unambiguous [s]-final words (e.g., *karkas* "carcass"). Another group heard the reverse (ambiguous *karka?*, unambiguous *karaf*). Only interpretation of *kara?* as *karaf* yields a word (*karas* is not a word); likewise, only interpretation of *karka?* as *karkas* yields a word. Thus, lexical information could constrain the final fricative's identity. The listeners in one group could learn that for the talker they heard, the ambiguous sound was an [f]; the listeners in the other group could learn that it was an [s]. Indeed, results from a subsequent categorization task, in which the ambiguous sounds were presented in neutral contexts, showed that listeners who had heard [?] in [f]-final words were much more likely to categorize ambiguous fricatives as [f] than the listeners who heard [?] in [s]-final words. Control conditions have shown that exposure in the lexical decision phase to unambiguous [f]-final words alone, or to [s]-final words alone, or to a contrast between these unambiguous words and [?]-final nonwords, is not sufficient to bias fricative categorization. The effect therefore appears to depend on the appearance of [?] in lexically-biased contexts in the exposure phase. These results demonstrate that lexical information can be used to train categorization of the speech signal. A new Ph.D. student, Eisner, joined the project in October. He will be continuing this investigation of the lexical retuning of speech perception.

Goudbeek began his Ph.D. project on auditory category learning. The work takes research on visual category learning as its starting point. This research has shown the importance of feedback (supervision) and of explicit (verbal) mediation in category learning. With feedback, adults can learn much harder category distinctions; with explicit mediation, success appears to depend on the dimensionality of the categories. However, neither feedback nor verbal mediation is available to infants, who nevertheless learn auditory categories. Goudbeek completed several experiments using a labeling procedure and a lexical decision distractor task to investigate the influence of both factors. Adult subjects were asked to listen to a series of sounds coming from two unidimensionally-defined categories. Depending on the condition, they were given a lexical decision task (to hinder verbal mediation), an implicit label signaling category membership of the preceding stimulus (a counterpart to feedback in traditional category learning tasks), neither, or both. Learning was slower when subjects were prevented from verbal rehearsal; however, after extended training all conditions yielded the same level of performance. These results extend to the auditory modality previous findings regarding the importance of explicit mediation for unidimensional visual categorization. Ongoing experiments are clarifying the effects of feedback and supervision on the learning of multidimensional categories, such as those found in speech.

Smits continued a joint research project with Jongman and Sereno (both U. of Kansas), which aims to uncover the fundamental mechanism by which listeners recognize phonemes. Experiments using nonspeech sounds had suggested that when formant frequency was varied listeners used a boundary-based categorization mechanism, whereas a distribution-based mechanism was used for stimuli varying in duration. Extensive quantitative model analyses have shed new light on the data. First of all, although the data showed a significant component of a distribution-based mechanism for the duration dimension, the analyses revealed that the boundary-based model actually provided a better quantitative fit. Second, in an attempt to account for all data by one model, a new model was developed incorporating aspects of both the distribution and boundary models. As in the boundary-based model, this model assumes that stimulus encoding is noisy. In addition, however, the model involves a similarity computation, like the distribution model. This calculation is also assumed to be noisy. By varying the sizes of both noise components, the behavior of the model can be made to resemble that of the boundary-

based or distribution-based models. The new model gives a satisfactory account of the categorization data for both stimulus dimensions at once, with different relative sizes of the noise components for the two dimensions.

## 1.3 Native phonology in adult listening

### 1.3.1 Rhythmic classes

Previous research in the group and with outside collaborators has identified language-specific procedures involved in listening to continuous speech. Some of these procedures draw on rhythmic structure; thus English and Dutch listeners exploit stress rhythm to segment continuous speech at likely word boundaries. Languages which do not have stress rhythm clearly do not offer listeners the option of using stress in segmentation. However, other types of rhythmic structure can also be exploited. Many lines of evidence indicate that French listeners can make use of syllabic rhythm, while Japanese listeners can use mora rhythm. These language-specific procedures play a role in the difficulty of listening to non-native languages; non-native listeners do not show the response patterns which native listeners show in segmentation experiments in a given language, but their responses instead tend to pattern as in their native language.

A new crosslinguistic comparison launched by Cutler and Murty, in collaboration with Otake (Dokkyo U.) and Kim and Davis (both U. of Melbourne), aims to select small groups of languages from the same rhythmic class - i.e., languages with comparable rhythmic structures. The goal is to choose sets with no further structural relationship than the rhythmic similarity. The proposal to be tested is that segmentation patterns will be uniform within but not across groups.

A first set of experiments involved Korean. Korean listeners responded to targets such as *ca-* or *cam-* in words such as *camay* or *campok*. Their responses showed the pattern typical of syllabically based responding (e.g., in French): Targets which corresponded exactly to a word-initial syllable were detected more rapidly than targets which were larger or smaller than a syllable. When the Korean materials were presented to Japanese- or English-speaking listeners, neither group showed the native Korean response pattern.

A second set of experiments is under way involving Telugu (a Dravidian language). Again, these experiments involve detection of target sequences in spoken Telugu words. Telugu exhibits rhythmic analogies to Japanese, in which the principal rhythmic unit is the mora. Japanese listeners find it very hard to detect targets whose boundaries do not correspond to mora boundaries. Previous experiments in which Japanese has been presented to non-native listeners (French-, English- or Portuguese-speaking) have failed to replicate this mora-sensitive pattern. However, the first experiment with Telugu listeners, in which they responded to spoken Japanese, produced a response pattern which closely resembled that of native Japanese listeners: All targets with boundaries corresponding to mora boundaries were detected more easily than targets which did not correspond exactly to mora structure.

### 1.3.2 Native phonology in non-native word recognition

When the phoneme categories of a non-native language do not correspond to those of the native language, the non-native categories may be inaccurately perceived. This may in turn impair spoken-word recognition in the non-native language.

Weber and Cutler investigated the effect of phonetic discrimination difficulties on competitor activation in non-native listening. They conducted an eyetracking experiment in which Dutch listeners heard English sentences. Weber's earlier work had shown that native competitors are activated during the recognition of non-native spoken words (Annual Report 2000). In this new experiment, Weber and Cutler tested whether Dutch listeners can use English phonetic contrasts to resolve potential competition. They monitored the eye movements of Dutch participants who followed spoken English instructions to click on pictures of objects on a computer screen. A target picture (e.g., a picture of a panda) was always presented along with distractor pictures. The name of a distractor picture either shared initial segments with the name of the target picture (e.g., target *panda*, /pændə/ and competitor *pencil*, /pensəl/) or not (e.g., a strawberry or a duck). Half of the target-competitor pairs contained English vowels that are known to be often confused by Dutch listeners (e.g., /æ/ and /ɛ/ as in *panda* - *pencil*), the other half contained vowels that are unlikely to be confused (e.g., /æ/ and /aɪ/ as in *parrot*-*pirate*). Dutch listeners fixated distractor pictures with confusable English vowels longer than distractor pictures with distinct vowels. The results demonstrate that

the sensitivity of non-native listeners to phonetic contrasts can result in spurious competitors that should not be activated for native listeners.

Broersma further tested the hypothesis that inaccurate phoneme processing by non-native listeners can lead to the activation of words that were not present in the speech signal, with the consequence that the lexical competition process in non-native listening becomes relatively complex and inefficient.

First, both Dutch and English listeners were presented with English words and nonwords in an auditory lexical decision experiment. The nonwords were formed by replacing one phoneme of a real word. For some of the nonwords, the change involved an English phoneme contrast without an analogue in the Dutch phoneme inventory, so that the substitution would be expected to be hard for Dutch listeners to detect (e.g., *dask* instead of *desk*). The pairs used were the vowels /æ/ and /ɛ/, and voiced and voiceless obstruent pairs in word-final position; nonwords formed by the replacement of a phoneme from one of these pairs were called "near words". Both Dutch and English listeners misjudged significantly more near words than nonwords, taking them for words. Thus, these contrasts were indeed acoustically difficult to make. However, the number of mistakes caused by this phoneme confusion was significantly larger for the Dutch subjects than for the English subjects.

Second, an English bimodal priming experiment was carried out, again with both Dutch and English participants. Visually presented target words were preceded by an auditory prime which was phonologically unrelated (*force-great*), related (*grade-great*) or identical to the target (*great-great*). Related primes differed from the targets in one phoneme. The phoneme pairs mentioned above were again used in the related condition. As expected, all subjects showed significant facilitation for targets preceded by identical primes (compared with the unrelated control case). English subjects showed slower responses in the related condition compared to the unrelated condition, interpreted as an effect of competition between the prime and target words. Dutch listeners did not show this inhibition effect, which suggests that the prime may have activated the target more strongly than it did for English listeners.

## 2 DECODING CONTINUOUS SPEECH

This project examines the mental processes and representations which listeners use as they decode the speech they hear. The central question is this: How do listeners map the information in spoken utterances onto stored lexical knowledge? The project evolved from the two projects Phonological Structure in Comprehension (PSC) and Spoken Word Recognition (SWR; see Annual Reports 1994-2000). The new project combines the empirical work on phonological structure from the old PSC Project with the computational work from the old SWR Project, and has a broader domain of enquiry: Work on spoken-word recognition is combined with research on the processes which precede and follow lexical access. There are four main lines of research. In the first, we have been examining prelexical processing, that is, the stage of processing which mediates between the speech signal and the mental lexicon (section 2.1). In the second, we have been investigating the interface between prelexical and lexical processing, looking specifically at how sensitive lexical access is to fine-grained acoustic-phonetic information in the speech signal (2.2). In the third line of research, we have been examining lexical-level processes, in particular how continuous speech is segmented into words (2.3). In the fourth, we have been examining word processing in sentence contexts: How listeners use higher-level knowledge when making decisions about speech sounds, and how sentential information influences the construction of utterance interpretations (2.4). Our emphasis has been on the way in which the rich sources of information in the speech code are used at all of these stages in the comprehension process.

Mauth completed her Ph.D. dissertation, on morphology in speech comprehension, in July. Her research focused on the role of inflectional morphology in segmentation and in phonetic categorization. The

dissertation was defended successfully in January 2002. Warner left the project in July for an assistant professorship at the University of Arizona. Cho joined the project in August. He will be examining the role of prosodic factors in speech decoding. Scharenborg (U. Nijmegen) started her Ph.D. project early in 2001. She is attempting to integrate the Shortlist model of human speech recognition (see Annual Reports 1994-2000) with a state-of-the-art automatic speech recognition model of phoneme recognition, thus modeling the entire process from the acoustic signal to word recognition.

## **2.1 Prelexical decoding**

### **2.1.1 Shortlist II**

Previous Annual Reports (1999, 2000) described how Smits, Warner, McQueen and Cutler conducted and analyzed a large gating experiment involving all 1,179 diphones of Dutch, gated at six points during each diphone. The ultimate purpose of this experiment is to make the Shortlist model sensitive to time-varying probabilistic information about incoming speech sounds. In collaboration with Norris (MRC Cognition and Brain Sciences Unit, Cambridge), Smits developed software which transforms the response frequencies obtained in the gating experiment into phoneme activation patterns. Given an input string of phonetic symbols, the new algorithms produce the activations of all Dutch phonemes as a function of time, which is represented by gate position. The activation calculations take left and right phonetic context into account by combining listeners' categorization data for the diphone consisting of the left context followed by the target phoneme, and the diphone consisting of the target phoneme followed by the right context. Norris has modified the Shortlist implementation such that it can process these phoneme activations as input. Behavioral and simulation experiments to validate the improved model are currently being planned.

### **2.1.2 Assigning cues to segments**

In most phoneme-recognition experiments, listeners know how many phonemes there are in the stimuli, and often the manner of articulation of those stimuli, whereas in normal speech recognition they do not. Smits started a joint project with Nearey (U. of Alberta), studying how listeners determine the number of phonemes in a given utterance and the identities of those segments. Synthetic VC(C)V stimuli were created consisting of a voiced part with closure transitions followed by silence, then a nasal

murmur, and finally a voiced part with opening transitions. The closure and opening transitions and the durations of silence and murmur were varied orthogonally. The resulting stimuli were presented to subjects for categorization, with these response alternatives: /p, t, m, n, pt, tp, mn, nm, pm, pn, tm, tn/. The results showed that with increasing durations of silence and nasal murmur, listeners were more likely to hear stop and nasal consonants, respectively. The probability of hearing two consonants increased with total closure duration and dissimilarity of transitions at onset and offset. Finally, if two consonants were heard, the perceived place of articulation of the first consonant was solely determined by the closure transitions; the same held for the second consonant and the opening transitions.

## 2.2 From sounds to words

### 2.2.1 Onset-embedded words

Salverda continued his dissertation project, using eye-tracking to study the lexical activation of onset-embedded words. Initial studies (see Annual Report 2000) showed that subtle acoustic information in an ambiguous sequence (e.g., /ham/) was used to favor its interpretation either as an embedded word (*ham*) or as the onset of a longer, carrier word (*hamster*). More fixations to a *ham* picture were observed when the first syllable of the target word *hamster* originated from a recording of the word *ham* than when it came from the first syllable of a different recording of *hamster*. Acoustic measurements of the experimental materials indicated that the duration of the ambiguous syllable was longer when it corresponded to a monosyllabic word than when it was part of a polysyllabic word (by 20 ms on average). Similar differences were observed in most tokens in the original recording of materials.

Follow-up studies focused on the role of this durational pattern on the lexical interpretation of the ambiguous sequences. When tokens of the ambiguous sequences from the original recording were selected so as to minimize the durational difference, no bias in interpreting the sequence as an embedded word or as a carrier word was found. When tokens of the ambiguous sequences were selected such that the usual durational pattern was reversed (the sequence corresponding to the embedded word being shorter than that corresponding to the first syllable of the carrier word), the longer sequence tended to be interpreted as an embedded word more than the shorter sequence. These results demonstrate a bias

toward interpreting longer syllables as embedded, monosyllabic words, reflecting the duration distribution in the recording sample and presumably in the language as a whole. This use of durational cues (or cues that correlate with duration) may reduce the word segmentation problem in continuous speech recognition.

### 2.2.2 Liaison in French

Spinelli (U. Paris V), McQueen and Cutler have continued their analysis of the effects of liaison on word recognition (see Annual Report 2000). In French, the final [r] of *dernier* "last" is not pronounced when the following word begins with a consonant, but it surfaces and is resyllabified into the following syllable when the next word begins with a vowel. Thus, *dernier oignon* "last onion" and *dernier rognon* "last kidney" are phonemically identical. A new series of cross-modal priming experiments have shown that both *rognon* and *oignon* are activated by both *dernier rognon* and *dernier oignon*, but that the word the speaker intended is more strongly activated than the unintended word. A speech production study further confirmed that French speakers make a small but systematic distinction between liaison and nonliaison consonants (e.g., the [r] in *dernier rognon* tends to be longer than that in *dernier oignon*). These acoustic differences appear to influence lexical activation. Like the results of Salverda, these results suggest that lexical access is sensitive to subphonemic variation in the speech signal (i.e., information which could not be captured by a phonemic transcription of that signal).

### 2.2.3 The voicing distinction in Dutch

Van Alphen's dissertation project is also on the effects of subphonemic variation on lexical access. She investigated this issue by varying the length of the prevoicing of Dutch voiced plosives at the beginning of auditory primes in several priming studies. In only one condition did the removal of the prevoicing in the primes result in slower responses to the targets (see Annual Report 2000). These results indicate that the presence of prevoicing does not contribute strongly to the perception of the plosive as being voiced. A production study was designed to investigate two questions. First, how does prevoicing vary in natural speech? Second, what other acoustic cues contribute to the perceptual distinction between voiced and voiceless plosives in Dutch?

Ten subjects produced a list of monosyllabic words in which the following factors were manipulated: Place of articulation (/b/ versus /d/); following

phoneme (vowel versus consonant); lexical status of the carrier stimulus (word versus nonword); and competitor environment of the carrier stimulus (replacing the first phoneme by the voiceless counterpart resulted either in a word or a nonword). 25% of all voiced tokens were produced without prevoicing. Furthermore, the following phoneme had a significant effect: Prevoicing of the voiced plosive was omitted more often or was shorter when it was followed by a consonant than when it was followed by a vowel. To examine the strength of the different voicing cues, the following acoustic variables were measured: The duration of the prevoicing, the burst, the vowel, and of the entire stimulus; the energy in the burst; the spectral center of gravity; and the F0 in the following phoneme. The outcome of logistic regression analyses with these measurements as variables will be used to design a new experiment to investigate further the effects of subphonemic variation on lexical activation.

#### **2.2.4 Vowels and consonants: A PET study**

Cutler, with Sharp, Scott and Wise (MRC Cyclotron Unit, London) investigated the processing of vowels and consonants in lexical access, using positron emission tomography. Normal volunteers heard nonwords and reconstructed real words from them by replacing a single vowel or consonant. In previous research in the group, involving three language populations, this word reconstruction task has consistently proven harder when a consonant has to be replaced than when a vowel has to be replaced (see Annual Report 1998, 1999). This behavioral result was again replicated in the present study. The asymmetry was not, however, accompanied by a dissociation of underlying neural activity. Both vowel and consonant replacement activated the same left lateralized system which included the inferior and middle frontal gyri (IFG and MFG) and premotor cortex. Bilateral cerebellar activation was also observed. Although no significant spatial differences in activation were observed, areas within the common network were significantly more highly activated by the harder (consonant) task. This finding offers no support for claims that anatomically separable cortical systems are involved in the processing of respectively consonants and vowels; instead, it suggests that vowel and consonant processing can simply differ in resource demands. A conjunction analysis between word reconstruction and a word generation task was also performed, revealing a common system including anterior cingulate, posterior parietal and Brodmann's areas 44/45 and 9. Problem-solving tasks on single words thus appear to produce a

common distribution of activation, most notably in left MFG and IFG/premotor cortex, although subsystems within this may demonstrate greater or lesser activity depending on the task demands.

## 2.3 Lexical decoding

### 2.3.1 The Possible Word Constraint (PWC)

We have argued that segmentation of continuous speech into words is achieved by competition, as in Shortlist, but that the PWC modulates the competition process. The PWC disfavors an activated competitor when the residue of speech between that word and a likely word boundary is not a possible word. McQueen and Cutler, together with Norris, Butterfield and Kearns (MRC Cognition and Brain Sciences Unit, Cambridge), carried out control lexical decision experiments for English word-spotting experiments which had tested the PWC. In one control experiment, listeners were faster to detect words taken from consonant contexts (e.g., *sea* from /siʃ/ than words taken from weak-syllable contexts (e.g., *sea* from /siʃəb/). This was the reverse of what had been observed in word spotting (see Annual Report 2000). The difficulty listeners had in spotting words in consonant contexts thus appears to have been because of the difficulty of segmentation in this condition relative to the weak syllable condition, as predicted by the PWC, rather than to some difference between the words themselves. Similarly, in the second experiment, listeners found it equally easy to detect words taken from consonant contexts, from lax-vowel syllable contexts and from tense-vowel syllable contexts (e.g., *canal* taken from /skənæʃ/, /zəkənæʃ/ and /zikənæʃ/ respectively), in contrast to the word-spotting results (where the first context was harder than either of the other two, which themselves did not differ; see Annual Report 1997). Again, the word-spotting results therefore appear to reflect segmentation difficulty. In combination with our other crosslinguistic research on segmentation in English, Dutch, French, Sesotho and Japanese (see Annual Reports 1995-2000), these experiments support the conclusion that the PWC is a language-universal constraint. Irrespective of the phonological constraints on what constitutes a well-formed word in any particular language, listeners of all these languages are sensitive simply to whether the stretch of speech between a candidate word and a likely word boundary contains a vowel.

### 2.3.2 Morphology in segmentation

Mauth conducted a final word-spotting experiment on the role of morphology in segmentation (see Annual Reports 1998-2000). In earlier experiments, where nouns (e.g., *probleem* "problem") were embedded in three nonword contexts (morphological, consonantal and syllabic), the syllabic condition, which the PWC predicts to be fastest, was slowest. Positive correlations of latencies with context durations suggested that listeners waited until the ends of the items before responding. To control for this confound, context lengths were matched (e.g., *probleem* in *probleemt.daaf* [morphological], *probleemp.daaf* [consonantal], and *probleem.dwaaf* [syllabic]). Although targets were spotted faster in the syllabic condition than in the other two conditions, positive correlations of latencies with context durations were again observed. The effect was in the predicted direction because the syllabic contexts were shorter than the other contexts. It was thus not possible to interpret performance in the morphological condition. The role of single-consonant morphemes in segmentation therefore remains unclear.

### 2.3.3 Segmentation using phonotactics in Korean

With Kim and Davis (U. of Melbourne), Warner and Cutler used the word-spotting task to investigate the influence of the complex phonotactic patterns of Korean on listeners' word recognition. Past research (Annual Report 1995, 1999) by McQueen and Weber has shown that Dutch, German, and English listeners can use the phonotactic constraints of their languages, such as the lack of /ml/ sequences at the beginning of words, to segment speech. Thus, English listeners recognize *luck* more easily in *poomluck* than *poosluck* because /ml/ cannot be a word onset, and thus signals a word boundary, but /sl/ can, and thus does not signal a boundary. These phonotactic constraints are relatively simple. The phonotactic patterns investigated in Korean, however, result from the interaction of several phonological processes (palatalization, nasal insertion, nasal assimilation, and coda neutralization), each of which applies only at certain types of boundary. As a result of these various processes, the sequence [ci] cannot occur at word boundaries in Korean, while the sequence [ti] can but need not occur at word boundaries, and the sequence [nni] is most likely to occur at word boundaries. Korean listeners were presented with real words such as [ipuniŋ] "evening" embedded in the nonwords *myatipuniŋ*, *myacipuniŋ*, and *myannipuniŋ*. Listeners detected the real words most easily after [nn] and least easily after [c], with the [t]

condition intermediate. This indicates that phonotactic patterns caused by several interacting phonological processes can affect listeners' segmentation of connected speech, just as simpler phonotactic constraints do.

## 2.4 Words in sentences

### 2.4.1 Morphology in categorization

In Mauth's final study of morphological influences on phonetic decision-making (see Annual Report 1999, 2000), listeners categorized the last sounds of inflected verbs (e.g., *vist* "fishes") and uninflected nouns (e.g., *gist* "yeast"), presented either at the end of sentences or in isolation. The sounds varied on a [t]-[k] continuum. The [t]-endpoints were words and the [k]-endpoints were nonwords. In sentence contexts, there was a bias towards [t]-responses for the nouns (e.g., *gist-gisk*) but not for the verbs (e.g., *vist-visk*). In isolation, both nouns and verbs showed a [t]-bias. Listeners appear to have made use of the morphological status of the last phoneme when the word and its inflection were predictable from the sentence context. When the sound was in a sentence-final inflected verb, it could be parsed from its context and identified without any contextual bias. For words in isolation, however, listeners could not use morpho-syntactic information predictively, and thus based their decisions for both verbs and nouns on lexical rather than sentential information.

### 2.4.2 The influence of sentential context on lexical interpretation

Dahan, in collaboration with Tanenhaus (U. of Rochester), conducted a series of experiments looking at the impact of contextual information that precedes a spoken word on the early lexical interpretation of that word. Context was defined as the semantic characteristics that a verb imposes on the noun filling its agent role, when that verb precedes the noun in the course of the sentence. In Dutch, verbs precede their subjects when the sentence starts with a prepositional phrase. In these experiments, participants' eye movements to a four-object display were monitored as they heard sentences mentioning one of the objects. The participants' task was to click and move the mentioned object. A critical display consisted of the picture of the target (e.g., *bok* "goat"), of a competitor which overlapped with the target word at onset (e.g., *bot* "bone"), and two distractor pictures. The target word in the sentence was preceded by a semantically constraining verb or nonconstraining verb (e.g., *Nog nooit klom een bok zo hoog* "Never before climbed a goat so high" vs. *Nog nooit is een bok zo hoog geklommen* "Never before had a goat climbed so

high"). Despite the match between the initial part of the input and the competitor's sound form, fixations to the competitor as the initial sounds of the target word unfolded over time were dramatically reduced (and in fact did not differ from fixations to the distractors) when the semantics of the preceding verb rendered this competitor a poor candidate (e.g., a bone cannot climb).

In a subsequent experiment, the form of the target word was manipulated by splicing the initial portion of the competitor name onto the final portion of the target name (e.g., bo[t] + [bo]k), so that the vowel contained coarticulatory information supporting the competitor over the target. Fixations to the competitor were found to be modulated by the presence of such coarticulatory information, even when the semantic features of the preceding verb had rendered this interpretation of the signal improbable. This study reveals that the lexical interpretation of a spoken word operates continuously by merging and weighting various sources of information (phonetic, semantic) to constrain the set of word candidates. Verb-subject relationships are probabilistically determined by language use (i.e., a specific verb tends to be used with agents that match a specific set of semantic features), and may easily be violated given an appropriate pragmatic context. By contrast, the predictions that are established on the basis of coarticulatory information, although probabilistic, cannot be violated (except by artificially manipulating the signal). Lexical interpretation thus appears to be sensitive to the degree of constraint that each source of information provides.



## 3 UTTERANCE ENCODING

The Utterance Encoding Project studies the way in which a speaker, in a conversational setting or otherwise, expresses an idea in speech. Among the simplest utterances we produce are single words. The ability to access information for individual words is, of course, an essential ingredient of the ability to produce larger utterances. Work in this project continued to examine the encoding of single word utterances (described in section 3.1), its relation to perception (3.2), and the encoding of multiple word utterances (3.3). The work on single word utterances and the relation to perception aimed to further test the theory of lexical access that has been developed by members of the project over the previous decade (an overview of the theory can be found in a BBS target article by Levelt, Roelofs, & Meyer 1999). Furthermore, work has continued on the computational implementation of the theory, the WEAVER++ model.

In 2001, Van der Meulen completed her dissertation on eye movements during language production. Bock and Erwin (U. of Illinois) finished their sabbatical year, and Hartsuiker (U. of Edinburgh) spent a month at the institute as a guest of the UE Project. Finally, Van Turenout left the project to establish her own research group at the F.C. Donders Centre for Cognitive Neuroimaging.

### 3.1 Single word utterances

Our theory sees word planning as a staged feedforward process, traversing from conceptual preparation (3.1.1), via lemma retrieval to word-form encoding and syllabary access (3.1.2 - 3.1.4). The theory has guided the design of new response time and electrophysiological experiments on lexical access.

### 3.1.1 Conceptual preparation

The theory holds that lexical access starts by activating a nondecomposed lexical concept representation (e.g., CAT(X) in naming a pictured cat) rather than a combination of primitive semantic features (e.g., FELINE(X), ANIMATE(X) and PET(X), the received semantic decomposition view). On the nondecomposition view, semantic features such as ANIMATE(X) may optionally be retrieved from CAT(X) but they are not necessary for accessing the word *cat*. Earlier work using lateralized readiness brain potentials (LRP) by Abdel Rahman has suggested that the conceptual information prepared in picture naming can indeed be very lean, supporting the semantic nondecomposition view. Further LRP work was conducted by Abdel Rahman, Van Turennout, and Levelt to determine exactly what conceptual information is obligatorily prepared in picture naming.

On the semantic decomposition view, animacy is likely to be a semantic feature that needs to be retrieved before lexical access can start, whereas animacy retrieval and lexical access may proceed in parallel on the nondecomposition view. These predictions were tested in an LRP study in which Dutch participants had to classify pictures using a manual two-choice go/nogo task. Earlier research (Miller & Hackley 1992) has shown that an LRP develops in nogo trials when the information that determines the hand for the button-response is available before the information that determines the go/nogo decision. Using this technique, Van Turennout and colleagues showed that semantic features like animacy are available in time before the phonemes of a word (see Annual Report 1994). In the current study, the choice of response hand was determined by an animal vs. object classification, whereas the go/nogo decision was based on whether the initial phoneme of the picture name was a vowel or a consonant. To selectively manipulate the duration of semantic feature retrieval, the choice of response hand was either based on the animal vs. object classification throughout an entire block of trials (the blocked condition) or based on one of two semantic classifications, namely animal vs. object (e.g., a boat vs. a shark) or existing inside vs. outside the water (e.g., a boat vs. a car), randomly intermixed in a block of trials (the mixed condition). On each trial in the mixed condition, a cue indicated which of the two semantic decisions had to be made.

The results showed that the stimulus-locked LRP onset latencies and response times were delayed for the mixed as compared to the blocked

condition, demonstrating that the duration of semantic feature retrieval was successfully manipulated by task mixing. Importantly, an LRP in nogo trials (the so-called nogo LRP) developed only in the blocked condition, that is, with fast semantic feature retrieval. Furthermore, the response-locked LRP onset latency was decreased in the mixed condition with the slow semantic feature retrieval compared to the blocked condition with the fast semantic retrieval. This indicates that phoneme retrieval can proceed while semantic feature retrieval is not yet completed - if phoneme availability strictly follows semantic feature availability in time, the response-locked LRP onset latencies should not have differed between conditions. These results suggest that a basic semantic feature like animacy, although retrieved prior to phonological information, is not essential for the initiation of lexical access, supporting the semantic nondecomposition view.

After a lemma is selected for a prepared concept, the form of the word needs to be encoded. According to our theory, this involves retrieving the lexeme and phonemes (3.1.2), rightward incrementally computing a phonological word representation that makes explicit the syllable structure and stress pattern (3.1.3), and finally, recovering syllable-based motor programs for the articulatory execution of the word (3.1.4).

### 3.1.2 Accessing the lexeme

The theory holds that homophones like the high-frequency adjective *more* and the low-frequency noun *moor* ("a tract of waste land") are represented by different lemmas but by a single lexeme, /mo:r/ (at least for certain dialects of English). Therefore, low-frequency *moor* should inherit the fast production latency of high-frequency *more*, which has been confirmed in previous research using an English-to-Dutch translation task (see Annual Report 1992). Jescheniak (MPI for Cognitive Neuroscience, Leipzig), Meyer (U. of Birmingham), and Levelt reconfirmed this finding for Dutch and demonstrated a high degree of inheritability for German homophones. During an internship, Shatzman (U. Nijmegen), in collaboration with Schiller (MPI & Maastricht U.), attempted to replicate these results using a picture naming task rather than the translation task used previously. The study used Dutch homophones of which both readings could be presented as a picture. For example, for *slot* there was a picture of a castle (low-frequency reading) and a picture of a lock (high-frequency reading). To assess the effect of frequency, the naming latencies for the low-frequency homophone pictures were compared to those of frequency-matched non-

homophone control pictures and the naming latencies for the high-frequency homophone pictures were compared to those of matched high-frequency nonhomophone controls.

The picture naming latencies for the low-frequency homophones were slower than those for the high-frequency ones. However, no frequency effect was found for the control words. Subsequent experiments indicated that the difference in latencies for the homophones could be attributed to processes earlier than lexeme access. Specifically, it appeared that there was much less name agreement for the pictures with low-frequency homophone names than those with high-frequency homophone names (e.g., participants were much less likely to spontaneously say "slot" to the pictured castle than to the pictured lock), causing the apparent frequency effect in homophone picture naming. The cause for the absence of a frequency effect for the control pictures is unclear and needs further investigation. The results suggest that, given the difficulty to control perceptual and conceptual processes, picture naming may not always be an ideal task and that a translation task may sometimes be a better option.

### 3.1.3 Time course of computing phonological words

Earlier research in the project (see Annual Report 1992) has provided evidence for the rightward incremental generation of phonological words using the task of monitoring for target phonemes and syllables in internal speech. Schiller and Levelt, together with Schmitt and Peters (Maastricht U.), confirmed another assumption of the theory; namely that stress is assigned from the beginning of a word to the end, with rightward incrementality. Participants had to indicate by means of a button-response whether disyllabic picture names had stress on the first or second syllable. Shorter monitoring latencies were obtained when participants were asked to decide on the stress location of a picture name with first-syllable stress (e.g., *LEpel*, "spoon") than with second-syllable stress (e.g., *libEL*, "dragonfly"). Similarly, monitoring latencies for trisyllabic picture names were faster with second-syllable stress than with third-syllable stress. Furthermore, using an English-to-Dutch translation task, it was observed that monitoring for target phonemes in the Dutch words (e.g., deciding whether the Dutch translation equivalent of *HITCHHIKER*, *lifter*, contains an /f/) was influenced by the specific morphological, metrical, and syllable structures of the Dutch target words. For example, all experiments showed marked increases in monitoring latencies between phonemes before and after a syllable boundary.

Furthermore, Schiller, in collaboration with Fikkert (U. Nijmegen) and C. Levelt (Leiden U.), tested for metrical priming effects of auditory distractors in picture naming. All picture names and primes were disyllabic. According to our theory, stress patterns are computed for regularly stressed words and retrieved from memory in parallel with phoneme retrieval for irregularly stressed words. If metrical and phoneme retrieval take about the same amount of time, the unprimed phoneme retrieval would set the pace and metrical priming should be impossible. The experimental results revealed that picture names with final stress were named more slowly than pictures with initial stress. Furthermore, pictures were named faster when the spoken distractor had initial stress than when it had final stress. However, no interaction between the two factors was observed, i.e., there was no metrical priming.

### 3.1.4 Phonological preparation of syllabary access

According to our theory, the phonological syllables in a constructed phonological word form the basis for the retrieval of syllable-based motor programs from a mental syllabary. In her Ph.D. project, Cholin further tested this claim using a speech preparation paradigm (the so-called implicit priming paradigm of Meyer, see Annual Report 1988). Earlier research has shown that response blocks with word-initial phoneme overlap have reduced production latencies, suggesting response preparation (see Annual Report 1988). The preparation effect should be larger when phoneme overlap allows for the preparation of a complete phonological syllable allowing for syllabary access than when it does not. Cholin tested this by using disyllabic verb forms sharing initial phonemes. The overlap of the first syllable among responses like *lei.den*, *lei.dde*, *lei.der*, and *lei.dend* should allow the speaker to prepare that syllable (which is CVV in all responses). In contrast, in the response set *ro.ken* (CVV), *rook.te* (CVVC), *ro.ker* (CVV), and *ro.kend* (CVV), the second response has a deviating CVVC syllable and therefore should block response preparation for the whole set. And this was indeed found: Production latencies were faster for the CVV sets than for the CVV/CVVC sets. These results suggest that when a complete phonological syllable can be prepared for all responses, an extra time benefit is obtained from syllabary access.

## **3.2 Relations to perception**

The well-established effectiveness of perceived primes and distractors in modulating word production indicates activation relations between perception and production. Furthermore, our theory holds that the word perception system is used for speakers' self-monitoring. Work has examined aspects of the activation relations (3.2.1 - 3.2.3) and perception-based self-monitoring (3.2.4).

### **3.2.1 Orthographic priming**

Earlier research in the project (see Annual Report 1991) has shown that picture naming can be speeded up to the same extent by spoken primes that share initial (e.g., first-syllable) and noninitial (e.g., second-syllable) phonemes with the target. For example, saying "hammer" to a pictured hammer is speeded up to the same extent by the spoken words *HABIT* and *SUMMER*. In contrast, with orthographic (i.e., written) primes, word onsets seem to play a special role in that priming is obtained for initial primes but not for noninitial ones (e.g., Forster & Davis 1991). However, in several word- and picture-naming experiments in Dutch using masked orthographic primes, Schiller obtained effects of both initial and noninitial primes, although the effect was smaller for noninitial primes than for initial ones. It seems that orthographic priming is different from auditory priming, although not to the degree suggested by the results of Forster & Davis

### **3.2.2 Perceptually increasing the activation of production representations**

It is generally assumed that shared semantic category membership and phonological representations mediate the effects of semantically and phonologically related distractors in picture naming. Abdel Rahman and Melinger used a variant of the picture-word interference paradigm to investigate whether stronger activation of shared representations directly leads to stronger interference and facilitation effects. Participants had to name pictured objects with either one (the classic situation) or two written word distractors superimposed on a single target picture. The pictures were combined with a semantically or phonologically related word and a row of Xs (e.g., target "cat", distractors *DOG* and *XXXX*, or target "cat" and distractors *CAP* and *XXXX*), two semantically or phonologically related words (e.g., target "cat", distractors *DOG* and *HORSE*, or target "cat" and distractors *CAP* and *CAN*), or two unrelated words.

With single word distractors, the classic semantic interference and phonological facilitation effects were replicated. When a second semantically related distractor word was presented, the semantic interference effect increased. However, when a second phonologically related distractor word was presented, the magnitude of the phonological facilitation remained unaltered. Subsequent experiments suggested that the absence of an effect of a second distractor on phonological facilitation was due to the extra perceptual cost associated with having two word distractors instead of one. When the row of Xs in the single distractor condition was replaced by an unrelated word distractor (e.g., CAP and XXXX replaced by CAP and TOY), a small but significant increase of facilitation was obtained. The phonological facilitation was further increased when one of the two phonological distractors overlapped with the initial portion of the target word while the second overlapped with the word final portion of the target (e.g., target "cat" and distractors CAP and MAT). These findings demonstrate that the introduction of a second word distractor boosts the activation of mediating representations, and thereby increases the interference and facilitation effects.

### **3.2.3 Naming Arabic digits, written number words, and dice**

Are Arabic digits named like written number words or like pictures? Roelofs conducted a series of number-Stroop experiments to examine this question. If digits are named like words, the interference patterns for numerosity (e.g., dice) naming and digit/word naming should differ, whereas the patterns for digit and word naming should be the same. Participants produced spoken numerals in response to the numbered sides of a die, Arabic digits, or written number words, while simultaneously trying to ignore incongruent numerosity, digit, or word distractors. The targets and distractors were all within the subitizing range (1-4). The distractors were presented to the left or right of the targets at stimulus onset asynchronies (SOAs) ranging from 300 ms preexposure to 300 ms postexposure in 100 ms steps. Stroop-like interference (i.e., a slower response with incongruent than with neutral distractors) was obtained from digit and word distractors on numerosity naming, but not from numerosity distractors on digit naming and word naming. In contrast, word distractors interfered with digit naming and digit distractors interfered with word naming to exactly the same extent. These interference patterns suggest that digit naming is achieved like word naming rather than numerosity naming. Simulations showed that

WEAVER++ successfully accounts for the interference patterns and their exact time course.

### 3.2.4 Perception based self-monitoring

During conversation, speakers not only talk but they also listen to their interlocutors' speech and monitor their own speech for errors. According to the theory, the speech comprehension system supports two self-monitoring routes, an external route that involves listening to self-produced overt speech and an internal route that involves evaluating the covert utterance plan. Lexical concepts and lemmas are shared between speech production and comprehension, but there are separate input and output representations for word forms.

In a computational study, Roelofs implemented critical aspects of the internal self-monitoring route in WEAVER++ and tested the model on seemingly problematic findings: the statistical overrepresentation of mixed semantic-phonological speech-errors (e.g., erroneously substituting "calf" for "cat" is more likely than substituting "horse" for "cat") and the reduced latency effect of mixed distractors in picture naming (e.g., distractor CALF presented with a pictured cat yields less interference than distractor HORSE). The simulations showed that, contrary to what is usually assumed (e.g., Rapp & Goldrick 2000), these findings are not problematic for WEAVER++ but, on the contrary, support its claims about the relation between speaking, comprehending, and self-monitoring. Specifically, mixed items are weaker competitors than other items in lemma retrieval, because they have the target as a member of their speech comprehension cohort (e.g., CALF and CAT are cohort competitors). Therefore, mixed items are more likely to remain unnoticed in perception-based error monitoring (yielding more mixed speech errors) and, as spoken distractors, they have a smaller effect on latencies (yielding less semantic interference). The simulation results showed that the model accounts for the mixed-distractor latency effect, the mixed error bias, and its dependence on the impairment locus in aphasia.

### 3.3 Multiple word utterances

Multiple access requires the speaker to recurrently perform lexical access. Multiple access presumably happens during the planning of complex numerals such as "three-thousand five-hundred seventy-six" (3.3.1) and, of course, during the planning of multiple word utterances (3.3.2),

including fixed expressions (3.3.3). Furthermore, multiple access raises the issue of the source of word order variation (3.3.4).

### 3.3.1 The production of complex spoken numerals

Meeuwissen started a new Ph.D. project investigating the production of complex spoken numerals. In two experiments conducted in Dutch, she compared the production of spoken house numbers and clock times in response to identical 3-digit Arabic numbers as stimuli, ranging from 200 to 955 in steps of 5. For example, participants said "op driehonderdvijfveertig" ("at three-hundred forty-five") to 345 and "om kwart voor vier" ("at quarter to four") to 3:45. Multiple regression analyses showed that the naming latencies of digital Arabic numbers as house numbers were mostly determined by morphophonological factors such as the number of phonemes, syllables, and morphemes. In contrast, the latencies of the clock time naming revealed a strong conceptual component. The latency patterns here were best explained by assuming a cognitive algorithm operating during conceptual preparation that plans clock time expressions with reference to the quarter, half, and full hour (e.g., 3:45 should be conceptually transformed into "quarter to four"). A second study showed that when conceptual preparation was made unnecessary by presenting written number words as stimuli (e.g., DRIEHONDERD VIJFENVEERTIG; KWART VOOR VIER), morphophonological factors determined the production latencies in both response modes. These results indicate that different planning levels are engaged in spoken numeral production depending on the response mode and perceptual input format, in agreement with our theory.

Earlier research in the project (see Annual Report 1988) has shown that the encoding of word forms proceeds strictly from the beginning of a word to its end. Serial planning has been observed for phonemes, syllables, and morphemes. It is unclear, however, whether seriality also holds for the lemma and concept levels. This was tested using complex numerals (e.g., thirty-five), which, different from most other word types, are represented by multiple lemmas and concepts. Roelofs, in collaboration with Schwichtenberg (U. Osnabrück), conducted a series of speech preparation experiments (cf. section 3.1.4) in which participants had to produce spoken numerals in response to sums ( $11 + 24 = ?$ ), Arabic numbers (e.g., 35), or written number words (THIRTY-FIVE). The responses in a block of trials shared constituents (e.g., "thirty-two", "thirty-five", "thirty-six"), allowing for response preparation, or there was no overlap. The

linear order of the constituents in the responses was manipulated by having the stimuli named in Dutch (ones-before-tens) and in English (tens-before-ones). The experiments yielded preparation effects for both initial and noninitial overlap in both languages and all three tasks. The preparation effect for noninitial overlap supports the idea that complex numerals are newly constructed from multiple lemmas and lexical concepts, and that seriality does not hold here.

### 3.3.2 Time course of multiple word access in producing sentences

A way to obtain information about the time course of multiple word access in sentence production is by registering the speaker's eye movements during the production of scene descriptions. Earlier research within the project (see Annual Report 1999) has shown that participants typically fixate the objects in the order of mentioning. Furthermore, when speakers are free to choose a syntactic structure describing complex pictures, some picture elements are fixated before the first named item (the "preview") followed by fixating the items directly before naming them (the "main view"). When speakers describe events such as a girl giving a plant to a man, the first fixated region is the so-called action region, presumably that allows the encoding of the event depicted or the verb of the sentence.

To explore this result further, Dobel and Levelt, in collaboration with Meyer, showed Dutch participants events with two relevant parts (e.g., a girl pushing a table) or three relevant parts (e.g., a girl giving a plant to a man). The events had to be described starting with one of three lead-in words (*hier* "here", *want* "since", or *omdat* "because"). In Dutch, depending on the lead-in word, the verb appears mandatorily in an early, middle, or late position in the sentence. In addition, sentence production was compared to producing the names of the major picture elements as a list (e.g., saying "a table, a girl" or "a girl, a plant, a man"). In the preview phase, participants tended to fixate the action region early in time when they had to produce a sentence as compared to producing a list, and when the action region contained an object (e.g., a plant that is handed over) as compared to when it did not. Whether or not the action region was fixated early in time did not depend on the position (i.e., early, middle, late) of the verb in the surface structure of the sentence. In the main view phase, fixation order again preceded the mentioning order, as observed in earlier work. These results suggest that verb encoding is an early process in sentence production.

### 3.3.3 Production of fixed expressions

A special case of multiple word access is the generation of fixed expressions, including idioms. In previous years, the theory of lexical access has been extended by including a representation of fixed expressions in the lexical network (see Annual Report 1999). Idioms such as "kick the bucket" are represented by "superlemma" nodes, which are connected to the "simple" lemma nodes of constituent words such as *bucket*. Superlemmas are activated by their own characteristic idiom concept. A superlemma activates its constituent simple lemmas, affecting their syntactic potential.

According to the superlemma theory, it should be possible to speed up the production of idioms by priming the simple lemmas via their concepts. This was tested in a study by Sprenger, Levelt, and Kempen. Dutch participants had to produce idioms such as "kick the bucket" in response to written stimuli such as *DIE*, while hearing spoken primes that were semantically related or unrelated to the last word of the idiom (the example is in English, but the study was in Dutch). For example, the planning of "kick the bucket" was primed by the related word *PAIL* or an unrelated word. Idiom production appeared to be significantly faster when primed with a semantically related word as compared to an unrelated one. The priming effect was present not only when the prime was presented before stimulus onset (i.e., SOA = -150 ms) but also when it was presented relatively long after stimulus onset (i.e., SOA = +200 ms). The semantic facilitation effect demonstrates that activating the conceptual representation of constituent words (e.g., *bucket* primed by *PAIL*) can effectively influence the production of the idiom, even when the meaning of the constituent word does not contribute to the meaning of the idiom, supporting the superlemma theory.

Up to now, frequency data of Dutch fixed expressions were not available. Therefore, Sprenger, in cooperation with the Institute for Dutch Lexicography (INL), determined the frequency of 1000 fixed expressions that were taken as a random sample from the Dutch Van Dale dictionary. First analyses of the frequency distributions revealed that a major proportion of the fixed expressions noted in the Van Dale dictionary is either of very low frequency or does not occur in the INL corpus (consisting of 52 million words) at all. About 48 percent of the fixed expressions in the sample did not occur in the corpus (e.g., "een dubbele kin", literally "a double chin"). The remaining 52 percent of the sample

confirmed the impression that the majority of fixed expressions in Dutch listed in standard dictionaries does not lead an active life in Dutch written language. For the 52 percent of fixed expressions that were listed in the INL corpus, about 27 percent had a frequency of one to ten occurrences (e.g., "een gespleten persoonlijkheid", "a split personality") and about 80 percent had a frequency of one to twenty (e.g., "olie op de golven", "oil on troubled waters"). Only one percent of the fixed expressions had a frequency between 500 and 1200 occurrences (e.g., "in beeld zijn", "to be in the picture"), and frequencies of 2000 or higher were only found for 0.5 percent of the items (e.g., "bij elkaar", "together").

### 3.3.4 Word order scrambling as a consequence of incremental sentence production

The incremental nature of human grammatical encoding may be an important source of word order variation. Given a language with some word order flexibility and an incremental grammatical encoder, constituents whose shape is determined at an early point in time during encoding will tend to precede constituents that arrive later in the utterance. Arrival time may depend not only on syntactic factors such as the complexity of the syntactic assembly process (e.g., whether the constituent is "heavy"), but it may also depend on lexical factors (e.g., different retrieval times for low- and high-frequency words) and on conceptual factors (e.g., salient fragments being conceptualized prior to less salient ones). If this view is correct, it eliminates the need for *syntactic* rules that explicitly control the linear order of the constituents - thereby benefiting theoretical parsimony.

Kempen and Harbusch (U. Koblenz-Landau) tested the viability of this incrementality approach by developing a statistical model generating a detailed pattern of constituent order variation on the basis of hypothetical constituent arrival times. Their test case was the so-called "scrambling" phenomenon of Subject (*S*), Indirect Object (*I*), and Direct Object (*O*) NP in German subordinate clauses. The data from several previous studies indicate that, while none of the six permutations of *S*, *I*, and *O* are definitely ruled out, some are judged considerably more acceptable than others. Furthermore, the acceptability ratings vary as a function of whether the constituents are full or pronominal NPs.

Theoretical accounts for the obtained data patterns usually employ a ranked or weighted set of Linear Precedence constraints (cf. Optimality Theory). A typical example is presented below, where the symbol "<<"

denotes linear precedence and the constraints are listed in order of decreasing rank/weight:

$S \ll \{I, O\}$

$[+PRO] \ll [-PRO]$  (pronominal before full NPs)

$I \ll O$

In contrast, on the incrementality account, *S* may tend to precede *I* and *O* merely due to the combined effects of conceptual, lexical, and syntactic processing factors.

The incrementality account was tested on the acceptability ratings published by Keller (2000), who applied the psychophysical method of magnitude estimation to elicit fine-graded grammaticality judgments, yielding data for 24 sentence types both with full and pronominal NPs and embodying all possible permutations of *S*, *I*, and *O*. The composition of Keller's data set allowed the estimation of precedence probabilities for 9 constituent pairs. A computer simulation program was implemented that searched virtually the entire space defined by different settings of the precedence probabilities. For every setting, it computed the probability of each of the 24 sentence types. Using a Least Squares method, precedence probabilities were obtained for the model that gave the best fit to the empirical data.

Inspection of the model's precedence probabilities revealed that they were in line with explicit ordering constraints such as those listed above. The *S* tended to precede both *I* and *O*. Pronominal NPs tended to precede full NPs. There was no clear preference for the *I* to lead *O*. Furthermore, pronominal *O*s strongly preferred to precede full *I*s.

The success of this approach suggests, firstly, that satisfactory accounts of the scrambling phenomenon under scrutiny may well be found in the conceptual or lexical domain rather than in the domain of explicit syntactic ordering rules. If so, the syntax of German needs no provisions at all for dealing with so-called "Midfield scrambling". Secondly, the incrementality-based approach appears to offer a viable alternative to published accounts in terms of a hierarchy of ordering constraints, e.g., Optimality Theory.



## 4 NEUROCOGNITION OF LANGUAGE PROCESSING

In 2001, the project moved to the *F.C. Donders Centre for Cognitive Neuroimaging*. Throughout the year the project members participated in setting up the research infrastructure in the new centre. To date, two ERP labs and a 1.5 Tesla MR scanner are fully functional and have already been used for part of the research described below. MEG facilities and a 3 Tesla MR scanner will be functional in the first half of 2002 providing new research possibilities for the project.

In June, a new postdoc, Petersson, joined the project and participated in setting up and validating the software for pre-processing and analyzing functional neuroimaging data at the *F.C. Donders Centre for Cognitive Neuroimaging*. His research focuses on fMRI investigations of language processing in collaboration with Indefrey and Hagoort.

### 4.1 The neural architecture of language processing

#### 4.1.1 Neural correlates of strategic effects in visual word processing

Indefrey and F. Hellwig in collaboration with Shah (FZ Jülich) have completed the analysis of a fMRI experiment on strategic modulations of lexical access pathways. Blocks of regular words were either preceded by a block of irregular words (enforcing visual lexical access) or by a block of homophonic pseudowords (enforcing phonological recoding). There was no evidence for differences in the hemodynamic activation patterns for the regular words immediately following irregular words and homophonic pseudowords. Significant differences between the two conditions, however, were found in the second half of the regular word blocks. Regular words preceded by irregular words elicited stronger activations in

cortical areas (bilateral premotor areas, bilateral occipito-temporal areas, right angular gyrus) also activated by homophonic pseudowords. Regular words preceded by homophonic pseudowords elicited stronger activation in a right posterior temporal region also activated by irregular words and associated with visual word-form access in a previous PET study (see Annual Report 2000). The results suggest that rather than keeping up the lexical access strategy enforced by the preceding stimuli subjects used the alternative strategy when the stimuli (regular words) allowed them to do so.

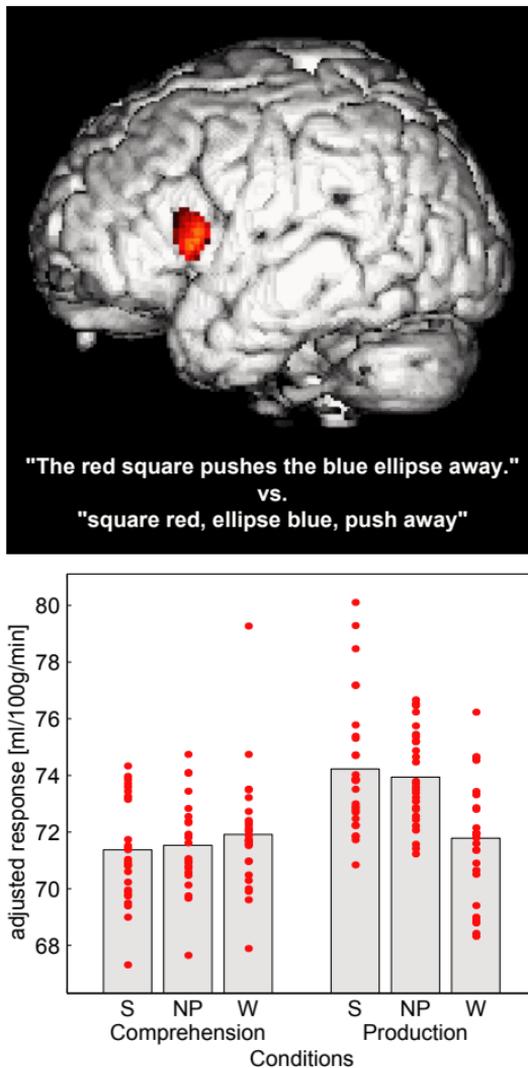
#### **4.1.2 Neural correlates of phonological recoding in reading Japanese Kana**

Indefrey and F. Hellwig in collaboration with Ischebeck (U. Nijmegen) studied phonological recoding in Japanese Kana (syllabogram) reading with fMRI. Words normally written in only one of the two phonologically equivalent but visually dissimilar syllabic scripts (Hiragana or Katakana) and pseudo-words were presented in both scripts to participants during a fMRI-measurement with a silent articulation task using an event-related design. Brain regions associated with phonological encoding (left premotor cortex, left inferior frontal gyrus, and left temporal fusiform gyrus) showed increased activity in both the pseudoword condition and the visually unfamiliar word condition as compared to the visually familiar word condition. This result suggests that words presented in a visually unfamiliar script draw on the same resources for phonological encoding as meaningless pseudowords or homophonic pseudowords.

#### **4.1.3 Neural correlates of syntactic parsing and encoding**

Indefrey, F. Hellwig, and Hagoort in collaboration with Herzog (FZ Jülich) and Seitz (U. Düsseldorf) completed a PET experiment on syntactic production and comprehension. Syntactic production was investigated with a scene description paradigm (Indefrey et al., 2001). Comprehension was tested with a new matching task involving the same visual scenes as in production. Descriptions of the scenes were, however, not generated by the subjects but presented auditorily. The earlier finding of an involvement of the Rolandic operculum in syntactic encoding was replicated (figure 4.1, upper panel). The same area was significantly more active in sentence-level production as compared to comprehension. The reverse comparison showed extensive bilateral temporal activations. No significant differences were found between listening to descriptions in full sentences and descriptions containing only syntactically unrelated words (figure 4.1, lower panel). Since it was possible to solve the matching task by

processing the auditory stimuli only at the word level, the results suggest that the degree of involvement of frontal areas in the syntactic processing of auditorily presented sentences depends on task demands.



**Figure 4.1:** Upper panel: Activation ( $p < .05$ , corrected) of Broca's area (BA 44) and the adjacent Rolandic operculum during the production of sentences compared to the production of syntactically unrelated words (MNI x,y,z,-coordinates of activation maximum -60,14,12). Lower panel: Regional cerebral blood flow (rCBF) across conditions at the activation focus shown in the upper panel. The activation during the production of noun phrases was almost as high as during the production of sentences. By contrast there was no activation when the same sentences and noun phrase sequences were presented auditorily.

#### **4.1.4 The neural correlates of word production**

Following up on previous work (Indefrey & Levelt, 2000), Indefrey and Levelt conducted a comprehensive meta-analysis of the relevant imaging literature on word production (82 experiments) and on auditory word/non-word perception (26 experiments). In addition to taking the spatial overlap of activated regions into account, they also analyzed the available data on the time course of activations. The analysis supported and extended earlier findings, specifying regions and time windows of activation for the core processes of word production: Lexical selection, phonological code retrieval, syllabification and phonetic/articulatory preparation. In addition, the time course of activations in word production was found to be, on the whole, compatible with the temporal constraints that processes of auditory and visual word and nonword perception impose on the component production processes they affect.

#### **4.1.5 The neural correlates of semantic and world knowledge violations**

Petersson, Hagoort, Indefrey and Hald have developed a fMRI paradigm based on the ERP research on the integration of world knowledge during sentence processing (see below). The data acquisition has been completed and the data are currently being analyzed.

### **4.2 Syntactic and semantic integration processes during comprehension**

#### **4.2.1 The integration of real-world knowledge during sentence processing**

Hald and Hagoort examined whether real-world knowledge is integrated on-line during sentence comprehension. This possibility was suggested by the results of a N400 study by Van Berkum, Hagoort and C. Brown (1999) indicating no difference between integrating a word in its local (sentence level) and its global (discourse level) semantic context. In the new ERP experiment, subjects were presented in three conditions with sentences like the following:

- (a) De stad Amsterdam is heel OUD en mooi.  
The city Amsterdam is very OLD and beautiful.
- (b) De stad Amsterdam is heel NIEUW en mooi.  
The city Amsterdam is very NEW and beautiful.
- (c) De stad Amsterdam is heel DUN en mooi.  
The city Amsterdam is very THIN and beautiful.

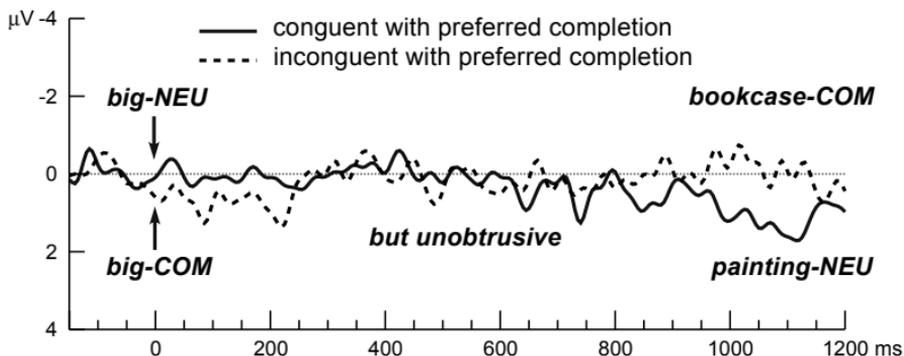
The critical condition (b) was used to test whether a typical N400 is elicited by a sentence that only violates real-world knowledge. Indeed a N400 was found for the world-knowledge condition that was comparable to the N400 found in the semantic condition. This result suggests that real-world knowledge is integrated within the same time course as semantic and discourse information during sentence comprehension.

#### 4.2.2 Discourse-based anticipation in spoken language comprehension

Van Berkum, V. Kooijman and Hagoort, in collaboration with Zwitserlood (U. Münster) and C. Brown, conducted an ERP experiment on discourse-based lexical anticipation in spoken-language comprehension. Everyday conversational experience, as well the systematic responses routinely elicited in cloze tests, both testify to the fact that people can use their knowledge of what the discourse is about to successfully continue somebody else's unfinished sentence. An as-yet unresolved issue, however, is whether comprehenders can use such knowledge rapidly enough to actually predict specific upcoming words in real time, as a sentence is unfolding. To explore this question, they created (Dutch) mini-stories such as *"The burglar had no trouble locating the secret family vault. Of course, it was situated behind a [...]"* which in an "off-line" paper-and-pencil cloze test were predominantly completed with one particular critical noun, e.g., *"painting"*. To test whether such discourse-based lexical anticipation would also occur "on-line" in real-time spoken-language comprehension, they presented the complete stories in spoken form in an ERP experiment, with one modification: The critical noun was now preceded by a gender-inflected adjective whose syntactic gender either agreed with that of the anticipated noun (*"behind a big<sub>NEU</sub> painting<sub>NEU</sub>"*) or did not agree (*"behind a big<sub>COM</sub> painting<sub>NEU</sub>"*). Relative to the gender-congruent control, the gender-incongruent adjective elicited a positive and somewhat right-lateralized ERP deflection, emerging right at the incongruent inflection (see figure 4.2). Because this ERP effect hinges on the arbitrary syntactic gender of an expected but not yet presented noun, it suggests that discourse-level information can indeed lead people to anticipate specific upcoming words as the local sentence unfolds. In addition, it suggests that the syntactic properties of those anticipated - but not yet presented - words immediately begin to interact with local syntactic constraints. Together, these findings suggest that language comprehension has a natural anticipatory component that goes beyond simple

"intra-lexical" priming, and in which both message- and syntax-level representations are involved.

***The burglar had no trouble whatsoever locating the secret family vault.  
Of course, it was situated behind a...*** (preferred completion: *painting-NEU*)



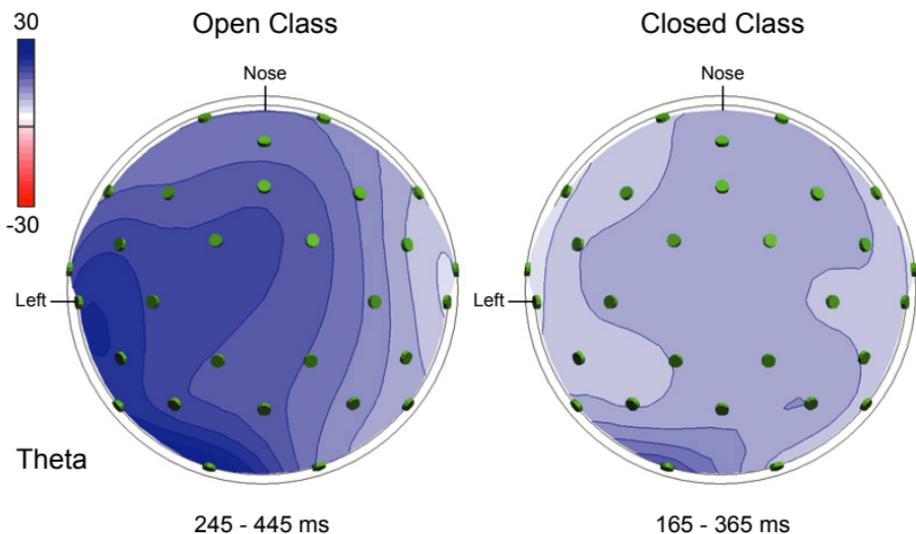
**Figure 4.2:** Average ERPs, at a right-temporal site, elicited by spoken adjectives whose gender inflection is congruent (solid) or incongruent (dashed) with the grammatical gender of the preferred noun in this discourse context. Acoustic onset of the adjective inflection is at 0 ms. The inflection incongruity effect is reliable within 50-250 ms; the effect at 800-1200 ms is a N400 effect elicited by later presentation of the preferred noun versus a less preferred alternative.

### 4.3 Event-related power changes during sentence processing

This project investigates frequency-domain correlates in the human EEG of different aspects of sentence processing. Initial research using a technique termed "induced band power analysis" (IBP, see Annual Report 2000) showed that induced amplitude changes in the theta frequency range, but not in the alpha frequency range, are highly sensitive to various aspects of sentence processing. Bastiaansen and Hagoort tentatively proposed that these event-induced amplitude changes in the theta frequency range might be linked to dynamical interactions between the hippocampal MTL system and the neocortex. This view was put forward in an elaborate theoretical paper (Bastiaansen and Hagoort, submitted).

### 4.3.1 Induced EEG responses to open-class and closed-class words

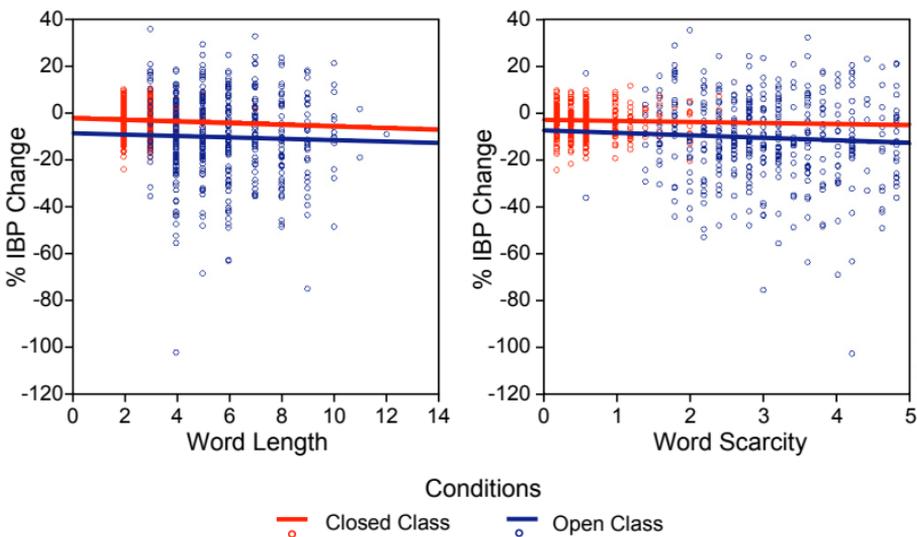
Bastiaansen and Van der Linden, in collaboration with Dijkstra (U. Nijmegen) and Hagoort investigated the theta IBP responses to open-class and closed-class words, through a re-analysis of an earlier EEG dataset collected for an ERP analysis by C. Brown, Ter Keurs and Hagoort (see Annual Report 1997). This dataset had been recorded from young subjects whilst they read a story. Separate waveforms were computed for open-class and closed-class words. An initial analysis confirmed the existence of a phasic theta power increase in the interval from 300 to 500 ms after word onset, which is consistent with the results from previous studies (see Annual Report 2000). Furthermore, differences between open-class and closed-class words were observed in the theta frequency range only. The theta power increase following open-class words was larger than following closed-class words over the left hemisphere only (see figure 4.3). In addition, the peak latency of the theta increase was different for the two word categories, (265 vs. 345 ms after word onset for closed- and open classes, respectively).



**Figure 4.3:** Theta power increases (indicated in blue) following open-class and closed-class words, in a 200 ms window around their respective peak latencies.

Since in other studies ERP differences between the two word classes were attributed to differences in lexico-statistical properties such as word length and word frequency, a multiple regression analysis based on single

items was performed in order to verify whether this is also the case for the differences in theta power. Figure 4.4 shows that the theta power increases are virtually independent of word length and/or word frequency. A multiple regression model explained only 0.2% - 0.3 % of the variance of the theta responses to individual words. This outcome confirmed the results of the ERP analysis (C. Brown, Hagoort & Ter Keurs, 1999).



**Figure 4.4:** IBP changes in the theta band as a function of word length and word scarcity (defined as  $5 - \log$  frequency), for open- and closed class words separately. Negative values on the y-axis represent power increases.

### 4.3.2 Long-range synchronization processes

Bastiaansen continued the implementation of new tools for investigating induced EEG responses. Power increases and decreases in different frequency bands of the EEG are thought to reflect changes in *local* synchrony of neuronal activity. Another parameter of interest in studying induced brain activity is the extent to which *spatially distant* brain areas synchronize their activity. Such information would complement the IBP analyses performed so far in the project. A number of analysis procedures have been collected, and some have been newly developed, by means of which such long-range synchronization processes can be studied. These procedures comprise techniques such as event-related coherence, phase synchronization analysis, and phase consistency analysis. They are currently being implemented, and will be used in the near future in order to

address the question of how spatially distant brain areas interact during the comprehension of spoken or written sentences.

#### **4.4 The time course of lexical access during word comprehension**

Müller continued his Ph.D. project under the supervision of Hagoort and completed the ERP study on the time course of access to lexico-syntactic and lexico-semantic information in language comprehension (see Annual Report 2000). In this experiment, participants read single Dutch nouns presented on a computer screen and performed two decisions concerning a push-button response. For one group of participants, the grammatical gender of the word indicated the response hand (left/right) and the semantic category of the word determined whether the response had to be executed or not (go/nogo). Another group of participants received reversed instructions, so that semantic category indicated response hand and grammatical gender determined response execution. The Lateralized Readiness Potential (LRP), reflecting response preparation for a particular hand, was derived for the go- and nogo-conditions of both instruction groups. When semantics specified response hand and gender determined response execution, a significant deviation from baseline was found for nogo-trials, running parallel to the standard LRP effect on go-trials for a short time and returning to baseline without causing an overt response. This indicates that hand preparation (based on semantics) occurred before inhibition by gender took place. On the contrary, no such deflection for the nogo-LRP was found when gender specified response hand and semantics determined response execution. This is in line with the aforementioned time course: Information to refrain from response execution (semantics) was available before response preparation on the basis of gender could start. Furthermore, in the nogo-conditions for both instructions, a negative deflection was observable (N2). The overall inhibition effect (nogo - go) was strongest at frontal electrodes and its onset as well as its peak occurred earlier when semantics determined inhibition than when gender determined inhibition. Both LRP- and N2-results suggest that semantics is activated before syntax during single word comprehension. However, modelling of these data with WEAVER++ in collaboration with Roelofs showed that the observed LRP- and N2-results are also compatible with an architecture in which lemma activation precedes concept retrieval.

## 4.5 ERP studies on language disorders

Wassenaar and Hagoort carried on with their research on syntactic comprehension problems in patients with Broca's aphasia. During 2001, the data acquisition of an ERP experiment on on-line sentence-picture matching was continued. The experiment focused on the following questions: (1) What does the ERP profile of normal control subjects look like when they hear sentences that either match or mismatch pictures? (2) Do the ERP effects in the Broca patients differ from the normal controls? (3) What is the relation between the ERP effects and the behavioral responses? In this experiment (see Annual Report 2000 for a more detailed description), subjects were shown a picture on a computer screen. After some inspection time had passed, a spoken sentence was presented. The sentence either syntactically matched or mismatched some aspect of the picture. During presentation of the spoken sentence, event-related brain potentials (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, 12 college-aged subjects, 10 patients with Broca's aphasia, and 8 patients with a right hemisphere lesion (RH patients) have participated in the experiment. The ERP data of the elderly controls showed that the mismatch between the event structure of the picture and the sentence was detected as soon as the verb form encoding the relevant syntactic information was presented. This was reflected in the ERP waveform by a negative deflection immediately followed by a positive shift. This pattern was also present in the RH patients. For the patients with Broca's aphasia, a dissociation was found between their on-line ERP data and their off-line behavioral responses. The waveforms for the Broca patients showed either a considerable delay in the on-line mismatch detection or no such electrophysiological response at all. The latter seems to be in contrast to their above-chance performance on the decision task. Longer push button response latencies for the Broca patients seem to suggest that, if on-line processing fails, a (mis)match detection can, to a certain extent, alternatively be made in a more off-line way. This implies that performance in off-line tasks can seriously mask the nature of on-line processing deficits.

## 5 GESTURE

In the past several years, the main focus of the Gesture Project has been on co-speech gestures, namely gestures that spontaneously accompany speech. In addition to the research on co-speech gestures, 2001 saw substantial increase in the area of sign language research. The catalyst to this new development was the arrival of Slobin (UC Berkeley), who is spending his sabbatical year at the Institute. He and Hoiting (Royal Institute for the Deaf 'H.D. Guyot') established the Sign Language Research Group (SLRG), which has begun to meet regularly at the Institute, bringing together researchers in sign language linguistics and psycholinguistics from across the Netherlands. Within the Institute, two Ph.D. students are working on sign language. Perniss started her project on spatial communication in German Sign Language (see Space Project 6.5). Pyers (UC Berkeley), visiting for a year with Slobin, works on the issues concerning theory of mind in users of Nicaraguan Sign Language.

The continuing investigation of co-speech gestures encompasses several major areas of inquiry: The relationship between speech and gesture production processes, the communicative function of gestures, the ethnography of pointing gestures, the relationship between the brain and gesture, second language acquisition and gesture, and the nature of gestural semiosis.

### **5.1 Crosslinguistic differences in gestures depicting motion events: A processing unit account**

Kita, Özyürek (Koç U.), and Allen (Boston U.) investigated the relationship between gesture and speech production processes. The goal of this subproject is to provide evidence for the Interface Hypothesis of speech-gesture production which holds that iconic gestures are generated from an

interface representation between spatial thinking and speaking. The interface representation is a "package" of spatio-motoric representation that can be uttered within a planning unit of speech production.

In order to obtain supporting evidence for the hypothesis, they compared iconic gestures produced by Turkish and English speakers. Narratives in these two languages were elicited for 10 animated cartoons. Each stimulus depicts a motion event that involves Manner and Path (e.g., rolling up). Turkish requires two clauses to express both Manner and Path ("he ascended, as he rolled"), while English can encode the pieces of information in one clause (Talmy 1985). The stimuli are designed in such a way that for half of the stimuli English speakers tend to separate Manner and Path into two clauses (Separation Items), and for the other half they tend to choose a one-clause expression of Manner and Path (Conflation Items). Since a clause is considered to approximate a planning unit for speech production (Levelt 1989), the Interface Hypothesis predicts that when speakers linguistically encode Manner and Path in two clauses, they are more likely to create "two packages" of information by separating the images of Manner and Path. This should lead to two separate gestures for Manner and Path. In contrast, when one-clause packaging of Manner and Path is chosen, speakers should be more likely to put Manner and Path in one image, leading to a gesture that expresses Manner and Path simultaneously. In support of the Interface Hypothesis, they found the overall tendency that Turkish speakers are more likely to produce two separate gestures for Manner and Path, and that English speakers are more likely to express Manner and Path in a single gesture, replicating prior findings (see Annual Report 1997). Furthermore, they found that English speakers tended to produce two separate Manner and Path gestures for the Separation Items and a single gesture conflating Manner and Path for the Conflation Items.

## **5.2 Functions of gesture and its relationship to speech**

Melinger and Kita developed two studies addressing the locus of the speaker-directed facilitation of co-speech gestures in speech production. They collected descriptions for networks of colored circles and compared when speakers produced gestures to when they did not. In both studies, the pictures were described from memory to a nonvisible interlocutor.

Melinger and Kita contrasted the likelihood of producing a co-speech gesture when either processes for conceptual planning or lexical retrieval

were taxed. For the former analysis, they compared gesture production for pictures with branching paths to those with nonbranching paths. Significantly more gestures were produced to branching pictures than to nonbranching pictures. Furthermore, this difference was limited to the non-deterministic sub-portion of path, not to the entire path. For the latter analysis, they looked at lexical repetitions under the assumption that retrieving a word for the first time is more difficult than retrieving it a second time. No difference in gesture frequency was found between the first and second mention of a lexical item. The results of this study support a model in which gesture facilitates speech planning at the conceptual level but not at the lexical level.

In a subsequent study, Melinger and Kita looked more closely at different types of conceptual complexity and their relationship to gesture production. Participants described networks with various types of complexity. They found that taxing certain conceptual processes such as spatial reorientation and decision making correlated with an increase in gesture production while taxing other processes such as memory load did not. This result suggests that only specific conceptual processes are facilitated by gesture.

Melinger and Levelt used a similar elicitation task to address the question of whether iconic gestures constitute part of the speaker's communicative intention. There is a debate in the literature as to whether iconic gestures are communicatively intended or produced solely for the purpose of facilitating speech production. In order to investigate this issue, a corpus of spatial descriptions was collected, again using networks of colored circles arranged along a path, in which a speaker communicated to a visible listener the path through the network and the color of each circle. The inclusion of path information in gesture affected the subsequent content of the linguistic description. For example, participants omitted information about the spatial relationship between two circles in speech more often when that same information was gestured earlier in the description. Furthermore, some speakers relied solely on gesture as a means to communicate spatial information, using speech only to indicate the color of the circle. These results suggest that the gestures were intended to communicate spatial information.

### 5.3 The recipient's attention to gesture

The attention to gestures by the recipient was investigated in two studies. The first study investigated how visual attention to gestures, as measured by gaze fixation, is influenced by different presentation methods. The second study investigated which physical features of the gesture affect recipients' visual attention to and information uptake from gestures.

Gullberg, in collaboration with Holmqvist (Lund U.), continued to explore recipients' attention to gestures in interactive communication using eye-tracking techniques. In a previous study (Annual Report 2000), recipients' gaze behavior towards speakers' gestures was compared in a live face-to-face condition and a video condition. The purpose was to substantiate the ecological validity of a video-based paradigm needed to study the relationship between visual and cognitive attention to gestures and sign languages. This follow-up study aimed to distinguish the effect caused by manipulating the projection size from the effect caused by manipulating the presence/absence of a live interlocutor. Therefore, the study compared recipients' fixations of the *same* speakers and their gestures in three conditions: (a) live face-to-face (b) projected as a life-sized video on a wall (c) as video on a TV monitor. The results showed that projection size affected the overall number of gesture fixations, such that significantly fewer gestures were fixated in the monitor condition than in the face-to-face condition or in the life-sized video condition. Peripheral vision is clearly more efficient in the monitor condition, and recipients do not have to refixate to attend to speakers' gestures. In contrast, the absence of a live interlocutor only affected the fixations of a sub-set of gestures; specifically, gestures that were fixated by the speaker him-/herself received fewer recipient fixations in both video conditions compared with the live condition. Speaker-fixation as a cue to joint attention appears to be essentially a social phenomenon. Overall, the results indicate that the life-sized video condition was more similar to the live condition than to the monitor condition. A paradigm based on life-sized video projection need therefore not compromise ecological validity.

Gullberg, in collaboration with Kita, explored the relationship between recipients' visual attention to speakers' gestures and their information uptake from the same gestures. Subjects were shown natural target gestures embedded in story retellings. Their fixations were recorded and information uptake was operationalized as the ability to graphically reproduce information that had *only* been present in gestures. The effect

of two articulatory gesture features (location and hold) and of speakers' fixations of their own gestures was tested. It was found that (a) holds and speaker-fixated gestures attract recipients' fixations, whilst location is irrelevant. This finding is important as it teases apart the independent effect on fixations of each of these gestural features that often cluster in spontaneous data; (b) only speaker-fixated gestures lead to uptake by the recipients reliably above chance; (c) there is no simple relationship between fixation and information uptake. Gestures appear to be fixated for different reasons, either reflexively (holds), or when cognitive attention has already been directed to a target (speaker-fixated gestures). In sum, speakers' gaze is a powerful cue to joint visual and cognitive attention.

#### **5.4 The neuropsychological basis for gesture**

In a project funded by the DFG (German Research Society), Lausberg and Kita investigated hemispheric specialization of gestures in split-brain patients. The study is realized in collaboration with Ptito (Montreal Neurological Institute) and Zaidel (UCLA). The focus of the investigation was the role of the right and left hemispheres in the production of volitional and spontaneous communicative gestures. They examined split-brain patients whose spontaneous and distinct gestures of the right hand can only be generated in the left hemisphere and vice versa. On this anatomical basis, one can infer hemispheric specialization from the performance of the right and left hands. Their sample comprised three patients with complete callosotomy and two gender- and age-matched control groups including five patients with partial callosotomy and eleven healthy subjects.

Three studies regarding hemispheric specialization for gesture were conducted. The first study concerned the "neglect" of left space in right hand pantomime (gesturing without speaking) in split-brain patients. The second study also concerned split-brain patients and it investigated the hemispheric specialization for production of motor patterns appropriate for various objects such as tools. The third study investigated the factors that determine the hand choice for co-speech gestures using the data from normal subjects.

Lausberg and Kita investigated hemispheric differences in the nature of gestural representation of spatial information. As the right and left hemispheres are specialized for various visuo-spatial and motor functions, they hypothesized that split-brain patients use the right and left hands

differently to display spatial information. Animated cartoons showing two objects moving in relation to each other on a horizontal line were pantomimed by the subjects without speaking. The subjects freely chose the hand(s) to be used for pantomiming and they spontaneously used both hands.

In pantomimes by the right hand, the split-brain patients differed significantly from the two control groups. The split-brain patients shifted the center and the left border of the scene to the right so that events in the left screen side were represented in their right personal space. In effect, the representation of the whole scene was squeezed into the right personal space. In contrast, the two control groups displayed events of the left screen space in the analogous space, i.e., their left personal space. In pantomimes by the left hand, the split-brain patients did not differ from the controls. Namely, they all represented events in the left screen space in the left personal space, and events in the right screen space in the right personal space. These data suggest that, in split-brain patients, there is a neglect of the left personal space in right hand gestures.

These findings do not concur with the proposition that the left hemisphere's specialization for right space is only due to suppression by the right hemisphere via corpus callosum (Plourde & Sperry, 1984). Instead, the results support the hypothesis that the separate left hemisphere is specialized for right space (Goldenberg, 1986; Kashiwagi et al., 1990).

Lausberg, Cruz (COPE Behavioral Services), Kita, Zaidel, and Ptitto examined the competence of the separate right hemisphere to retrieve movement concepts as a response to visual presentation of objects. Pantomime to visual presentation of objects and demonstration with object manipulation was tested.

The patients with complete callosotomy showed a significant left hand dyspraxia for pantomime to visual presentation of objects but not in the demonstrations with the object in hand. The data suggest that the separate right hemisphere is deficient in retrieving movement concepts associated with visual object recognition. However, the right hemisphere is competent to perform meaningful movements on the basis of tactile object recognition. The separate left hemisphere is competent in controlling movement in both modalities. In this respect, the data partly support Liepmann's original hypothesis (1908) that the left hemisphere is motor

dominant. However, the right hemisphere has some task-dependent motor competence.

Lausberg and Kita investigated the hand preference in spontaneous speech-accompanying iconic gestures and pantomimes (without speaking) in 10 normal right-handed subjects. Gestures were elicited by narration and silent pantomime demonstration of animations in which two objects move in relation to each other on a horizontal line. In both conditions, the left hand was used as often as the right hand to display iconic gestures. The data show that language lateralization and/or handedness are not the sole determinants of the hand preference in iconic co-speech gestures. The hand choice in co-speech gestures was influenced by the spatial location and the mobility of objects. Furthermore, there was a shift of hand preference from right to left in the course of the speech condition. This is compatible with the interpretation that left hemisphere involvement decreased due to repetitive verbalization of similar contents.

## 5.5 Lip-pointing in Laos

Lip-pointing is a common but little described form of deictic gesture. Enfield collected a set of examples of lip-pointing gestures from video recordings of natural interaction among speakers of Lao (Southwestern Tai, spoken mainly in Laos). They showed consistencies in form as well as semiotic function of lip-pointing. Lip-pointing has a "recognitional" or "presuppositional" tone, and is mostly restricted to pointing out things and locations which are in conversational focus (especially as answers to "Where?" or "Which one?" questions). Speaker gaze plays an important role in lip-pointing, always aligned to the referent. This gave rise to a "gaze switch" hypothesis, namely that the function of the lip action is not to set up an indexical vector of its own, but to index the (more accurate) vector of the gaze.

## 5.6 Editing gesture diagrams

In co-speech gesture (as well as in signed language), "diagrams" can be created in the gesture space, and these have spatial and temporal cohesion: The "diagram" persists over time as if something were actually "there" in the gesture space. Enfield examined video recordings of speakers of Lao, focusing on the question of what techniques people use to "edit" gesture diagrams when changes to the configuration are necessary. The speakers were discussing nonspatial kinship relationships

(e.g., marriage rules concerning cousins, and kinship terminology used between brothers). The Lao data reveal four strategies for dealing with the need to "edit" a gesture diagram: (1) move the body so as to increase one's reach and effectively make the gesture space larger; (2) use a "hold-and-drag" move, in which one hand "holds" a meaningful point in the diagram and "drags" it to a new place, while maintaining the basic configuration of the diagram; (3) use a "hold-and-work-with-free-hand" move, in which one hand "holds" a meaningful point in the diagram while the other makes a change or fills something in; (4) a certain referent, which is associated with a point in the diagram, is simply reassigned to a new point in the diagram.

### **5.7 Learner-specific varieties in second language speech and gesture: The case of anaphoric linkage**

In this project, Gullberg studied gestural equivalents to a learner variety phenomenon in speech focusing on anaphoric linkage in story retellings by learners of French and Swedish. Independent of their first and second language (L1, L2), all learners at early stages typically over-mark maintained referents or topic elements in speech, using full NPs rather than pronouns or zero anaphora. This study showed that over-explicitness in speech was mirrored by (over-)marking in gesture. L1 speakers map discourse referents onto space by associating new referents with specific spatial locations using abstract deictic gestures. In contrast, learners not only anchor new referents, but also anaphorically indicate maintained referents gesturally. The gestural over-marking disappears with the development of pronouns or zero anaphora in speech. In an addressee-based perspective, this over-marking in gesture and speech may pertain to ambiguity resolution. In a speaker-based perspective, anaphoric over-marking may be related to L2 speech planning and processing load.

### **5.8 Acquisition of Sign-Supported Dutch and Sign Language of the Netherlands**

Hoiting and Slobin studied the early acquisition of two varieties of signing by deaf children and their hearing parents, using data gathered by Hoiting in the northern part of the Netherlands. In 1995, the Sign Language of the Netherlands (SLN) was introduced as a first language in the education of deaf children at the Royal Institute for the Deaf 'H. D. Guyot' in Haren, replacing the earlier use of Sign-Supported Dutch (SSD). This choice had

been motivated by the conviction that SLN as a first language opened up better perspectives for language acquisition in both the signed and spoken modalities. Hoiting and Slobin are evaluating this position, using acquisition data from two populations of deaf children (age 18-36 months) with hearing parents: One group using SSD (studied before 1995) and the other using SLN. Both L1 (children) and L2 (parents) acquisition data are examined, in comparison with a small group of children with Deaf parents. The data are being analyzed with the help of the Berkeley Transcription System (BTS), which provides for analysis of signed utterances at the level of meaning-components, both manual and nonmanual. It is shown that the communication of the SSD-acquiring individuals (children and parents) does not match the complexity shown by the SLN-acquiring group, and that parent-child communication is richer and more successful in the latter group. Hoiting and Slobin argue that the contrast in linguistic typology between spoken and signed languages does not allow for successful simultaneous communication in the two modalities, as required in SSD.



## 6 SPACE

The Space Project investigates the nature of spatial parameters in natural languages and their relation to nonlinguistic spatial cognition. In this summary of the 2001 research, the first section reports on results of joint research on the semantic encoding of static topological relations cross-linguistically. The next section reports further work on "Frames of Reference" (FoR), with a study showing that Li & Gleitman's critique of earlier work is misconstrued, further work on the acquisition of the Tzeltal Mayan absolute and intrinsic system, a study on the linguistic encoding of FoRs by bilinguals, and a new project on FoRs in German Sign Language. Section 6.3 reports on two systems of nominal classification, one of which is relevant for the differentiation of objects with respect to their shape and one of which shows interesting interrelations between deictic classifiers and locative verbs. We also present new insights into some of the demonstrative systems under research, report research on locative verbs and positionals, and describe a completed Ph.D. project on the spatial grammar of Marquesan. Finally, we report the first results from a new subproject on spatial thinking in nonspatial domains.

### **6.1 The semantic encoding of static topological relations: Adpositions**

Continuing in the direction sketched in the Annual Report 2000, our research gathered data on the use of spatial adpositions from 13 languages: Yélf Dnye, Tiriyo, Dutch, German, Russian, Ewe, Trumai, Lavukaleve, Yukatek, Kilivila, Hindi, Polish, and French. The objective is to assess the degree of commonality across languages in the underlying semantic distinctions in spatial adpositions, starting with this sample. The background question is to what extent so-called topological spatial notions

(like "in", "on", "under", "near") are universal, based on innate concepts or ecological uniformities, hence making this core spatial domain easy for children to learn. Four of the five closely related Indo-European languages (German, Russian, Polish, and French) were removed from the sample to avoid genetic biases, as well as Hindi and Kilivila where the data are still under analysis. We report here then on the comparative results for the following 6 languages (with the number of speakers who contributed data in parentheses): Tiriyo (11), Yéli Dnye (8), Ewe (7), Trumai (1), Yukatek (5), and Lavukaleve (1). The data were gathered in the field by (respectively) Meira, Levinson, Wilkins, Ameka, Guirardello, Bohnemeyer and Terrill using the Topological Relations Picture Series booklet, an elicitation tool developed by Bowerman and Pederson, which contains 71 spatial scenes to be described.

Levinson and Meira analyzed the resulting data in two different ways. First, "Venn diagrams" representing the extensions of the various spatial adpositions in each language were drawn - that is, grouping scenes in the elicitation tool that receive the same spatial adposition were grouped together. Figures 6.1a & 6.1b exemplify this for Tiriyo and Ewe (extensions of distinct adpositions are ringed in different colors).

As can be seen in figures 6.1a and 6.1b, the disposition of the pictures changes from language to language, since every map was made in such a way as to group scenes treated with the same adposition. We then turned our attention to trying to find a single disposition of pictures onto which all adposition extension sets from all languages could be mapped, without dividing scenes grouped together by any language. This task is computationally intractable, and must be approached through trial and error driven by hypothesis. The best result so far is the disposition illustrated in figures 6.2 and 6.3, onto which the extension sets of four languages (Tiriyo, Yéli Dnye, Ewe, and Trumai) can be mapped. Figure 6.2 contains the Tiriyo sets, which are the same as in figure 6.1a; one can see how the sets have to be deformed to fit in figure 6.3.

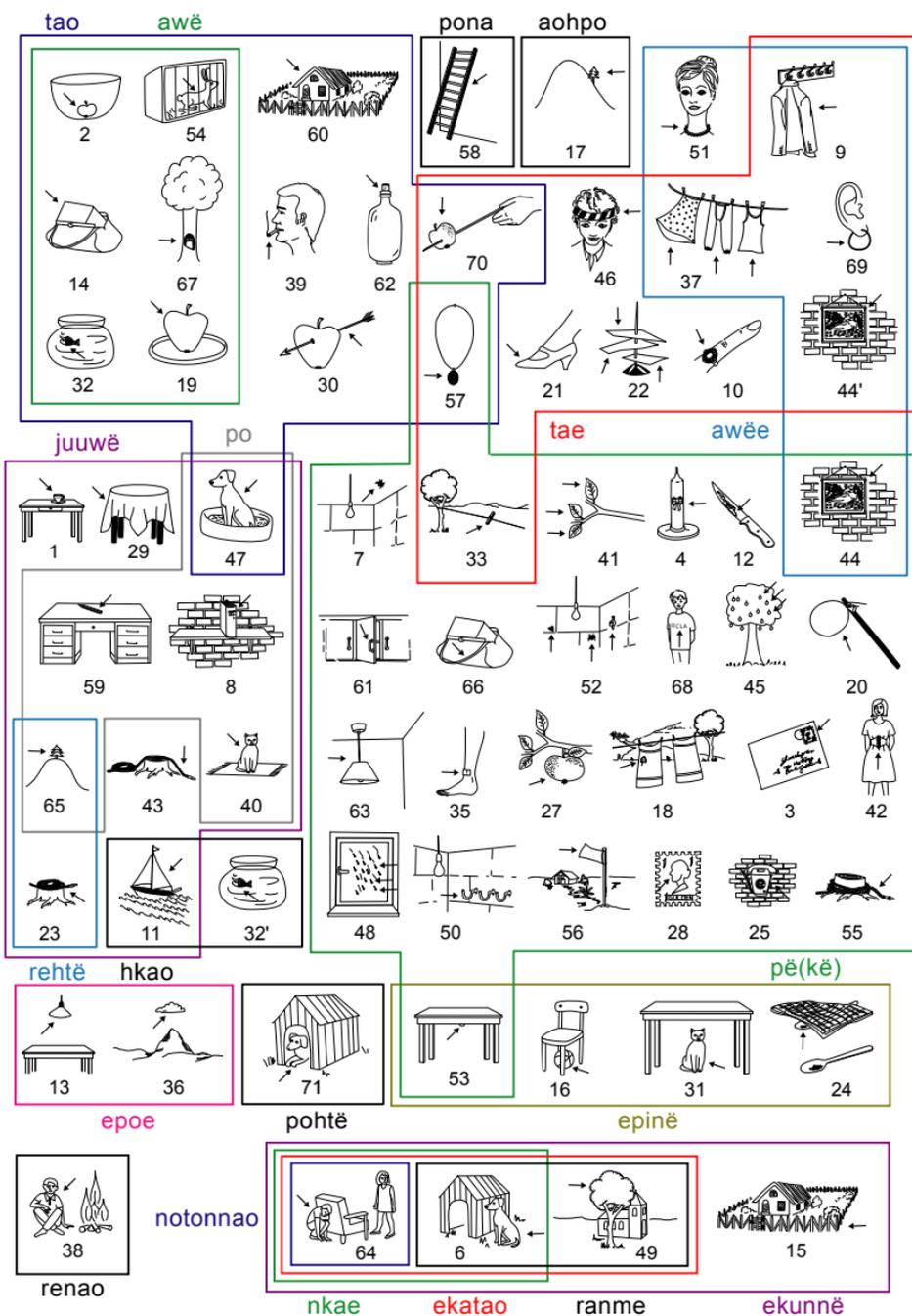
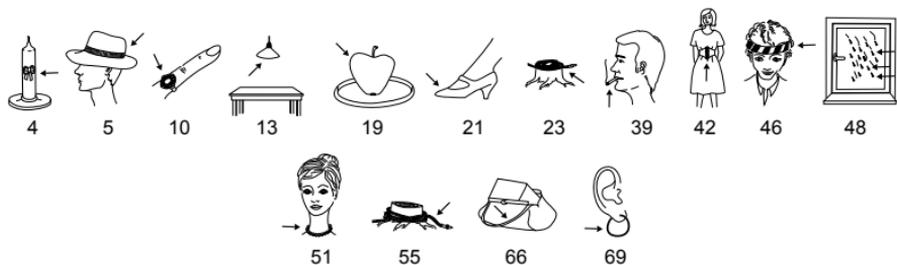
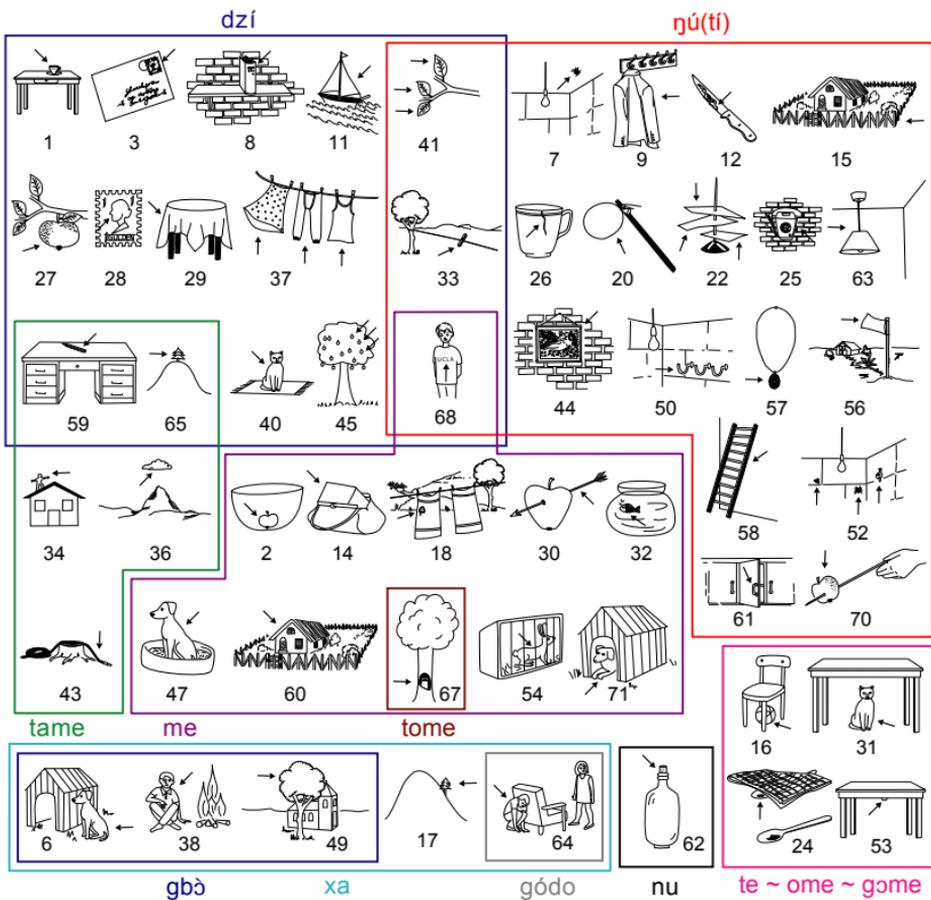


Figure 6.1a: 'Venn Diagram' for Tiriyo



(no spatial postpositions)

**Figure 6.1b:** 'Venn Diagram' for Ewe

(1) Prepositions: 7 core members, 1 locative (others: allative, perlativ, ablative, extent/"until", dative, comit/instr) (2) Postpositions: many have evolved from, and are homophonous with, body parts. They specify the 'search domain'.

**dzi**: "upper surface"; **nú(tí)**: "outer surface"; **tame**: "apex, peak"; **me**: "containing region of" (= "confines"?); **tome**: "hollow, interior"; **xa**: "beside"; **gbò**: "place, vicinity"; **gódo**: "outside of, other/opposite side of"; **nu**: "entrance, opening, end point"; **té ~ ome ~ gome** (dialectal variants): "under, bottom";

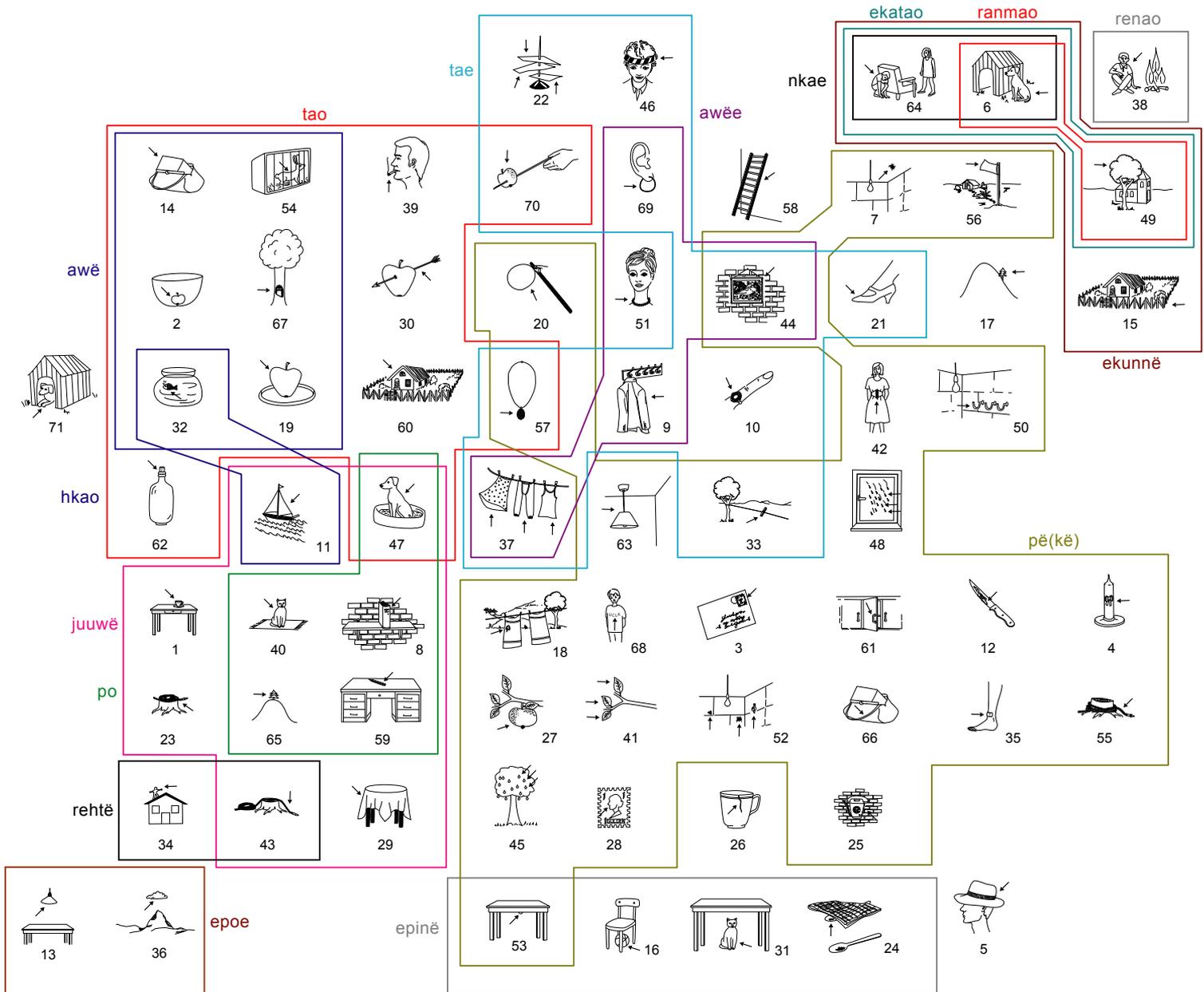


Figure 6.2: Adposition map of Tiriyo



Figure 6.3 is a superposition of the extension maps of Tiriyo, Yélf Dnye, Ewe, and Trumai. It is immediately evident that, even considering only four unrelated languages, there is no obvious consensus on major groupings. This seems to suggest that there are no simple absolute universals in this domain, that is, no large natural categories (e.g., ON or IN categories) respected by all languages.

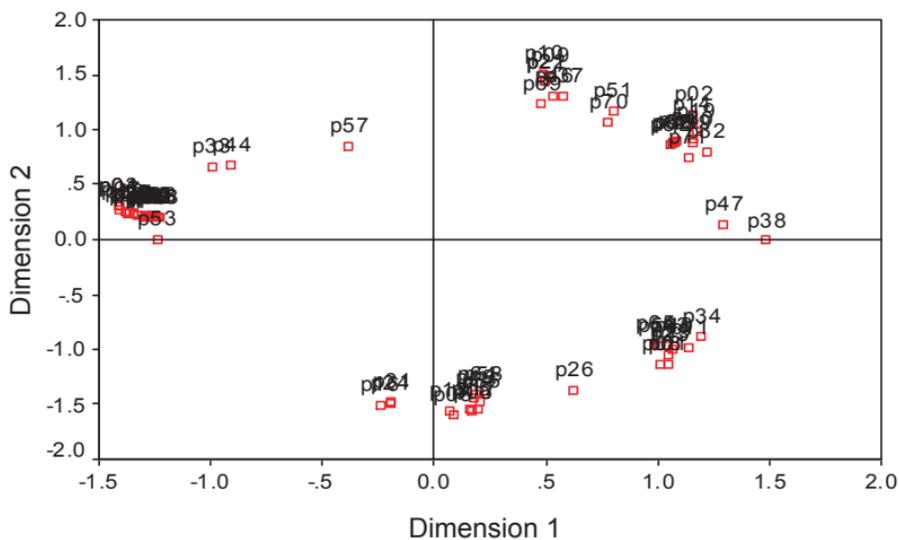
Nevertheless, there may be universal tendencies. In order to examine this possibility, a statistical approach was taken to the same data. For each language, the adpositional extension data were transformed into dissimilarity measures reflecting the level of dissimilarity between any two given pictures, according to the following rules:

For every two pictures  $p_1$  and  $p_2$  in a language  $L$ , count the number of adpositions that treat  $p_1$  and  $p_2$  alike (e.g., for Tiriyo, in figure 6.1a, pictures 2 and 54 are treated alike by two adpositions, /tao/ and /awë/, while pictures 2 and 1 are not treated alike by any adposition).

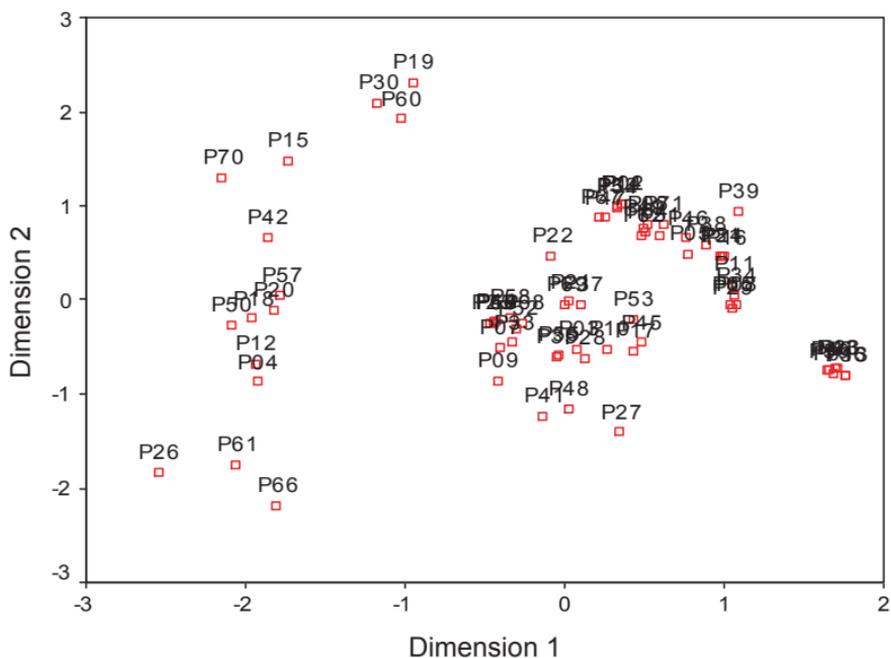
Subtract the number obtained above from the total number of adpositions for that language, thus obtaining the number of adpositions that did not treat  $p_1$  and  $p_2$  alike. For Tiriyo, the total of spatial adpositions in the data is 20; thus, for pictures 2 and 54, one obtains  $20 - 2 = 18$ , and, for pictures 1 and 2,  $20 - 0 = 20$ .

Divide the number obtained above by the total number of relevant adpositions for that language (20 in Tiriyo); the resulting number is the dissimilarity coefficient between  $p_1$  and  $p_2$ . Thus, for pictures 2 and 54, one has  $18/20 = 0.9$ , and for pictures 1 and 2,  $20/20 = 1.0$ .

The resulting coefficients were tabulated, forming a dissimilarity matrix. To this matrix the statistical technique of multidimensional scaling was applied (ALSCAL, SPSS, version 7.5), producing, for Tiriyo, the diagram in figure 6.4, in which the dissimilarities between pictures are represented as distances (the numbers -  $p_1$ ,  $p_2$ , etc. - represent the pictures). It shows that pictures form clearly identifiable clusters, which are not the same as the extension sets in figure 6.1a. Similar diagrams were made for all 6 languages, after which a composite diagram was calculated. This was done by simply adding all the dissimilarity matrices for all the languages and obtaining a resulting composite dissimilarity matrix, to which the same multidimensional scaling technique was applied. The composite diagram is shown in figure 6.5.



**Figure 6.4:** Derived stimulus configuration Euclidean Distance Model - Tiriyo only



**Figure 6.5:** Six languages - Composite Diagram

By looking at this final diagram, one can see that there are still clearly identifiable clusters (although not as sharp as in figure 6.4). This suggests that the cuts made by the various languages are not so arbitrary as figure 6.3 might have suggested. By examining the final clusters, one can still identify in them some of the features that had been suggested as relevant (see Annual Report 2000): Inclusion, partial inclusion, adhesion, contact, etc. It would thus seem to be the case that the distinctions made by adpositions tend to respect such features. In retrospect, these tendencies can perhaps be spotted in figure 6.3, where almost every picture is separated from its neighbors, but often by a "cut" made by only one language. Figure 6.5, on the other hand, shows general tendencies: The clusters indicate the general grouping tendencies in the sample of languages, which do indeed preserve the features mentioned above.

In summary, this work suggests that there are no direct absolute semantic universals in topological spatial adpositions, whereby all languages would agree that a small set of scenes will be grouped, e.g., by an ON relation. Nevertheless, on the basis of a small crosslinguistic sample, there is some reason to believe that there may be statistical tendencies to respect a small set of underlying semantic parameters.

## 6.2 Positional verbs in locative description

Earlier work in the project had established that locative verbs can play an important semantic role in locative description (see Annual Report 1999). We proposed a typology of locative predication along the following lines (the terminology here supercedes the earlier one):

- Type 0: No verb in basic locative construction (Saliba, Austronesian, Papua New Guinea)
- Type I: Single locative verb (or suppletion under grammatical conditioning) Ia:
  - Ia: Copula (i.e., dummy verbs used in many other constructions; English, Tamil, Chukchi, Tiriyo)
  - Ib: Locative (+ Existential) verb (Japanese, Ewe, Yukatek, Lavukaleve)
- Type II: Postural verbs (i.e., a small contrastive set of posture verbs (3-6 verbs) (Arrernte, Dutch, Goemai)
- Type III: Positional verbs (a large set of dispositional verbs, 12-100) (Tzeltal, Zapotec, Laz, Likpe)

The sets of verbs in systems of Type II and III can carry important contrastive spatial information. Ameka conducted further research on the

semantics of Likpe positional verbs of Type III using the Picture Series for Positional Verbs (PSPV) book (Ameka et al. 1999), as part of on-going work on the linguistic and cultural documentation of the languages of the Ghana-Togo Mountains languages, an isolated group of the Kwa branch of the Niger-Congo family. The main features of the Basic Locative Construction (BLC) in Likpe were outlined in the Annual Report of 1998 (pp. 60-61) where they were compared with those of the BLC in Ewe, the dominant lingua franca of the Likpe speaking area. Unlike Type II languages like Yélfí Dnye (see Annual Report 1999), Likpe and other Type III languages provide detailed and rather precise information about the overall configuration of Figure and Ground, as well as the shape and orientation of the Figure, or its multiplicity. Thus whereas the location of bottles in mixed positions (some standing, some lying) on a table (picture 46 PSPV, figure 6.6a) can be localized in Yélfí Dnye using the "stand" verb alone (the default verb for bottles), in Likpe the preferred response characterizes the exact configuration using the verbs for "stand" and "lie" as in (1):

- (1)      *ɛtsywənyē*      *ana*      *labe*      *lǎ́*      *ɔpúnu*      *əsué*  
           three stand      four      lie      LOC      table      BODY  
           "Three are standing, four are lying on top of the table"

The use of the verb *labe* "lie" with an inanimate figure is pragmatically marked. It is used to indicate contrasting positions. Outside such a context the verb is not used for inanimate figures. Thus, it is rejected for locating a bottle lying on a rock (picture 26 PSPV, figure 6.6b), and for 7 bottles lying on a table (picture 52 PSPV, figure 6.6c). For both situations the verb *tǎkə́* "be at horizontal surface" is preferred. This verb gives information about the overall configuration of both Figure and Ground. For picture 6.6c however, one can also just give information about the multiplicity of the Figure and use the verb *kpo* "mass/multiple Figure be somewhere".

Another finding is that the semantic features encoded in the verbs are rather detailed. For instance, some of the verbs contrast in the feature "tight fit": *má* "fixed" vs. *mánkla* "gripped"; others contrast in terms of "point suspension". Thus, there are two verbs for HANG -*fáka* "hang" and *yóma* "suspend". Interestingly, these kinds of features tend to be encoded in adpositions in other languages with a rich system such as Tiriyo or Yélfí Dnye (see Annual Report 2000: 77). One property of Type III languages is that they have very few spatial-relational adpositions. Likpe, for instance,



**Figure 6.6a:** Picture 46 PSPV



**Figure 6.6b:** Picture 26 PSPV



**Figure 6.6c:** Picture 52 PSPV



These classifiers are grammaticalized from a form class consisting of four postural verbs ("hang/move", "sit", "stand", "lie") and one existential predicate, which are used contrastively in spatial descriptions (they are locative predicates of Type II in the typology in 6.2). These verbs and classifiers encode information about whether or not the Figure maintains an orientation that extends beyond the Ground, and, if so, how it maintains this orientation (e.g., by a supporting base or by adhesion). In addition, they encode classificatory information in that every physical object is associated with one default postural verb, based on its canonical orientation. These default assignments can be used in spatial descriptions regardless of the Figure object's actual orientation at the moment, and in this way they form an implicit nominal classification system.

The existential belongs to the same form class, but it is semantically more general in that it encodes existence at a location, without presupposing any orientation. However, it only replaces a postural verb when the orientation of the Figure is either unknown or not otherwise describable. This distribution can be captured pragmatically: In a set of alternates, the use of the informationally weaker form (the existential) implicates that the stronger form (the relevant postural) does not apply (see Annual Report 1999: 53).

The semantics of posturals and the existential differs crucially from that of a set of positional verbs (e.g., "face down"). These are similar to Type III predicates in the typology in 6.2 above - it would be unusual for a language to have both postural and positional verbs in the basic locative construction. However, these do not encode locative relational and existential information, but rather spatial information about the internal disposition of an object, so perhaps should be called "dispositionals" to contrast with Type III positionals proper. Dispositionals can occur in the locative construction to focus on a marked internal property of the Figure, but they cannot occur as classifiers in the demonstrative.

Many languages explicitly classify nominal referents by spatial properties, in particular shape, by means of a closed class of linguistic expressions such as numeral classifiers, verb classifiers or noun-class systems (see Annual Report 1996: 72). Seifart has begun the study of nominal classification in Miraña, an indigenous language of Colombia, for a doctoral dissertation. In this language, nouns with nonhuman referents usually combine in their singular forms with one out of approximately 50 class markers which specify their shape, as in the following examples (where,

e.g., "CL. container" glosses a class marker restricted to nominals denoting containers):

*ʔúvi:-ba*                      *á:kité-ʔi*  
 basket-CL.container    fall.down-PRED  
 "The basket fell down"

*tájne-u*                      *ádZu-u*  
 my-CL.round    eye-CL.round  
 "My eye"

In Miraña, the shape information about a referent is all in the class marker, so a bare noun stem only refers to an abstract concept such as a botanical species:

*úhE*  
 "banana (as a botanical species)"

*úhE-ʔo*  
 banana- CL.oblong  
 "a banana (fruit)"

*úhE-ko*  
 banana- CL.shaft  
 "a banana (plant)"

Shape-specifying semantics are dominant in most systems of nominal classification. However, we know little about the use that speakers make of this categorization in situated discourse. To investigate the actual use of classifiers when referring to abstract shape distinctions, a picture-object matching task was designed in which one speaker (the director) instructs another (the matcher) on how to arrange a constellation of differently shaped, afunctional wooden objects. We now have data for this task from Lao (Enfield), Kilivila (Senft), Yucatec (Bohnenmeyer), and Miraña (Seifart).

Preliminary results suggest that typologically similar systems of nominal classification have different functions. Kilivila and Miraña have similar systems regarding the number of class markers, their morphosyntactic loci and semantics. But while in Miraña the class markers are the preferred resource for distinguishing differently shaped objects, Kilivila does not use classifiers for shape distinctions, relying for those on complex verbal

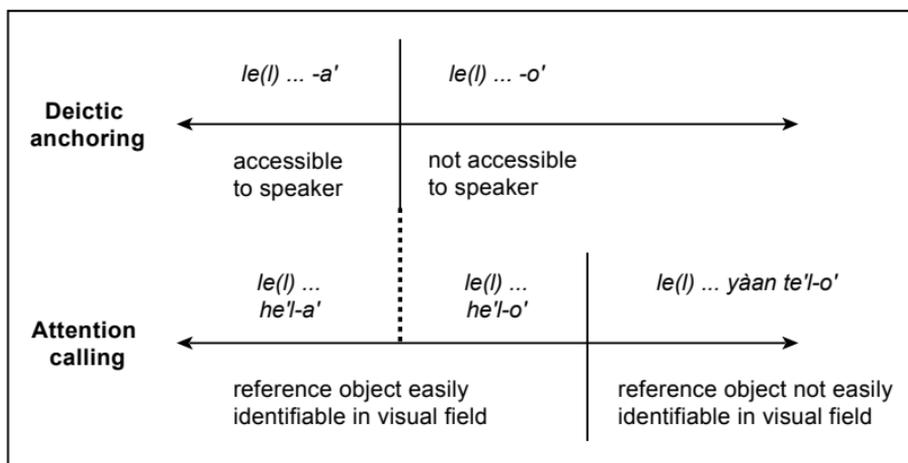
descriptions. Classifiers are rather used to refer to the material of the presented objects in this language. In Lao, numeral classifiers are used to distinguish these objects by their shape, while the Yucatec numeral classifiers do not serve this function. In languages such as Kilivila, shape classifiers seem to be conventionally associated with nouns, so a classifier can only be used when the referent is referred to by a noun which is associated with that classifier. On the other hand, Miraña and Lao classifiers seem to classify referents more directly, so they can be used independently of a name for the referent to refer to the differently shaped objects that have no name in those languages.

#### **6.4 Demonstrative systems and deixis**

Bohnemeyer completed the analysis of data collected with speakers of Yukatek Maya using the Demonstrative Questionnaire (see Annual Report 1999: 54). Preliminary results had shown that Yukatek demonstrative forms operate on a simple binary distinction of distance from speaker, such that the location of the addressee has no direct impact on demonstrative choice, contrary to Hanks 1990 (see Annual Report 1999). Distance is coded primarily in terms of physical accessibility to the speaker. "Proximal" forms express exophoric reference to objects or places within the speaker's zone of accessibility. "Distal" forms are semantically neutral regarding the distinction between exophoric and anaphoric reference. In exophoric reference, they are merely pragmatically preempted from use in the proximal domain and thus dispreferred there, while proximal forms cannot be used at all in the distal domain. However, distal forms are considered infelicitous in reference to the speaker's body (parts) and to objects touched or pointed to at close range.

Orthogonal to the accessibility distinction, there is a distinction between simple demonstrative forms used under a joint focus of attention and more complex forms used to direct the addressee's attention to the reference object or place. These complex forms are augmented with either the deictic place adverb *te'* "here/there" or the presentative adverb *he'* ("here/there is..."). The choice between the two complex forms depends on a binary distance distinction which is coded not in terms of physical accessibility, but identifiability in the visual field. Thus, if an object in the center of a football field is pointed to from the side of the field, a *he'*-augmented form will be used to direct the addressee's attention; but if the object is on the far side of the field, a *te'*-augmented form is used. If the

object is relatively close to the speaker, but occluded from the speaker's vision by the addressee's body, again a *te'*-augmented form is used. figure 6.7 summarizes the analysis:



**Figure 6.7.** Anchoring and attention calling in Yukatek deictics

There is a complex relation between the semantic distinctions built into demonstratives and their actual use in context. To explore this, Enfield videotaped exophoric uses of demonstratives in natural interaction among Lao speakers. Lao (Southwestern Tai) has two demonstrative determiners, a spatially unmarked term *nii*<sup>4</sup>, contrasting pragmatically with a "distal" demonstrative *nan*<sup>4</sup>, which has the added specification that the referent is something "NOT HERE". The video data (mostly from marketplace exchanges) revealed how this extremely simple semantic distinction corresponds to referential distinctions in interactional contexts. The mutual salience of available referents, and the presumed perimeter of "HERE", were determined by physical and cultural properties of the interactional space, e.g., barriers such as walls, or "possessed" areas such as market stalls, as well as social interaction factors like the "closures" set up by interactional and attentional engagement. In addition to how the interactional space was divided into zones ("HERE" versus "NOT HERE"), crucial factors determining use seem to be joint attention to, and the mutual accessibility of, referents.

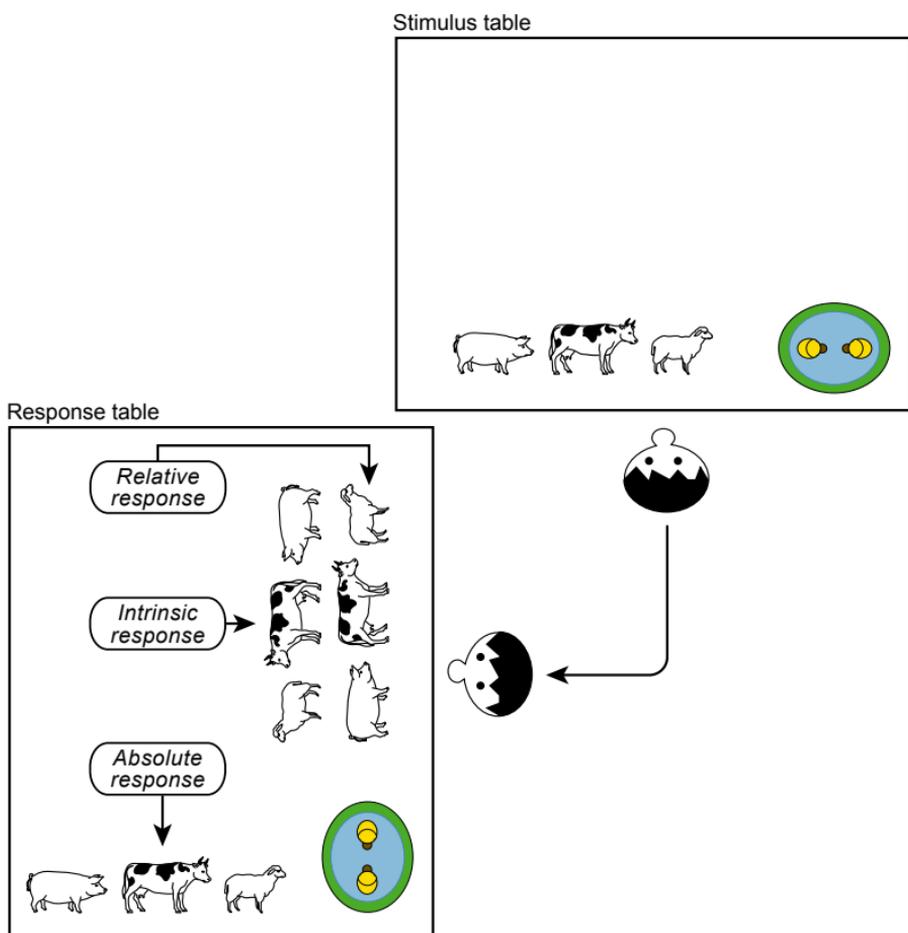
Referents can be mutually accessible without being either physically present or recently referred to, and many languages use demonstratives to refer in these circumstances (Himmelman, 1996 has called this "recognitional deixis", as in *I finally read that book by Smith*). Enfield

compared two English "recognitional" expressions, *what-d'you-call-it* and *you-know-what*, and a special recognitional use of the Lao distal demonstrative *nan*<sup>4</sup>. It emerged that while the successful use of these expressions depends heavily on calculations of mutual salience, there are also encoded semantic contrasts which account for their different distribution. The English term *what-d'you-call-it* signals that speakers "can't say the word" for the referent they are thinking of, while the term *you-know-what* communicates that they "don't want to say the word", and in both cases speakers are explicitly signaling that they assume the listener can figure out what is meant. The Lao "distal" demonstrative *nan*<sup>4</sup> in its recognitional use signals that speakers "don't know how" to express what they are thinking of (which often relates not to lexical access problems but more to deliberate avoidance of saying negative things). Further cross-linguistic study of such recognitional expressions would be worthwhile.

## 6.5 Frames of Reference

In earlier annual reports, we reported quite robust cross-cultural tendencies for the conventional selection of frames of reference (FoRs) in language to correlate with frames of reference used in nonlinguistic tasks, suggesting a limited kind of "linguistic determinism". Li & Gleitman (in press) have questioned these results, claiming that choices between FoRs are ecologically rather than linguistically induced. They ran some modified versions of our nonlinguistic tasks, which seemed to show that American subjects can be prompted to use an "absolute" (geocentric, cardinal-direction) FoR either by being placed out of doors, or by being given strong indoor cues. Levinson, Kita, Haun (U. of South Carolina) and Rasch (U. Trier) have tried unsuccessfully to replicate their "outdoor" effect on Dutch subjects - our subjects outdoors remain firmly "relative" in coding style, preferring to use egocentric left/right coordinates in memory and inference tasks, over the only other available FoR apparently in their repertoire, namely "intrinsic". Li & Gleitman's indoor cueing turns out not to be an "absolute" effect at all. Li & Gleitman had subjects remember the direction of a line of toy animals on a table on which there was a salient object ("duck pond"), say to their left. Under 180 degree rotation, subjects could then be induced to remake the line in the direction of a second "duck pond" to their right. Li & Gleitman interpret this as an "absolute" result (if subjects had coded the line as, say, heading north, then what was left would become right under 180 degree rotation). We however presumed it

experiments to confirm this: Instead of rotating subjects 180 degrees, we rotated them 90 degrees (see figure 6.7). Under these conditions, subjects can still be induced to line up the animals heading to the "duck pond", even though they are now heading e.g., west! This shows clearly that the responses are based not on an "absolute" FoR, but on an orientation-free "intrinsic" FoR, in which the "duck pond" is part of the array to be preserved in recall. Interestingly, when we modified the experiment to increase memory load, our subjects switched back to their preferred "relative" FoR. Now Dutch speakers, just like American English speakers, colloquially use just "relative" and "intrinsic" FoRs in language for small-scale arrays. So the availability of both "relative" and "intrinsic" coding in nonlinguistic memory is just what is predicted on the basis of the hypothesis that FoRs used in language influence the FoRs used in nonlinguistic cognition.



**Figure 6.8:** The layout of the experiment with 90-degree rotation

The Li & Gleitman arguments rely partly on a mistaken equation between the absolute FoR and orientation to "landmarks". The acquisition of absolute FoRs sheds some interesting light on the difference. P. Brown examined in detail older children's acquisition of the Tzeltal absolute and intrinsic FoRs (see also Annual Reports 1995-1997). Acquiring the Tzeltal absolute system involves grasping the concept of an abstract conceptual "slope" (with north = "downhill", south = "uphill", and the orthogonal axis = "across") as a means of specifying the spatial location of one object relative to another. Contrary to what has been presumed by Li and Gleitman, this is not the same as using landmarks to establish an axis (as in "The bank is downtown-wards from MacDonalds") - though both are allocentric systems, an absolute FoR has important properties distinct from the use of landmarks:

Landmarks are places that can be approached from different directions, whereas absolute axes are fixed directions without any physical endpoint that can be reached from some other direction.

Landmark uses are conceptually analogous to an intrinsic FoR, since they are both allocentric and orientation-free (that is, independent of a larger spatial framework). The absolute FoR shares the property of being allocentric, but it is orientation-bound. "The cow is facing the church" does not give us a direction of facing outside the array in the way that "The cow is north of the church" does.

Landmark systems, just like intrinsic systems, do not support logical inferences (if "The cow is facing the church" and "The horse is facing the cow" we cannot infer "The horse is facing the church"). In contrast, the absolute FoR does support logical inferences (e.g., if "The cow is north of the church" and "The horse is north of the cow", then it follows that "the horse is north of the church").

There are several reasons to think landmarks would be easier to learn than absolute axes: (i) landmarks are probably universally available for spatial description, while an absolute system is not; (ii) landmarks are cognitively simpler than absolute axes, and (iii) psychological evidence from certain linguistic and nonlinguistic spatial tasks by Western children aged 6 to 10 shows an early preference for "environmental cues" (i.e., landmarks) as well as "body-based cues" (i.e., left and right). For these reasons, one might predict that children learning an absolute system

should go through a stage of using landmarks first, prior to real absolute axes. Data from the interactional "Farm Animal" referential communication task (see Annual Report 1993) for four adult Tzeltal pairs and 16 child pairs was examined, to see how reference to spatial relations of objects in a novel table-top task is made by adults and by children of different ages. Adults use three kinds of FoR in this task: Absolute (e.g., "the cow is uphill of the horse"), landmark (e.g., "the cow is towards the doorway"), and intrinsic ("the cow's nose is at the horse's flank"). Examination of the cues used by Tzeltal child directors does not confirm the priority of landmark cues: While the children do use deictics, and both intrinsic and absolute FoRs, none of the children in the youngest 5-7 age group used landmark cues, even though all but one of them used absolute cues. By age 7-9, all the children were accurate and confident users of the absolute FoR, but landmark uses are still rare. A likely explanation for the absence of early child use of landmarks in this task is that, for Tzeltal adults, landmarks are mainly used to establish a more precise angle than the absolute system allows; younger children were not concerned to be as precise in their angular descriptions as were the adults and the oldest children (age 15-17).

In a study conducted in Siberia, Dunn addressed the apparent problem of bilingualism for the linguistic determinism hypothesis mentioned above. If the linguistic encoding of FoRs can be shown to influence nonlinguistic cognitive processes involved in spatial problem solving, what is the cognitive impact of speaking two or more languages that differ in preferred FoRs? Dunn carried out fieldwork in Chukotka with bilingual speakers of Russian and Chukchi, as well as with monolingual Russian speakers. Russian speakers included people with an urban background, as well as people coming from rural areas of Chukotka. The Chukchi speakers were all from Chukotka, and all knew Russian, although they differed as to the age at which their exposure to Russian began.

In a standard linguistic description task ("Men and Tree" task), both the urban and the rural groups of Russian speakers use a relative frame of reference system, producing descriptions like "the man is to the right of the tree facing left", similar to English descriptions. The Chukchi speakers prefer an intrinsic system, describing orientations in terms internal to the scene, supplemented by egocentric terms to specify things where the scene itself does not provide enough cues. Thus, the scene described above (the man to the right of the tree facing left) was described as "the man looking towards the tree to the left side/from the right side". The

left/right terms in this expression could be relative, but might also be construed intrinsically, since they only appear to distinguish things which themselves are only distinct if the ego is treated as part of the scene.

The most interesting result was that of the bilingual speakers responding in Russian. Both the Chukchi dominant speakers and the Russian dominant speakers responded to the task in Russian using a mixed intrinsic-relative system similar to that used in Chukchi. The monolingual Russian-speaking Chukchis responded in the same way as the monolingual Russians. Thus, the frames of reference system used seemed to depend not on the language spoken at the time, but rather on the first language of the speaker irrespective of actual response language.

	Language of description	
	Chukchi (no. of trials)	Russian (no. of trials)
1. First language speakers of Chukchi	<i>Intrinsic+relative</i> (6)	<i>Intrinsic+relative</i> (3)
2a. Chukchi-heritage Russian speakers; some Chukchi language (during childhood)	—	<i>Intrinsic+relative</i> (2)
2b. Chukchi-heritage Russian speakers; little or no Chukchi language	—	<i>Relative</i> (3)
3. Chukotka Russians	—	<i>Relative</i> (2)
4. Urban Russians	—	<i>Relative</i> (1)

**Table 6.1** Responses to "Man and Tree" frames of reference elicitation

These results suggest that covert systems of linguistic construal of space from Chukchi are transferred intact into Russian even by speakers whose Russian is apparently standard. The apparent problem of bilingualism for linguistic determinism is rooted in the assumption that a bilingual is an individual who embodies two different monolingual language competencies, i.e., that a bilingual is somehow two monolinguals housed in one brain. Research in the second language competence of very advanced learners (or near-native speakers) shows that this may not be the case, and that first-language semantic influences may still be detected in a second

language in various subtle ways long after it ceases to be noticeable in interaction (as recent work by Grosjean and Carroll et al. evidences).

The study of sign language within the context of the crosslinguistic investigation of the relationship between linguistic and nonlinguistic spatial representation is especially interesting in light of the fact that three-dimensional space is used to represent spatial relationships in the visual-gestural modality. Perniss has begun the study of FoRs and perspective in German Sign Language (DGS, Deutsche Gebärdensprache) for a Ph.D. Signed narratives are analyzed to determine: (1) how referents are located and oriented in signing space; (2) how signers navigate between different vantage points based on the established spatial scene; (3) how signers integrate perspective changes into narrative structure.

In relating events, signers shift between what McNeill calls an "observer perspective" versus a "character perspective" (roughly equivalent to relative and intrinsic FoRs), thus repeatedly shifting their FoR for locating referents. Movement, location, and spatial/topological relations are encoded through the use of property markers (Slobin's term for so-called sign "classifiers"), i.e., handshapes that represent the shape, function, or way of handling objects. These manual, property-marking representations of referents are continuously adjusted according to changes in point of view, as well as changes of scale and Figure-Ground configuration. A central aim of the research is to investigate the modality-specific effects of signing on spatial conceptualization by examining the differences in the use of FoRs in spoken and signed languages, and the special demands that signing places on maintaining consistent, detailed mental images of the scenes described.

## **6.6 The linguistic encoding of space in Marquesan**

Cablitz completed her dissertation, "Marquesan - a grammar of space", based on extended fieldwork on this East-Polynesian language. The dissertation focuses on various locative constructions and the formal classification, meaning, and use of spatial lexemes. Locative constructions in Polynesian languages have a structural similarity with such Indo-European locative constructions as English *in front of*. However, unlike the Indo-European complex prepositions, Marquesan locative constructions are complex NPs that are not lexicalized phrases with fixed components; they allow for much modification and variation. Locative prepositions, modifying words (e.g., demonstratives, directional particles) and three

types of attributive NPs combine in complex ways with the lexical head. Although the lexical head of these locative NP constructions, which can consist of a body-part term, a local noun or a place name, often contains the "richest" spatial information, other parts of the construction semantically interact with the lexical head and often contribute crucial information to it. Another major concern is to show how the nominal classes of spatial lexemes, which denote locations and places, are distinguished from other nominals denoting, for instance, concrete objects. Marquesan distinguishes between the "language of locations" and the "language of objects". Thus speakers mark a difference between a "what-" and a "where"-category in their language. Despite this neat distinction, two nominal classes (body-part terms and landmark nouns), which are typically used to refer to locations, represent interesting borderline cases. These findings confirm Lyons' observation (1977) that landmarks hold an intermediate position between "being an entity" and "being a place". This "in-between" category is clearly reflected in the locative case-marking: These nominals allow the locative case marker of the "where"-category ( *i*-marking) as well as that of the "what"-category ( *'io*-marking). In the case of body-part terms, the locative case-markers *i* and *'io* draw a clear border between the domain OBJECT and the domain SPACE.

It is also shown that the semantic structuring of SPACE has culture-specific components, such as the grammaticalized forms for SEA and LAND which are found in many Oceanic languages. These forms are the preferred linguistic means for referring to the location of objects in "table-top" space. They constitute a landmark-based set of spatial axes, SEA/INLAND/ACROSS, but these are not the only kind of (quasi-) absolute system available, as speakers also employ an absolute system that is based on local as well as equatorial sea currents. Curiously, this system is partly a local landmark-based system because the use of the UPSTREAM/DOWNSTREAM-expressions change when the sea currents change around the island. In some areas of the Marquesas UPSTREAM/DOWNSTREAM-expressions are also used in "table top"-space.

## 6.7 Space in thinking

As part of an ongoing project on spatial thinking in nonspatial domains, Enfield investigated the question of how abstract nonspatial conceptual structures are represented spatially in co-speech gesture. Interviews were conducted with speakers of Lao about the structure of the Lao kinship

system and the meanings of some Lao kinship terms. The use of space in representing kinship relationships displayed a number of properties. First, speakers tended to use gesture to spatially represent the relationships they were explaining, particularly when they were describing complex hypothetical scenarios. Second, gesture "diagrams" were created with deictic and metaphoric gestures, exhibiting both spatial and temporal cohesion - that is, these ephemeral tracings persist over time, independent of individual gestures, remaining available for reference at later stages in the discourse. Speakers have specific techniques for maintaining, "editing" and "resizing" complex gesture diagrams, but when they adjusted the configuration of diagrams, they preserved the diagram's essential topology.

Second, the use of space was quite consistent in terms of spatial metaphor. There are indications that different conceptual distinctions (e.g., genealogical descent versus laterality) are signaled by different dimensions of space.

# 7 EVENT REPRESENTATION

## 7.1 Introduction

The Event Representation Project has evolved out of the Argument Structure Project. The new name, adopted in 2001, reflects the broadening of the project's domain to include issues of event encoding and event construal. Languages portray 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, or undergoing a change of state or location in the course of the event. The Event Representation Project uses both within- and across-language analyses to study the coding of events and their participants and how children acquire these structures. Special attention is paid to crosslinguistic differences in the way events are construed for verbal encoding and event participants are mapped onto syntactic clause structure, to language-particular and universal constraints on this variation, and to how children master predicate meanings, syntactic structures, and their interactions.

From its beginnings, a unique feature of this project has been the integration of linguistic field work on understudied non-Indo-European languages with research on first language acquisition. Comparative data from typologically widely differing languages are brought to bear on theories of language development that have often been based on a small set of relatively homogeneous European languages. Questions about language acquisition, in turn, stimulate research on the field languages of the project. Project members jointly develop stimuli, elicitation techniques, and experimental designs that serve in both lines of investigation. This combination of field linguistics and language acquisition research provides

a unique perspective on the nature of linguistic knowledge and the workings of the language-cognition interface.

In the following, studies focusing on the argument structure domain (predicate semantics and the mapping of participants onto syntactic arguments) are reported first, followed by research on event construal and event encoding.

## 7.2 Argument structure

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 two studies discussed below examine the relationship between predicate semantics and argument linking, while the subsequent three studies explore argument structure constructions and the overt realization of arguments.

### 7.2.1 Predicate semantics and argument linking

Bohnemeyer has continued his investigation of the semantic motivation of formal predicate classes and their argument structure properties in Yukatek Maya. Previous research (see Annual Report 1998) has indicated that membership in the five verb-form classes of the language (transitive verbs and "active", "inactive", "positional", and "inchoative" intransitive verbs) cannot be motivated straightforwardly in terms of the lexical aspectual feature of telicity, contrary to what claims in the literature would lead us to expect (Lucy 1994). The classes are defined by two formal properties: Patterns of aspect-mood inflection and privileges of undergoing valence-changing derivations. The current research, which examines in depth certain systematic mismatches between the participant structure features of agentivity, causativity, and control, and the aspectual features of state change and telicity, has suggested two separate motivations for these properties. The patterns of aspect-mood inflection are motivated in terms of the aspectual distinction between processes and state changes. "Degree achievement" verbs, which lexicalize change without a discrete end state and thus are atelic by default (comparable to English verbs such as *darken*, *harden*, *widen*), pattern with the other state-change verbs in

this respect, contrary to Krämer & Wunderlich (1999), who argue that the relevant form classes are motivated exclusively in terms of discrete change. Verbs expressing uncaused manners of motion, like "to roll" or "to slide", and uncaused emission of sound ("to buzz") or light ("to shine"), which lack state-change semantics, have the inflectional pattern of the active form class. But unlike all other verbs of this class, these verbs take a causer argument when they transitivize. This suggests that valence-changing operations are sensitive not to the state change distinction, but to the presence or absence of a feature of "internal causation" in the verb's semantics. Taken together, these findings show how Yukatek verb classes can be discussed in the approach to unaccusativity developed in Levin & Rappaport-Hovav (1995).

Eisenbeiß continued her research on how children learn the language-particular and lexeme-specific ways events are construed and mapped onto syntactic positions and case/agreement markers. She has extended her feature-based account of the acquisition of accusative and ergative case systems to other morphological case systems and provided more supportive empirical evidence. She argues that the acquisition of case is based on the predisposition to establish grammatical features encoding two aspects of events: The control that event participants have over an event and the dependency relations between the participants. When children encounter a case-marked argument noun phrase, they determine whether the participant it refers to controls the event, i.e., initiates, sustains, is capable of terminating it, and they establish whether a participant  $P_1$  can be construed as dependent on another participant  $P_2$ , either because  $P_1$  is causally/physically affected or perceived by  $P_2$  or because  $P_1$ 's existence/movement depends on  $P_2$ . Children use this dependency information to construct hierarchically organized semantic representations: The  $P_1$  argument is assigned a lower position than the  $P_2$  argument if  $P_1$  is construed as dependent on  $P_2$ . Children then determine whether the occurrence of a morphological case marker indicates that the marked argument refers to a participant in control of the situation, or specifies instead that the argument occupies a particular position in the argument hierarchy. Children acquiring a language in which argument marking depends on control (such as Batsbi - Holisky 1987) will find markers that appear only on arguments referring to participants that control the event. Children acquiring an ergative language are confronted with markers that occur only on arguments that dominate lower arguments

(ergative). And children learning an accusative language encounter markers that are restricted to arguments dominated by higher arguments (accusative).

These procedures lead to the creation of lexical entries for case markers and to the integration of positive feature specifications into these entries; e.g., for the marker of the argument referring to the controlling participant, the specification [+control]. Markers that are restricted to neither [+control] arguments nor arguments in a specific position have *underspecified* lexical representations. For example, nominative and absolutive are both lexically underspecified (as represented by [ ]). In accordance with the Elsewhere Principle (Kiparsky 1982), they occur only if no positively specified marker can be applied to the argument. This approach is, then, based on the idea of radical underspecification: only positive feature specifications are stored in lexical entries; negative feature specifications are not part of lexical entries, but are assigned to underspecified forms due to contrasts with positively marked forms.

Evidence for this approach to the acquisition of case comes from two sources: (i) analyses of the cross-sectional and longitudinal corpora of German child language that Eisenbeiß has continued to collect (see Annual Report 2000), and (ii) reaction-time experiments with adult German speakers. The corpus analyses show that children make almost no case errors with verbs expressing unambiguous dependency relations between participants, including nonagentive verbs like *hören* "to hear", but they do make errors when it is hard to establish a unique dependency relation - for example with psych-verbs, like *schmecken* "to taste good to", which describe situations in which a STIMULUS causes an emotion in an EXPERIENCER, but it is the EXPERIENCER who perceives the STIMULUS. These results were partly obtained with the use of new elicitation techniques (see Annual Report 2000). Analysis showed that the elicitation techniques were effective: In comparison to spontaneous speech data, there was a significant increase in the number of utterances involving the targeted constructions, and children made no types of errors that did not occur in spontaneous speech as well.

The reaction time studies provide evidence for the assumption of radical underspecification. In a sentence-matching experiment conducted by Eisenbeiß in collaboration with Janssen and Penke (U. Düsseldorf), native speakers of German had to decide as quickly as possible whether two

visually-presented sentences were identical. It has been shown that in this task, reaction time is longer for identical pairs with case/agreement errors than for the same pairs without the errors. In the present experiment there was a delay when an affix contained positive specifications that did not match the features of the syntactic context in which it appeared, but no delay when an affix had mismatching negative feature specifications, which result from contrasts within morphological paradigms. For example, the dative masculine/neuter singular affix *-m* - which can be represented as [+DAT, -FEM, -PLURAL] - produced an ungrammaticality effect in an accusative masculine singular context for which the positive feature [+DAT] was inappropriate, but not in a dative plural context for which the negative feature [-PLURAL] was inappropriate. This suggests that there is a level of representation at which only positive feature specifications play a role in syntactic processing.

### 7.2.2 Argument structure constructions and argument realization

Enfield investigated the linguistic encoding of three-participant events in the heavily isolating language Lao (Southwestern Tai). These events present interesting challenges in Lao, given that the core of single-verb clause structure in this language is reserved for no more than two full arguments. Enfield found that the language uses a range of strategies, but in no case can it host three fully fledged - i.e., freely modifiable - nominal arguments within the single-verb clausal core. There are three constructions in which a single verb can be used when three participants are referred to. First, contextually retrievable arguments may simply be ellipsed, allowing predications to be made about participants to which there is no explicit reference:

- (1) kuu<sup>3</sup> haj<sup>5</sup> man<sup>2</sup>  
 1SG give 3SG  
 "I gave (it to) him".

Second, theme arguments may be incorporated. In the following example, the incorporated postverbal nominal *ngen*<sup>2</sup> "money" is not a full argument, since it is non-referential and cannot be modified (e.g., by an adjective or determiner):

- (2) kuu<sup>3</sup> haj<sup>5</sup> ngen<sup>2</sup> man<sup>2</sup>  
 1SG give money 3SG  
 "I gave money (to) him".

Third, theme arguments may be expressed in extraclausal slots, such as the focal "left position":

- (3) ngen<sup>2</sup>    kuu<sup>3</sup>    haj<sup>5</sup>    man<sup>2</sup>  
       money    1SG    give    3SG  
       "Money, I gave him".

It is possible, however, to express three fully fledged nominals in the clausal core by using two verbs in a multi-verb sequence or "serial verb construction" (see below for information on other kinds of multi-verb sequences in Lao). The main two types are the "handling-dispatch" construction and the "dispatch-dispatch" construction, so named because of the semantics of the two verbs (in the following two examples, "take" is a "handling" verb, while "give" and "send" are "dispatch" verbs):

- (4) kuu<sup>3</sup>    qaw<sup>3</sup>    ngen<sup>2</sup>    haj<sup>5</sup>    man<sup>2</sup>  
       1SG    take    money    give    3SG  
       "I gave him money." (literally: "I took money (and) gave (it to) him".)

- (5) kuu<sup>3</sup>    song<sup>1</sup>    ngen<sup>2</sup>    haj<sup>5</sup>    man<sup>2</sup>  
       1SG    send    money    give    3SG  
       "I sent him money." (literally: "I sent money to (give to) him".)

Other constructions were also found for expressing three-participant events, such as the use of adjuncts for overt expression of a third participant (either a theme or a goal) in the periphery of the clause.

In her dissertation research on verb classes in Jalonke (Western Mande, Guinea), Lüpke investigated the alignment between lexical argument structure and the realization of arguments in natural discourse. In a pilot study, she coded 350 verbal clauses from multi-party conversations, noting the lexical argument structure of their heads (as established according to independent criteria) and the number of arguments actually realized in the clause. The correlation between the lexical argument structure of verbs and the number of their realized arguments was found to be much higher in Jalonke than in English (see Thompson & Hopper 2001 on English). One reason for this is that Jalonke does not allow argument ellipsis—all deviations from lexical argument structure can be explained by reference to the imperative and to alternations licensed by the language (passive, unexpressed object alternation). The passive, which is not morphologically marked, does not permit the syntactic

expression of the agent even though semantically an agent is entailed. For other Western Mande languages, it has been argued that candidate passives - the appearance of transitive verbs with a patient subject - are better described as reflecting indeterminacy in argument structure rather than an alternation between active and passive voice. But in the Jalonke corpus, only 4.9% of the transitive verb tokens appear in single-argument clauses with a patient subject. This suggests that the two-place use of transitive verbs is basic and that their much less frequent one-place use is, after all, better analyzed in terms of a passive alternation. The unexpressed object alternation (cf. English *He ate*) is marginal in Jalonke & only three verbs, "pray", "read/study", and "vomit", permit it. Note that for these verbs, the agents are maximally distinct in animacy from their themes. The inability of other transitive verbs to appear without their objects may be due to the ambiguity that arises from the existence in Jalonke of a morphologically unmarked passive alternation. That is, if the unexpressed object alternation were routinely possible, it would be unclear how to interpret constructions in which a transitive verb occurs with a single argument in subject position: is the argument a patient (as in the passive alternation) or an agent (as in the unexpressed object alternation)?

Together with Budwig (Clark U.), Narasimhan investigated patterns of argument realization in child Hindi. In Hindi, as in many languages, arguments of verbs can be omitted relatively freely. Children acquiring Hindi must discover that the basic transitivity of the verb cannot be inferred directly from patterns of overt realization of arguments and come to understand the role of discourse-pragmatic information in constraining argument realization. According to Du Bois (1987), arguments comprising new information tend to be realized as lexical NPs in S position (if the verb is intransitive) and in O position (if it is transitive). Hindi is an interesting language to investigate in this respect because of its split-ergative patterning. Children acquiring Hindi are confronted with input in which, depending on tense/aspect morphology, either S and A or S and O receive identical morphosyntactic treatment. If children learning Hindi respect discourse-pragmatic constraints on argument realization, they should exhibit an overall preference to realize pragmatically prominent arguments as lexical NPs (versus pronominal/null) in S/O position. If they are not sensitive to such constraints, they might realize arguments as lexical in NPs with roughly the same frequency in S/A position and S/O position,

following the mixed bases for classifying arguments (when realized) at the morphosyntactic level.

To investigate this, Narasimhan and Budwig conducted a study of naturalistic child-caregiver discourse in 12 Hindi-speaking families. Following Clancy (1993) and Allen (in press), they coded an argument as pragmatically prominent if it (a) referred to a participant that had not been talked about within three prior utterances, (b) was the answer to a query, (c) contrasted with other referents in the discourse, (d) was inanimate. They found that by the age of 3-4 years children learning Hindi are indeed sensitive to the influence of discourse-pragmatic prominence on grammatical role and referential form: (a) Lexical NPs are more often pragmatically prominent than null/pronominal forms, (b) Pragmatically prominent referents occur more frequently as S/O than as A, and (c) lexical NPs occur more often in S/O positions. These findings suggest that children are able to establish the pragmatic bases for the "ergative" skewing in the referential form of realized arguments at an early age, even in a language where the morphosyntactic basis of classifying (realized) arguments might encourage a reliance on split-ergative patterning in other domains as well.

### 7.3 Event construal and event encoding

The encoding of events in language presents a nontrivial problem for the syntax-semantics interface. The information conveyed about an event is often not just bundled into a single lexical item (a verb root or stem), but is spread across one or more clauses. Consider (6)-(7):

(6) Sally went from Nijmegen to Arnhem in the afternoon.

(7) Sally left Nijmegen at 3 pm. At 3:20, she arrived in Arnhem.

In (6), the adjuncts *from Nijmegen* and *to Arnhem* single out two parts or "subevents" of a journey - departure and arrival. In (7), each of these parts is packaged in a separate clause. This difference in packaging affects the "construal" or semantic form of the event representations. A notion that has proven useful in previous research on event construal is that of a "macro-event" property (see Annual Report 1999, 2000). Constructions with this property require temporal operators to have scope over all subevents combined, i.e., over the "macro-event". Thus, in (6) both the departure and the arrival are in the scope of the time adverbial *in the afternoon*. In (7), in contrast, they are each in the scope of a separate

adverbial. Note that separate time specifications for departure and arrival are impossible in (6). In (6), then, the journey is presented as a single macro-event, whereas in (7) it is segmented into two macro-events.

In recent years, project members have dedicated considerable effort to research on the extent to which languages differ in event packaging, what language-specific and universal constraints there are on this variation, and how children learn to package event information in a way consistent with the adult language. A phenomenon of particular interest has been so-called "serial" or "multi-verb constructions", in which an event representation is distributed across a string of multiple verb forms none of which is structurally dependent on another. Below, adult-language studies on packaging and construal in multi-verb constructions are reported on first, followed by research on event packaging and construal in child language.

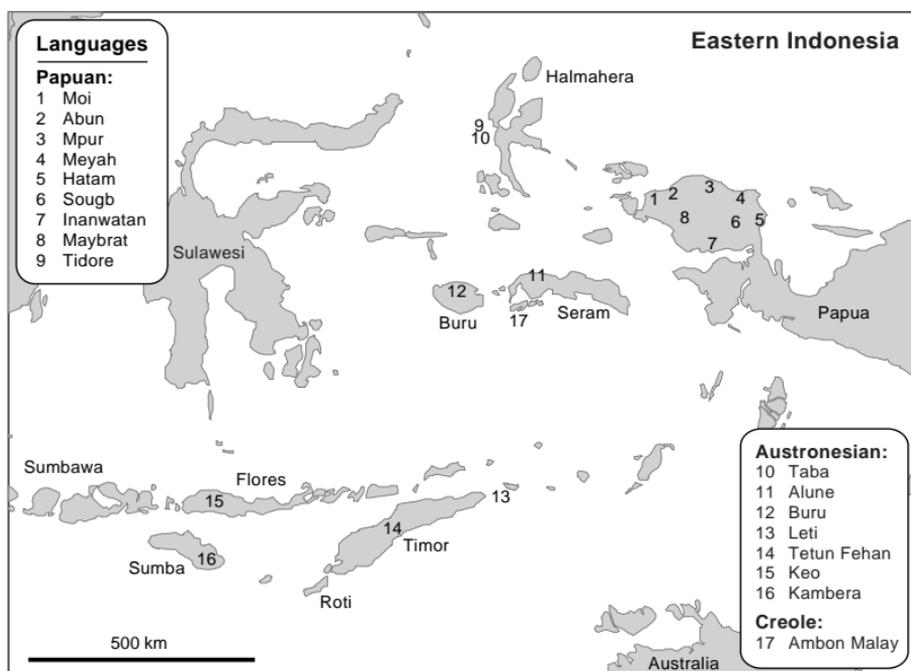
### 7.3.1 Multi-verb constructions

In work within the project on serial verb constructions in Austronesian and Papuan languages (Annual Report 2000), Van Staden, in collaboration with Senft and Reesink (Leiden U., Spinoza program "Lexicon and Syntax") has developed a model for analyzing serial verb constructions based on their typical morphosyntactic characteristics, functions, and the semantic contribution of the verbs to the complex. Four morphosyntactic types were distinguished: *Complex verb serialization*, in which the verbal prefixes precede the first verb and the suffixes follow the last verb in the sequence, *independent serialization*, in which all the verbs are fully inflected, *dependent serialization*, in which only one verb carries the verbal inflection, and *co-dependent serialization*, in which the object of the first verb is also the subject of the second. Two functions of serial verb constructions were distinguished, drawing on the notions of macro-event and subevent as developed by Bohnemeyer (Annual Report 2000): (1) linking subevents in a single macro-event expression (component serialization), and (2) linking macro-events to form larger narrative structures (narrative serialization). The two basic functions and the four morphosyntactic types are summarized in (8):

(8)	<i>Functions</i>	<i>Morphosyntactic types</i>
	Component serialization	Complex verb serialization
	Narrative serialization	Independent serialization
		Dependent serialization
		Co-dependent serialization

Each morphosyntactic type can in principle fulfill either function, giving eight possible types of serial verb constructions - component independent serialization, narrative independent serialization, component dependent serialization, etc. Of these eight, only one, narrative co-dependent serialization, has not yet been found. On the basis of two questionnaires (<http://www.mpi.nl/cgi-bin/gunter/QuestMenu.pl> and <http://www.mpi.nl/world/E-Nusantara/index.html>) and literature research, it appears that narrative serialization is found almost exclusively in Papuan languages and not in Austronesian languages, except in cases where language contact can be presumed as, for instance, in Kilivila (see below).

Van Staden and Reesink have used this typology for a first inventory of serial verb constructions in seventeen languages of Eastern Indonesia (see figure 7.1).



**Figure 7.1 :** Seventeen languages of Eastern Indonesia

The aim of this study was to determine whether certain types or functions of serial verb constructions can still be considered “typically Austronesian” or “typically Papuan” in a geographic area where there has been extensive contact between the two language families for at least 2,000 years. Initial results indicate that this is indeed the case. First, narrative serialization is

marginal on the whole in this area, but where it does occur it is in the Papuan languages, confirming our earlier findings. Second, only the Austronesian languages of Eastern Indonesia have complex verb serialization. Austronesian languages that do not have complex verbs almost all have highly productive verb compounding. The Papuan languages generally have neither. An example of complex verb serialization from Fehan Tetun:

- (9) n&itak                      be'o    ta            lolo                      á  
 3SG-throw.on.ground    shatter    already    earthen.water.pot    DEF  
 "having thrown the earthen water pot to the ground such that it shattered". (Fehan Tetun, Austronesia, Van Klinken 1999:257)

Third, there is much variability in the morphosyntactic types of component serialization in the Austronesian and Papuan languages. Fourth there is some patterning in the semantic contribution of the verbs to the semantics of the whole. Austronesian serial verb constructions typically express direction (e.g., (10), which involves complex verb serialization). All the languages in the sample also have serial verb constructions expressing state changes or resultatives/purposives (e.g., (11), which is an instance of independent serialization), but these are more frequent in the Austronesian than the Papuan languages.

- (10) dong    su    ba    pi    antua    pung    barang-barang  
 1PL        PRF    carry    go    3SG.M    POSS    thing-thing

"They have brought his stuff away". (Moluccan Malay, Austronesian Creole, Tjia 1997:39)

- (11) n=babas    welik    n=mot    do  
 3SG=bite    pig    3SG=die    REAL

"It bit the pig dead". (Taba, Austronesian, Bowden 2001:311)

In the most frequent component serial verb constructions of the Papuan languages, the first verb expresses e.g., the agent's motion towards the activity expressed in the second verb (a construction type that Van Staden and Reesink have labeled "precursion", see (12)), or an aspectual modification of the event expressed by the verb (13).

- (12) n&un            n&jaw            ba(r)&bwa  
 3SG.F&go    3SG.F&pick.up    thing&leaf

"She went to pick up vegetables". (Mpur, Papuan, Odé questionnaire 2001)

- (13) una            wo&maleko            wo&reke  
 3M            3M.ACTOR&continuously    3M.ACTOR&cry

"He cried on and on". (Tidore, Papuan, Van Staden 2000:309)

The typology sketched here can, then, indeed be used to shed light on the distribution of serial verb constructions, even in an area where the languages have been in contact for a very long time.

Van Staden, Senft and other colleagues from the MPI and the universities of Nijmegen and Leiden have also developed an elicitation tool called "Staged Events" to elicit descriptions of complex events. The focus is on how speakers of different languages segment such events, what kind of information they express, and how they organize the information in discourse. Staged Events consists of a set of video clips, and stills taken from these clips, which depict various scenes with human actors and culturally recognizable objects.

Senft used this tool to collect data on serial verb constructions (SVCs) in Kilivila. The Kilivila event reports were analyzed using the typology of SVCs developed by Van Staden in cooperation with Reesink (Leiden U.) (see above). First analyses show the following types of verb serialization in this language:

(i) *Narrative independent serialization*: Two or more macro-events are linked and presented in a (semi-) fixed script, time and place are not necessarily the same for all verbs, verbs can be modified independently, and all verbs are fully inflected. For example:

- (14) m&to&na            tau            e&kau            regisa            e&kau            e&weya            e&taitau  
 DEM&CLF.M&DEM    man            3&take            axe            3&take            3&bring            3&cut  
 bwa&tala            kai  
 CLF.wooden&one    wood

"This man takes an axe, he takes it he brings it he cuts a piece of wood".

- (15) m&to&na                      tau    e&kau    la       nepa  
 DEM&CLF.M&DEM            man   3&take   his       bushknife  
 e&la    e&viviya                kai  
 3&go   3&chop                wood

"This man takes his bushknife he goes he chops wood".

(ii) *Component independent serialization*: All verbs express components of a single macro-event, and all verbs are fully inflected. For example:

- (16) ma&ke&na                      turaki    e&sakaula    e-la    e&katukwevivila    e&ma  
 DEM&CLF. wood&DEM    truck   3&run       3&go 3&turn.round    3&come  
 i&kota                                beya  
 3&arrive                              here

"This truck it runs it goes it turns it comes it arrives here".

- (17) ma&na&na                      vivila    e&kau    hama       e&katuvi    paledi  
 DEM&CLF.F&DEM    girl    3&take   hammer   3&smash   plate

"This girl takes a hammer she smashes a plate".

(iii) *Component co-dependent serialization*. In this type, which is relatively rare in Kilivila, each verb expresses a component of a single macro-event, and the object of the first verb is the subject of the second. For example:

- (18) ...avaka            bi&lukwe-mi            buku&lagisi  
 ...what                3FUT&tell&you        2FUT&hear

"...what he will tell you you will hear".

Kilivila speakers produce elaborate event reports that combine these three types of serialization. Each type may be subdivided further into verb serializations with facultative NPs realized between verbs – these constructions are called “noncontiguous SVCs” (see examples (15) and (17)); and SVCs in which the verbs are produced in contiguous succession; these constructions are called “contiguous SVCs” (see examples (14), (16), and (18)). However, so far Senft has found no noncontiguous SVCs in component co-dependent serialization.

Verbs constituting SVCs in Kilivila share polarity, but they need not share tense, aspect, or modality, nor are they necessarily predicated of the same subject. Although they are produced under a single intonation contour without internal pauses, they are used to describe not only what is

conceptualized as a single event, as is often claimed of SVCs in the literature, but also what is conceptualized as a complex event consisting of up to several macro-events.

It is sometimes suggested that events are segmented with finer granularity in languages with verb serialization than in those without. To explore this, Senft compared Staged Event reports in Kilivila with those collected by Schiering (U. Köln) from native speakers of English. He found that the hypothesis holds for reports of some types of events, for example motion events, but not for others. Finally, it seems that event reports in Kilivila need a minimum of "framing" or "contextualization" of what is considered the most important information. For instance, unlike English speakers, Kilivila speakers will not describe a scene showing two men having a conversation as "They are just having a conversation"; the shortest event report for this particular "staged event" consists of the following SVC:

- (19) e&tota&si e&bigatona-si  
 3&stand- PL 3&talk-PL  
 "They stand they talk".

SVCs meet the requirement that to produce well-formed, acceptable, and situationally adequate event reports, speakers must contextualize the main event at least minimally.

Enfield continued ongoing analysis of clausal grammar in Lao (Southwestern Tai; see also 7.2.2), concentrating on expressions which involve series of verbs whose relationships to each other are not explicitly marked. Data were gathered from both spontaneous audio recordings and elicitation tools developed in 2001 (Staged Events, Cut/Break, ECOM). This work has also involved associated analysis of the basic argument structure of Lao clauses and verbs. Enfield described an inventory of over two dozen distinct structural arrangements underlying expressions of the basic form V1-V2 (i.e., two verbs or verb phrases in an unmarked sequence). These were distinguished on a number of grammatical grounds, including the identity of one verb (phrase) as grammatically subordinate to the other, as well as by reference to a range of semantic distinctions.

One construction type focused on was "depictive secondary predication" (cf. English *She ate the fish raw*), which allows addition within a clause of a secondary predicate about one of the participants in an event (where

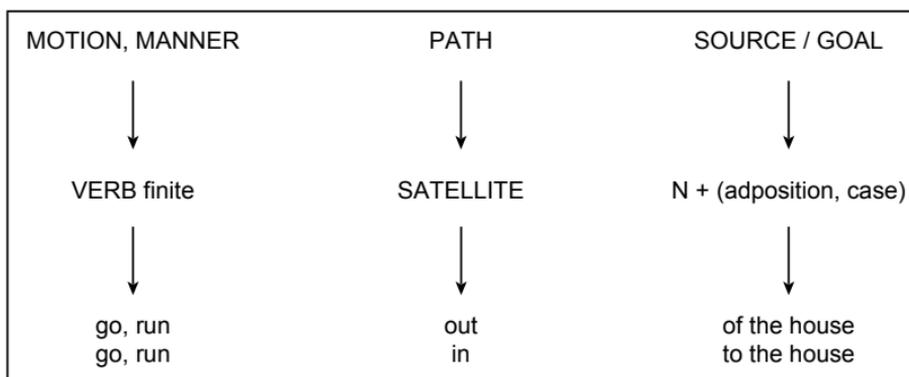
this predicate expresses no relation - such as manner or result - to the main verb). In Lao, secondary predicative verbs appear in V1-V2 sequences, with subtypes in which either the V1 or V2 element makes the secondary predication. V2 depictives express simple states such as "raw" or "fresh", while V1 depictives express states which are the inherent outcome of prior events, such as "sitting" or "drunk". Nominals can make secondary predications, either as adjoined classifier phrases or hosted in adjuncts headed by the verb *pên*<sup>3</sup> "be", where the nominal provides a semantic description of the physical form of one of the primary predicate participants. One notable feature of this construction is its common use of classifiers, often meaning "whole" or "as a unit", as in the following example:

- (20) phen<sup>1</sup>    kin<sup>3</sup>khaj<sup>1</sup>    pên<sup>3</sup>    nuaj<sup>1</sup>  
       3HON    eat egg    be    CLF  
       "He ate (the) egg(s) whole."

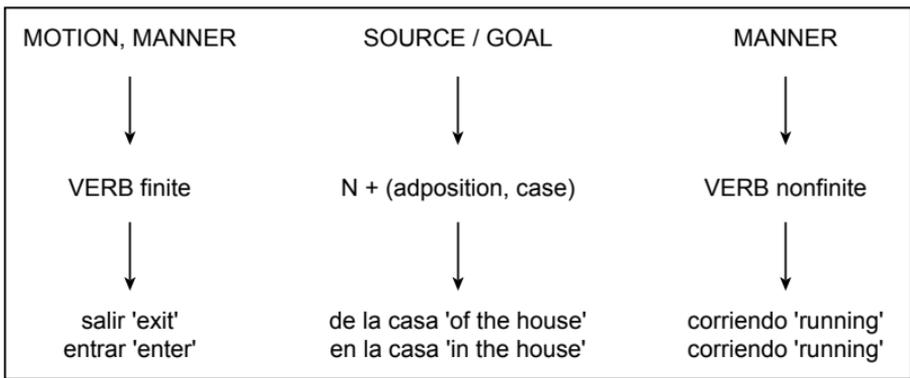
In further work, Enfield studied the role of "event typicality" in multiple verb constructions. Some types of events or event sequences are more typical in experience than others, and this may have consequences in both language and cognition, e.g., for (a) how real-world events are perceived and/or categorized; (b) how perceived events are linguistically described (or "packaged"); (c) how linguistic descriptions of events are interpreted; (d) how complex semantic structures (e.g., in verbs, derivational morphemes, and constructions) are acquired; (e) the distribution and productivity of grammatical resources in a language. Some examples noted in the literature include constraints on noun incorporation, serial verb constructions, covert verb class distinctions, cross-clausal gapping, and distribution of lexical causative verbs. Enfield focused on the typicality of multi-verb posture-plus-activity combinations (e.g., "eating sitting down" versus "eating standing up"), and effects on the semantic and grammatical behavior of a class of multi-verb sequences in Lao, namely, "associated posture" constructions. Analysis of data collected using elicitation materials that manipulated combinations of certain activities with certain manners resulted in two main findings. First, the status of possible combinations of conceptual subcomponents in complex expressions as more or less "normal" (as culturally defined) affects the accessibility of such combinations to certain productive morphosyntactic processes (e.g., insertion of various connectors or logical relators, marking of modal and

aspectual distinctions, ellipsis, specific intonational properties, prosodic integration). Second, event typicality influences the construal of the semantics of verb serialization. Interpreting multi-verb sequences straddles a blurry line between true syntactic composition and conventionalized/idiomatic meaning (usually involving metonymy). Context-situated interpretations are contingent on cultural typifications, in that the overall meanings of a multi-verb sequence will be construed as pragmatically enriched where existing cultural representations encourage or license this, and as purely syntactic/combinatorial elsewhere.

Ameke and Essegbey (Leiden U.) investigated the expression of complex translational motion events in three verb-serializing languages: Ewe, Akan (both Kwa languages of West Africa), and Sranan (a Creole language of Suriname). They argue that verb-serializing languages do not fit into the typology of lexicalization patterns proposed by Talmy (1985, 2000). Talmy distinguishes two types of languages according to the way they characteristically encode the meaning component “path” in motion event descriptions. Verb-framed languages like Spanish code the path together with the fact of motion in a main verb and a co-event such as manner in a subordinate nonfinite verb. By contrast, Satellite-framed languages like English code the path in a satellite (e.g., verb particle or prefix) and the co-event and the fact of motion in a verb. The two modes of packaging motion can be schematically represented as follows (after Slobin 2000: 109):

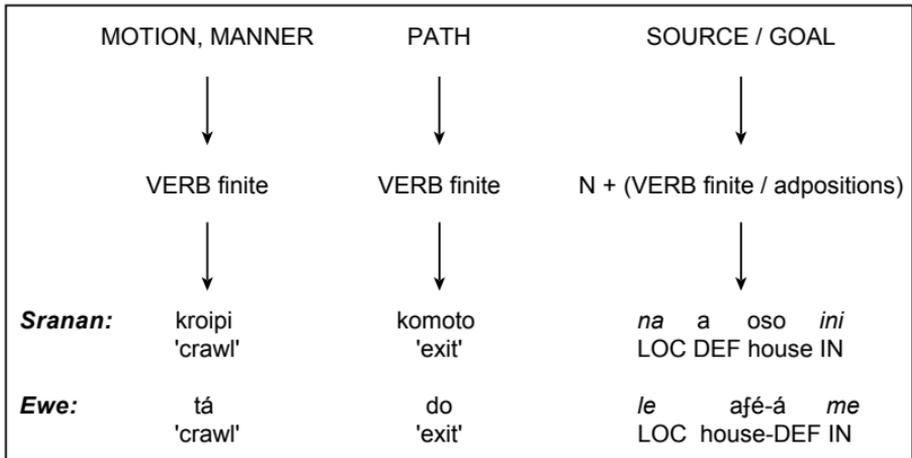


**Figure 7.2:** Satellite-framed construction type (English examples)



**Figure 7.3:** Verb-framed construction type (Spanish examples)

In contrast to both these patterns, the serializing languages that Ameka and Essegbey explored encode complex motion events in a single clause with two or more finite verbs without any marker of syntactic dependency between them. Thus, both manner and path are coded by verbs, as illustrated below in figure 7.4:



**Figure 7.4:** Serial-verb construction framing pattern

This pattern also holds for other languages that make use of serial verb constructions, e.g., Thai and sign languages (Slobin and Hoiting 1994).

Slobin has proposed that the lexicalization typology of a language may have consequences for how its speakers "think for speaking" about motion events (see Annual Report 1995). His hypotheses are based on investigations of a dozen or so languages having features of the two main types. Given that serializing languages frame motion events differently

than V(erb)-framed and S(atellite)-framed languages, Ameka and Essegbey hypothesized that their speakers would also behave differently at the discourse level. They found that these speakers behave like S-framed language speakers with respect to some parameters and V-framed language speakers with respect to others.

Slobin tested his hypotheses using different instruments: narratives generated using a wordless picture story book, *Frog where are you?*; translations of motion descriptions in novels etc.; and newspaper reports of the same occurrences in the different languages. Ameka and Essegbey based their findings on frog-story narrations from 10 Ewe speakers and 4 Sranan speakers, supplemented by responses from the "Come and Go" questionnaire and the Route Description task (Space and Cognition Kit Version 1.0, 1993).

One of Slobin's findings is that the number of ground elements per verb and the number of path elements per trajectory are higher in S- than in V-framed languages, probably because S-framed languages can string together several path-denoting elements in a single clause. Serializing languages also allow speakers to string together several path verbs in one clause, and Ameka and Essegbey found that speakers of these languages indeed behave more like speakers of S-framed languages in this respect. Slobin also proposed that speakers of S- and V-framed languages present the physical settings of motion narratives differently: speakers of S-framed languages tend to focus on the dynamics of movement while speakers of V-framed languages present scenes more statically. Speakers of serializing languages are found to behave more like speakers of V-framed languages in this respect.

A third proposal by Slobin is that speakers of S-framed languages break up motion events into more components than speakers of V-framed languages. For example, in narrations of the "cliff scene" in *Frog where are you?*, Slobin found that speakers of S-framed languages mention more of the following components than speakers of V-framed languages (three vs. two, on average).

1. Change of location: Deer moves, runs at cliff
2. Negative change of location: Deer stops at cliff
3. Change of location: Deer throws boy, makes boy/dog fall
4. Change of location: Boy/dog falls into water

Ameka and Essegbey found that their Ewe and Sranan speakers mentioned three or more of these components in narrating the “cliff scene”.

Table 7.1 summarizes the main findings of this study, showing both how the three kinds of languages frame motion events and the consequences of this framing for speakers' on-line discourse about motion.

Language type	Path	Co-event (Manner)	Grounds per clause	Number of components of cliff scene mentioned	Scene-setting descriptions
V-language	verb	subordinate	max. 2	less than 3	static
S-language	satellite	verb	multiple	3 or more	dynamic
Serializing language	verb	verb	multiple	3 or more	static

**Table 7.1:** A comparison of S-languages, V-languages and serializing languages

### 7.3.2 Event packaging and construal in first language acquisition

Languages differ in how they map motion event semantics onto surface forms, and children must learn the nature of this mapping for their language. Narasimhan investigated motion event descriptions in a longitudinal case-study of one child (16&22 month age range), which forms part of a corpus of videotaped naturalistic child-caregiver interactions in three families. Preliminary findings suggest early sensitivity in child language to the relative paucity of *manner of motion* information in the motion event descriptions characteristic of adult Hindi. While both path verbs and manner verbs appear at 16&18 months, the number of path verbs used consistently outstrips manner verbs within each developmental period (16&18 months; 19&20 months; 21&22 months). Further, among the path verbs, *gir* “fall” and *uThaa* “lift”, which specify vertical directionality, are productive only at 19&20 months, relatively late compared to verticality expressions such as “up” and “down” in English 14& to 16&month-olds (Choi & Bowerman 1991). The concepts expressed spontaneously in the earliest stages of this study (16&18 months) include topological notions such as removal from containment (e.g., *nikaal* “take out”) and “opening” (e.g., *khol* “open”). Since verticality is commonly expressed in *closed-class*

elements (particles) in English, the encoding of verticality in closed-class elements (e.g., case, adverbials) in motion (and location) contexts in early child Hindi was also examined. The data suggest that topological notions of containment and contact/support (in adverbials *uupar* "on top (location on vertical plane)", *andar* "inside", and cases *-par* "on", *-mE* "in"), appear earlier and are more productive than terms encoding proximity relations with featured reference objects, such as *aage* "in front" (cf. Johnston 1985). The directional use of *uupar* "up" appears relatively late, and the use of *niice* "down" is both infrequent and relatively late, paralleling the patterns in the class of open-class elements in Hindi.

The preference in early child Hindi for topological notions such as containment and contact/support echoes similar findings in child language research crosslinguistically (Slobin 1985, Bowerman, de León, & Choi 1995). However, concepts such as verticality, which predominate in early lexical acquisition in languages like English, are not evident at a similarly early stage in child Hindi (cf. de Leon 2001 for similar findings in Tzotzil). Further, the strong skewing towards verbs encoding path over manner suggests early language-specificity in aspects of motion event encoding. More fine-grained crosslinguistic research is needed to precisely determine the balance of universal and language-specific factors which constrain the acquisition of (motion) event semantics.

Another rich domain for exploring event representation, besides motion, is causality: languages differ in how they segment and package information about causal events, and children must work out the characteristic encoding patterns of the language they are learning. In the first phase of a planned study together with Choi (San Diego State U.) comparing causal encoding in the acquisition of English and Korean, Bowerman investigated how English-speaking children learn to combine two causally-related subevents ( $E_1$  and  $E_2$ ) into a single complex event, and eventually a macro-event (see figure 7.3 above). Data came from the spontaneous speech records of two children (Bowerman's diary data).

In the first phases (about 1½ to 2½&3 years), the children's causal constructions - simple lexical or periphrastic causatives such as *Mommy open butter* and *I make it full* - specify a causer (the participant referred to by the subject) and a change of state or location undergone by a causee ( $E_2$ , e.g., becoming open or full), but do not explicitly mention what it was that the causer did ( $E_1$ ) (except in constructions with relatively

conventional verb-particle combinations like *I pull socks up* and *man chop tree down*). For both children, the first productive device for integrating  $E_1$  and  $E_2$  into a single complex event expression (emerging at around 3 to 3½ years) involves *anaphora*: the children first state  $E_1$  and then refer back to it anaphorically as the subject of a subsequent lexical or periphrastic causative - e.g., (21). Syntactically, this technique is minimally demanding. But semantically, it represents an important advance: one whole event can now be presented compactly as the causer of another event.

(21) E 3;5 I should cry, too; that will water my eyes. (E has something in her eye and M has just given her some suggestions on how to get it out.)

Soon after this step both children acquire several different devices that allow them to integrate  $E_1$  with  $E_2$  directly, without presenting it first in an independent utterance. First, constructions like (22) replace anaphoric constructions like (21), with a nominalized verb or verb phrase expressing  $E_1$ :

(22) E 3;10 Stepping down from it won't break it; of course not. (Stepping off a plywood slab on which her mattress usually rests; M has earlier told her not to bounce on the bed springs under another mattress.)

A second new construction pattern involves *by*-clauses, as in (23), which flesh out  $E_1$ , presenting it as a component of the larger whole. (At first, *with* was often used instead of *by*, which suggests that the children conceptualized the role of the *by*-clause as analogous to that of a simple object instrument in sentences like *I opened it with a key*; cf. Fillmore 1971 for a parallel analysis of adult English.)

(23) C 3;6 Anyway, you made me cry with putting that up there. (After M moves an object C wants up out of her reach.)

Finally, "caused motion" and resultative constructions (cf. Goldberg 1995) became highly productive (see (24), and Bowerman 1982); these provide a compact way to include information about both  $E_1$  (a causer participant's action) and  $E_2$  (a change of state or location) in a single clause. Notice that unlike the other constructions discussed here, these constructions

integrate the two subevents into a single macro-event, such that any temporal adverbial must have scope over both subevents.

(24a)E 3;9 A gorilla captured my fingers. I'll capture his whole head off.  
His hands too. (Playing with rubber band around fingers.)

(24b)C 3;8 I pulled it unstapled. (After pulling stapled booklet apart.)

Although subject nominalizations, *by*-clauses, and novel caused motion/resultative constructions are formally quite distinct, they emerge at almost the same time in both children's speech. Their common denominator is semantic construal: they all allow  $E_1$  and  $E_2$  to be expressed together as components of a single complex event. This suggests that an important step in the development of causal encoding is learning how to construe two events as subevents of a higher-order causal event.

## 8 THE ROLE OF FINITENESS

The present project grew out of the former Institute project "The acquisition of scope relations" and focuses on one of the four project topics pursued: There structure and functioning of "finiteness" in first language acquisition, second language acquisition, and also in adult language. The distinction between finite and nonfinite verb forms has been familiar since the days of the Greek grammarians, but has never found a proper definition. Traditionally, it has been primarily regarded as a morphological phenomenon: Verb forms that are inflected for tense, mood, person, number and maybe other categories are considered to be finite whereas all others are considered as nonfinite. 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 the majority of English verb forms can be finite as well as nonfinite. Second, there are numerous syntactic, semantic and pragmatic phenomena that are clearly associated with the presence or absence of finiteness. These include, for example, basic word-order rules, the licensing of grammatical subjects and of expletive elements, constraints on gapping, nonspecific readings of indefinite noun phrases in nonfinite constructions, the temporal interpretation of verbal elements, the role of temporal adverbials, and the interaction with focus particles such as *only* or *too*. It appears, therefore, that finiteness is not a mere fact of verb morphology but a grammatical category in its own right. It is argued 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. Many of the structural repercussions of finiteness seem to follow from this analysis.

## 8.1 Finiteness in learner language

The structural and functional role of finiteness phenomena is clearly reflected in language acquisition. First and second language learners typically start with nonfinite forms (often misleadingly called "root infinitives") and only then slowly acquire finiteness, a process which leads to a substantial reorganization of their sentence structure. Dimroth and Jordens compared this process in first and second language acquisition of Dutch. Against initial appearances they found that the acquisition of finiteness involves the same principles of language learning in both cases. At the so-called "Conceptual Ordering Stage" (COS) in both children and adults, constituents are related by adjunction, while their ordering is based on principles of information structuring. Furthermore, the relation between the Topic and the Predicate (Pred), i.e., the nonfinite component of the utterance, is established by a closed class of lexical phrases expressing illocutionary force. These "Illocutionary Phrases" (ILPs) allow learners to express "volition", "ability", "possibility", "obligation" and "contrastive assertion", while the expression of ordinary "assertion" occurs by default. At the relevant stage, the striking similarity between utterances of child L1 learners and adult L2 learners can be illustrated with examples, as in:

	Topic	ILP	Pred	
child L1 Dutch	Peter	moet	zitten	<i>P has-to sit</i>
	Ruti	wel	bad zitte	<i>R indeed bath sit</i>
	papa	eve	make	<i>Daddy just fix</i>
	ikke	óók	boot hees	<i>I too boat been</i>
	poesje	0	vinger bijte	<i>kitty finger bite</i>
adult L2 Dutch	vrouw	moet	keuken	<i>woman must kitchen</i>
	ikke	wel	handwerk	<i>I indeed handwork</i>
	ik	even	bellen	<i>I just call</i>
	ik	óók	zo thuis kopen	<i>I too so house buy</i>
	vier twintig			
	juni mij man	0	thuis	<i>24 June my husband at home</i>

While it is typical of the L2 learners that many of them do not progress beyond the COS, Jordens could show that children learning Dutch are able to achieve a more adult-like developmental stage within a period of

weeks rather than months. Developmental progress in children appears to be tightly connected with the acquisition of the auxiliaries *heb/heeft* (have/has) and *ben/is* (am/is). Past-participle forms with the auxiliaries *heb/heeft* and *ben/is* are used to express the perfect aspect. They cause a reanalysis of the ILPs to express both illocutionary force and grammatical aspect. As a result of this, there is a distributional opposition between *heb/heeft* and *ben/is* expressing the perfect aspect, *doe(t)* expressing the imperfective aspect and *gaa(t)* expressing the perfective aspect. Examples are:

die <u>heeft</u> jou maakt	<i>that-one has you made</i>
<u>doe</u> je Pino make?	<i>do you P make?</i>
ik <u>gaat</u> Pino make	<i>I go P make</i>
ik <u>heef</u> óók appel gete	<i>I have too apple eaten</i>
Jaja <u>doet</u> kitkat opete	<i>J does kitkat up-eat</i>
<u>gaan</u> ze almaal ete, zie?	<i>go they all eat, see?</i>

Due to the acquisition of AUX, modal expressions with illocutionary force are reanalyzed as AUX as well. They function as the head of a functional projection of an AUX-phrase. Furthermore, they are used with productive, finite morphology. The relevant stage is, therefore, referred to as the "Finite Linking Stage" (FLS). Illocutionary phrases such as *nee* (no) and *ullelja* (want), *mag-ikke* (may-I) or *handigniet* (handy-not), *niet* (not) are unable to function as auxiliaries. Therefore, they must become obsolete. The same is true for scope particles such as *eve* (just), *g(r)aag* (please) and *ook* (too). They, too, disqualify as heads of a functional projection. However, while scope particles as well as the negator *niet* cannot function as instantiations of AUX, they may remain functional as modifiers of VP structure.

Gretsch extended her work on the acquisition of finiteness and Topic Time to early nominal elements. In a previous study she had shown that the development of finite and nonfinite verb forms can be represented as a sequence of "cell fissions", whose precise form varies across languages (see Annual Report 2000: 90-91). Nominal elements are never finite; still, they involve temporal variables and thus take part in the development. Gretsch found that Czech nominals reveal an early morphological fission for case-marked nominals with a corresponding time/world reference similar to the one observed for the [+/-finite] opposition in early verbs. If no

verb frame is given, the stand-alone nominals in requests and assertions differ obligatorily in their case marking: The default case becomes associated with the default temporal reference (here & now) and the nondefault case associates with the nondefault interpretation (distant from here & now, i.e., fantasy world). As with the verbal differentiation, children pick up this pattern as soon as the morphological bifurcation is productive. Thus, children already make use of their earliest morphological markings to grammatically encode temporal reference and illocutionary force during the "one-word to two-word stage".

## 8.2 Finite forms, nonfinite forms and temporal variables

Klein continued his work on the expression of temporality. Two assumptions are fundamental to this work. First, a sentence typically involves more than the classical temporal variables, such as Reichenbach's S, E and R. This is obvious for compound constructions such as *He planned to have eaten the scrambled eggs in five minutes from now*. But it is also true for simple sentences such as *Eva opened the door*, in which there must minimally be a time at which the door was not open, a time at which it was open, and a time at which she did something; hence, the "event time" itself has an inner temporal structure. In general, sentences typically involve a highly complex array of time spans that are somehow related to each other:  $t_i$  may be before  $t_j$ , after  $t_j$ , included in  $t_j$  etc. Second, a clear distinction must be made between such a more or less rich time structure and the way in which its components, the temporal intervals, are further characterized - either by the descriptive content of linguistic expressions with which they are associated, or by contextual information. In a root clause, the topmost interval in this structure is not provided by the lexical verb but by finiteness marking, and it is interpreted as the time for which an assertion is made - the "Topic Time". This gives rise to the idea that tense marking does not directly localize "the event" in time; instead, it relates the time about which something is asserted to the Time of Utterance. Other temporal intervals are contributed by the semantic content of a verb or a copula. A "telic" verb such as *to open* provides three intervals - one for the first argument, characterized as being somehow active (e.g., pushing a handle), and two for the second argument, characterized as being not open and being open, respectively. But verbs may also involve two temporal intervals with the same descriptive properties for a single argument, as with *to remain*. In *He was allowed to remain in Spain*, only the second of two descriptively identical intervals

("be in Spain") is affected by the modal verb. In general, each such "time-argument pair" provided by the verb is selectively accessible to morphological and syntactical operations, such as participle formation or modification by adverbials. Klein showed that this idea naturally explains a long-standing puzzle in semantics - the "repetitive-restitutive" ambiguity of adverbs such as *again*, *wieder*, *weer*. The sentence *Eva opened the door again* can mean that the entire action of Eva's opening the door is "repeated", or that only an earlier state, at which the door was open, is "restituted". The two readings may be due to a lexical ambiguity of the adverb, to a structural ambiguity, or to a combination of both. Intuitively, however, there is no lexical ambiguity: The adverb always adds the meaning component "not for the first time". The structural account faces the problem, that at least on the surface, there is only one syntactic structure under both readings. If we assume that *to open* provides two time variables for the second argument,  $t_1$  and  $t_2$ , with  $t_2$  being later than  $t_1$ , then the two readings naturally reflect the fact that the adverb may affect either both variables, and hence the "entire process" is repeated; or it affects only the second variable, at which the door is characterized as being open; this leads to the "restitutive" reading. In both cases, the adverb means exactly the same, namely "not for the first time". In contrast to decompositional analyses with a change-of-state operator, this analysis naturally extends to similar ambiguities with atelic verbs such as in *The shares fell again*. These verbs do not involve a change-of-state operator in the familiar sense; under a Vendlerian analysis, they behave like activities rather than accomplishments or achievements. But under the present analysis, they also involve two time spans  $t_1$ ,  $t_2$  for their single argument with the descriptive properties: higher than at  $t_2$  - lower than at  $t_1$ . The account also extends to broader scope ambiguities of *again*, *wieder*, *weer*, such as *He again read a book* vs *He read a book again*.

This line of analysis was adopted by Gretsch and Jolink in a study on how the particles *wieder* and *weer* ("again") were acquired by German and Dutch children, respectively. An initial corpus analysis of the actual use of *weer* in adult spoken language revealed a third interpretive category beyond the repetitive and the restitutive reading of this particle: It most often functions as a kind of modal particle, as illustrated in the following dialogues (taken from the Ernestus corpus):

1. Wat deed je ook al weer? Roeien he?
2. Het is altijd weer de keerzijde, he.

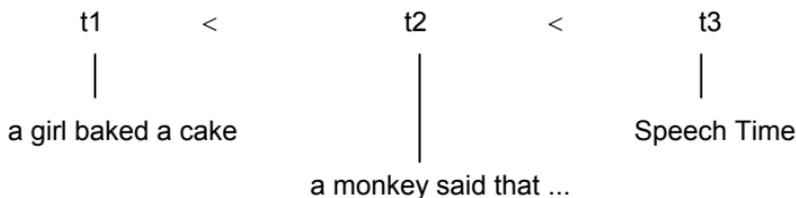
3. En dan, nou ja, het aantal particuliere abonnees is zeer beperkt toch weer wel, dus er zijn wat ruilabonnementen, ik geloof dat je dan wel 300 abonnees hebt verder, dat is het zo ongeveer.
4. A: nee, voor een tropisch paradijs in de winter ga ik liever naar een sauna of zo. B: Ja, maar daar kan je met HELE kleine kinderen ook nog weer niet naar toe.

Instead of just listing the various modal particle clusters as fixed expressions, research into the combinatorics of these clusters lead to the suggestion that the lexeme *weer/wieder* branches into two distinct groups of interpretation: (i) a first group involving repetition at the core of its meaning (where repetition, as argued by Klein, either concerns both temporal intervals or only the second one) and (ii) a second group where the particle appears detached from this meaning with only highly remote allusions to repetition proper, if at all. Depending on the meaning of the other added modal elements within the modal particle cluster, a contrastive, additive or habitual interpretation is effected in this second group. Regarding the distribution of the two groups in spoken language, the occurrence of *weer* within a modal particle cluster covers an unexpected two-thirds of the overall *weer* occurrences. An elicitation task conducted with Dutch and German children revealed that the first group of interpretations must be split yet again into a content-oriented interpretation of the notion of "repetition" and a text-organizational one. The latter was labeled "topic-restitutive" usage since it marks the re-appearance of a topical element and occurs as early as at the age of 2;7 in the experimental data. Further investigations on the occurrence of *wieder* in three longitudinal corpora of German child language showed an early onset (1;7 in the Kerstin corpus) with a range of MLU<sup>W</sup> between 1;5, to 2;5 with a preferred restitutive reading.

Matsuo carried out two studies on children's acquisition of complex temporal structures, one of them dealing with Dutch children's production of two finite verbs in subordinate structures, and the other dealing with their interpretation of (nonfinite) participles. Under Klein's analysis of tense, this category marks the relationship between a Topic Time and a Speech Time; for example, a past tense calls for a Topic Time (TT) placed prior to the Speech Time (ST). Although children only have to know the relationship between a Topic Time and a Speech Time to perform well in the part of this experiment involving simple sentences, they have to know more in sentences involving complex structure, for example, if, in addition

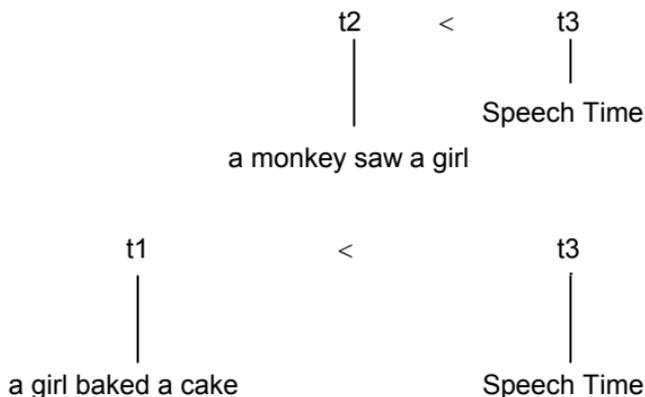
to the external Speech Time, there is an "embedded" Speech Time and hence two Topic Times. Examples (1) and (2) are English equivalent of the Dutch test sentences in the experiment:

(1) A monkey said that a girl baked a cake. (complement clause)



In (1), there are two Topic Times, to which the two "events", i.e., the monkey's speaking and the girl's baking a cake, are related. The first past tense in *said* positions the first Topic Time (TT1) prior to the external Speech Time and the second past tense in *baked* also positions the second Topic Time (TT2) prior to the external Speech Time. However, there must be some anchoring mechanism necessary between the first and the second Topic Time; there is no interpretation in (1) where TT2 is closer to the external Speech Time than TT1. This anchoring is not necessary in a sentence such as (2) where a relative clause instead of a complement clause is used:

(2) A monkey saw a girl who baked a cake. (relative clause)



In (2), TT1 can be either before or after TT2 as long as they are both placed past with respect to the Speech Time. Thus, in complementizer clauses, tense marking, as indicated by the finite element, is related to two relevant times - the external Speech Time as well as the "embedded" Speech Time. In matrix clauses as well as in relative clauses, speakers need not keep track of such a twofold relation. It is predicted that this leads to differences in finiteness markings. A total of 57 children (age 4;1

to 6:7) plus 5 adults took part in this experiment. First, the prediction that children might give similar responses to matrix and relative clauses was confirmed in the types of errors that the children produced. In both matrix and relative clauses, children produced uninflected forms twice as often as compared to the present tense. The opposite pattern was observed for complement clauses: Children produced present tense twice as often as an uninflected form. Thus, the prediction is borne out. What still must be accounted for is why children produce uninflected forms when the Topic Time has a relationship with a Speech Time, whereas they produce present tense when the anchoring is necessary.

The second ongoing experiment concerns the interpretation of time variables involved in nonfinite constructions, such as participles. They have no inherent Topic Time, hence are not directly relatable to the Speech Time. How are these variables temporally interpreted? Consider (3) and (4):

- (3) I would like to order a boiled egg.  
 (4) Could I have some boiling water?

In earlier work, Klein argued that the participles *boiled* and *boiling* are normally not understood to be simultaneous to the situation time in (3) and (4). In their Dutch equivalents we would hope that an egg we order is not already boiled when sentence (3) is uttered. Similarly, we would not like the water already boiling when we utter sentence (4). A pilot study with Dutch children (17 children age ranging from 5;6 - 7;0) showed that even these older children have problems with the temporal interpretation of past participles, but hardly any problem with present participles.

### 8.3 Scope phenomena

Three projects rounded off work from the predecessor project on the acquisition of scope relations. Nederstigt continued her research on the acquisition of *auch* "also" and *noch* "still" in German. Previous research had already shown that children as well as adults treat the two focus particles differently (cf. Annual Report 1999:77 and 2000:82). However, there are also systematic differences between the use of stressed and unstressed *auch* as in the following examples:

- (1) Oh, [das freut mich] auch [sehr, daß wir da zusammen hinfahren können]

"Oh I'm looking forward to being able to go there together with you, too."

(2) ...wir können auch [zum Abendessen gehen] ...

"...we could also go for dinner ..."

Nederstigt argues that in an utterance like (1) the particle functions as an overt assertion marker, marking repeated assertion. Consequently, the whole utterance functions as the domain of application of *auch* and the particle is analyzed as a fully functional phrase above the VP. Repeated assertion requires that the *auch*-utterance bear a contrast with respect to a preceding assertion. This contrast is established in the preceding context; the contrasting element, *mich* "I" in (1), always precedes the particle. In (2), the particle expresses the addition of *zum Abendessen gehen* "go to dinner" to other activities. Here, the domain of *auch* is restricted to the phrase following the particle; the particle is a constituent to this phrase and is almost exclusively located to its left. Adding entities to already existing ones also requires a contrast between these entities. However, this contrast is established in the *auch*-utterance itself and is marked by a pitch accent within the domain. This is supported by evidence from acquisition data. Stressed *auch* appears four months before unstressed *auch* and initially children seem to have problems with finite verbs in *auch*-utterances since they also mark assertion. These problems do not occur with unstressed *auch*, because children manage to establish the contrasts themselves.

In collaboration with Gretsche, Tracy (U. Mannheim) studied the acquisition of a range of scope particles (*auch*, *noch*, *nicht*, *wieder*, *mal*, *immer*) in seven longitudinal corpora of German child language. Whereas the findings of Nederstigt showed nearly no deviance from the target-adequate positioning of the scope particles *auch* and *noch* in one German corpus, these data reveal a developmental process towards a scope-adequate topological placement of these elements. Consider, for example, the following uttered by a child of 2;7

J. (2;7) (talking about measuring rectal temperature:)

Das tut weh NICHT.

this does hurt NOT

J. (2;8) (J wants the music to be louder:)

Mami, ich mag meine Musik so ganz leise NICH anhören.

Mum, I want my music so very soft NOT listen-to

They show that rules for the placement of focal elements and rules for scopal restrictions enter into competition with each other.

Van Geenhoven continued her research on "pluractionality", that is, on plurality in the temporal domain (see Annual Report 2000: 83-85). She investigated the question of how the treatment of frequentative aspect in terms of pluractional operators could be extended towards a treatment of habitual aspect as a special case of frequentativity. An account of habitual aspect in terms frequentativity represents an alternative to the by now standard semantic treatment of habitual sentences as generic sentences. Whereas in the latter approach the semantic representation is said to contain an implicit adverb of quantification, the former approach assumes the presence of an implicit frequency operator in the semantic representation of habitual sentences. She was able to show that some shortcomings in the genericity treatment of habituality do not arise in a pluractionality treatment of habituality.

## 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 coordinate 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 Nijmegen. 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 project takes an approach in which the process of second language acquisition is not characterized in terms of errors and deviations, but in terms of the two-fold systematicity which it exhibits: The inherent systematicity of a learner variety at a given time and the way in which such a learner variety evolves from one into another. If we wish to understand the acquisitional process, we must attempt to uncover this two-fold systematicity, rather than look at how and why a learner misses the target.

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. What learners do when acquiring a given target language can inform us about the organization of that language in general. This is possible because basic learner languages are simpler than their

corresponding native languages yet not completely different in nature. Although certain features may be lacking, the basic system of organizing and communicating information is maintained as language acquisition progresses. It may be partly overruled by target-language dependent properties but the basic system remains.

An underlying assumption of the project is that learner varieties develop towards the target language when the available linguistic means do not allow the learner to cope with specifiable discourse contexts, in the sense that a learner wishes to express that Topic Time and Situation Time (Klein 1994) do not coincide or that the inherent temporal properties of an utterance are at variance with its intended temporal relationship to other utterances in the discourse, or where the semantic role of an argument is at variance with its discourse status. It is in these contexts that the morpho-syntactic specifics of the target language emerge: Pronominal paradigms, focalization devices, and finiteness marking on the verb, hence grammatical agreement, tense and aspect. The acquisition of finiteness is once again of significance for the successful integration of negation, scope particles and temporal adverbials (see Benazzo and Dimroth, Annual Report: 114-115).

It is these assumptions that determine the choice of the main research topics pursued by the individual research centers. The following reports provide examples for research done in the domains of temporality (9.1), finiteness and scopal items (9.2, see also 7.1) and also on a new and closely related project on untutored second language acquisition in younger and older children currently being jointly conducted by the Institute and the U. Köln (9.3).

The work of Dimroth, Starren, and Schmiedtová was carried out at the Institute itself whereas that of Becker and Noyau at exterior centers.

## **9.1 The acquisition of temporality**

Noyau investigated the interplay between temporal morphology and the expression of temporal relations. Taking up results of a number of longitudinal and cross-sectional studies on the development of temporal-aspectual morphology in L2, she examined the construction of temporal structures in discourse in order to find functional explanations for the development of morphologization. Temporality can be conveyed without morphology in discourse, and morphologization is best accounted for

within the context of discursive activities and their communicative constraints on reference. L2 learners tend to develop lexical hypotheses (specific verbal endings are associated with specific verb types), semantic hypotheses (specific verbal endings are associated with specific temporal-aspectual concepts) and discourse hypotheses (specific verbal endings are associated with specific discursive structures), inevitably leading the learners to conflicts between different kinds of hypotheses. This view, which draws upon Bates and MacWhinney's (1987) competition model, helps explain both the very early attempts at making sense of morphology, and the resilience of other structures, which, even very late, manage to resist modification - the "upper limits" of the acquisition of L2 tense-aspect morphology.

Noyau also studied the expression of temporality in texts emphasizing two key aspects of the conceptualization of event structures in texts (cf. Noyau 1997, 1999, Noyau & Paprocka 2000):

- a) *granularity*, or the degree of temporal partitioning of situations;
- b) *condensation*, or the degree of hierarchical organization of event structures.

These studies attempt to characterize qualitatively the ways in which learners with developing varieties present complex events and embed them in time in order to shed some light on various aspects of the evolution of learner varieties in text production. The results show that *granularity* is a pertinent variable between early and intermediate stages of acquisition, whereas *condensation* helps differentiate intermediate and more advanced stages. Furthermore, crosslinguistic comparisons of L2 and L1 adult productions show that typological features of individual languages lead speakers to exploit more or less heavily these dimensions in conceptualizing situations, resulting in different strategies of embedding events in time, and that L1 influence can help explain some non-native aspects of very advanced learners in L2.

Schmiedtová investigated the acquisition of temporal expressions for simultaneity in a second language. In her experimental research project she looked at how adult second language learners describe temporal simultaneity in narrative discourse with learners of Czech whose native languages are English and German.

In discourse native speakers and second language learners usually do not mark simultaneity overtly at all. Instead they infer information regarding simultaneity from sources other than overt elements specifying the temporal relationships within a sentence. Two very important factors here are the given situational context and shared world knowledge. Therefore, Schmiedtová designed an elicitation production task where simultaneity must be marked explicitly by the use of unambiguous linguistic means.

English and Czech have similar ways of expressing simultaneity. Thus, one could assume that English native speakers learning Czech would have an advantage over German native speakers because German has no inflectional morphology for marking simultaneity and learners must learn to do so in Czech from scratch.

Based on first results from this project, this prediction appears to be true: Out of twelve German learners of Czech only eleven used adverbials for marking simultaneity. Ten of the fifteen English learners of Czech used morphological aspect for this purpose (in spite of the fact that in the experiment they used it in their source language only in combination with other linguistic devices such as adverbials).

The results of the German learners suggest that the source language plays a significant role in the acquisition of the linguistic encoding of complex temporal relations such as simultaneity. Just as in their mother tongue, German learners use adverbials or adverbial phrases for marking simultaneity and do not apply any marking for aspect. In other words, they use a default verb form - in Czech they chose the perfective form - ignoring the existence of the imperfective.

It appears that at a certain point during the acquisition of a second language the source language must play a significant role. It influences not only the choice of linguistic means for expressing simultaneity in the target language but also the way the learners use these means in combination.

Starren concluded her Ph.D. research on the development of temporal reference in the untutored acquisition of Dutch and French by Turkish and Moroccan learners. The overall picture that emerged from her analyses is that all learners of the present study first went through a stage in which adverbs (in combination with discourse-pragmatic means) established most of the temporal relations. Those learners who had left the basic lexical stage developed free morphemes (proto-AUX and proto-COP) in

order to express grammatical viewpoint aspect and tense. Proto-AUX were embedded adjacent to the verb in order to express the aspectual character of the verb and proto-COP were embedded in utterance-initial position to anchor the total utterance on the time axis (tense): Two important conclusions can be drawn on the basis of these findings:

- (1) The basic positioning of temporal adverbials functions as a mold for building up a morphosyntactic tense and aspect system

In accordance with basic principles of information organization, the temporal adverbial in the topic component has scope to the right over the whole utterance, while the adverb in focus affects only the focus, the expression of the event or state expressed by the verb. The same distribution reoccurs later with the same systematic shift between initial and noninitial position for early tense and aspect markings.

- (2) Grammatical aspect marking before tense marking

The analysis of the semantic properties of the first occurrences of morphological markers has also shown that proto-AUX contrasts embedded within the focus component precede proto-COP contrasts. These protoverbal auxiliary markings are a precondition to acquiring the expression of the relation between Topic Time (TT) and Situation Time (TSit), i.e., grammatical viewpoint aspect. For some learners in this study lexical and discourse-pragmatic means for the expression of viewpoint aspect appeared to be communicatively inadequate in the diagnostic contexts. In contrast, for the expression of tense, learners seem to be satisfied for a long time with temporal adverbials and discourse-pragmatic means for indicating the relation of TT to Time of Utterance (TU).

## 9.2 The acquisition of negation and finiteness

Becker studied the principles guiding the placement of the negator in Italian adult learner varieties of German. It is assumed that the placement constraints operative at different levels of acquisition are related to the semantic and pragmatic knowledge base of the learners, particularly to the knowledge of the background-focus structure of the utterance and semantic knowledge of the categories *negation* and *finiteness*. Finiteness is understood as a semantic notion expressing the assertion of a state of affairs for a certain time span (Klein 1998). Finiteness and negation function as operators: The operator FIN has scope over NEG and over the focus component of the utterance.

At the earliest stage, *the prebasic level of acquisition*, utterances are rudimentary and do not contain verbs. Finiteness is not overtly marked. The structure of negated utterances is basically organized into three parts:

background elements (mainly left implicit) < negator < focus elements

*The basic level of acquisition* is characterized by the appearance of thematic verbs and their arguments. The most agentive argument is usually attributed background status, while the verb and the second (internal) argument is attributed focus status. There is no marking of finiteness on the verb. Consistent with the tripartite structure adopted earlier, the constituents are linearized in the following way:

background constituents < negator < focus constituents (lexical verb + complement)

Morphosyntactic marking of finiteness occurs at *the postbasic level of acquisition*. It first appears in AUX/MOD-V-constructions in which the auxiliary/modal functions as the carrier of FIN. The middle part of the tripartite structure now contains two elements, the carrier of FIN and the negator. The order is as follows:

background constituents < carrier of FIN (aux./mod.) < negator < focus constituents  
(infinite lexical verb + complement)

In the final stage observed by Becker finiteness is marked on thematic verbs. This requires an operation in which the lexical verb is shifted to the position reserved for the carrier of FIN:

background constituents < carrier of FIN (finite lexical verb) < negator < focus const.

The placement of the negator in the acquisition process is a constant: The negator precedes the focus part from beginning to end and follows any carrier of FIN. This order corresponds to scope relations in the semantic representation of the utterance.

Dimroth, Gretsche, Jordens (U. of Amsterdam), Perdue (U. Paris VIII), and Starren finished work on their stage model of finiteness in first and second language acquisition. Following Klein (1998) they adopted a semantic account in which finiteness is understood as being a property of utterances (as opposed to morphological finiteness that is a property of verbs). Semantic finiteness results from two separate pragmatic operations called *anchoring* and *linking*. Anchoring provides the spacio-temporal coordinates into which the rest of an utterance is embedded, and

linking validates the state of affairs expressed in the utterance for these coordinates.

The semantic notion of finiteness accounts for properties of learner varieties in which morphological finiteness does not yet play a role. The first linking expressions attested in first and second language learner varieties do not adapt their form to the anchoring information. They are lexical linking devices, elements from a closed class of particles, adverbials and protomodals that express (along with other possible meaning components) that the state of affairs mentioned in the utterance does indeed hold for its topical elements.

The development of the expression of finiteness first through lexical linking devices and, later on, in the form of morphological finiteness makes it a suitable gauge for distinguishing successive acquisitional stages. For an application of this stage model to a comparison of Dutch as L1 and L2 see Dimroth & Jordens 8.1.

### **9.3 The age factor in second language acquisition**

Together with Stephany (U. Köln) Dimroth received DFG funding for a project investigating the role of the age factor in second language acquisition. This project is a case study based on the longitudinal observation of two Russian sisters aged 8 and 14 acquiring German as a second language. Data collection started immediately after their arrival in Germany and covered one hour of free conversation per week over a period of 18 months. This research was carried out in cooperation with Stephany, Bast and Lehmann (all U. Köln). Preliminary results are based on the learners' first few months of L2 contact. In the domain of temporality the younger learner tended to use grammatically correct TL forms (basically present tense), but which communicatively inadequate in past contexts. In those same contexts, the older learner constructed idiosyncratic forms, some of which were target-language deviant, to cope with communicative needs. In the domain of nominal morphology the older learner applied a relatively large number of nouns in both singular and plural form and some overgeneralizations of plural allomorphs, which can be taken as indications of a productive number system. The nouns used by the younger learner appear in either the singular or plural form with relatively little overlap between both groups. As with temporality she demonstrated less productivity but fewer erroneous forms.

Research on the role of the age factor traditionally aims at establishing a one-to-one relation between the learner's age at the beginning of second language acquisition and rates of ultimate attainment. The first results of the longitudinal case study discussed above indicate that it is also worthwhile to carry out an in-depth comparison of the process of second language acquisition in younger and older subjects. If we knew more about similarities and differences in the way younger and older learners go about learning and using a new language, we might be able to shed new light on the correlation between age of onset and level of ultimate attainment.

# 10 OTHER RESEARCH

## 10.1 The semantics of quantifiers in natural languages

In 2001 Seuren's work concentrated mainly on the semantics of quantifiers and negation in natural language. Since the meanings of quantifiers and negation define a logical predicate calculus, the effort resulted in the construction of a new predicate calculus, differing from the standard Russellian calculus in interesting ways and more closely reflecting the use of quantifiers and negation in natural language. The new system can be regarded as a close approximation of the quantificational logic underlying human cognitive processes. This new system has turned out to bear a strong resemblance to the original predicate calculus as devised by Aristotle in the 4<sup>th</sup> century BC. The minor differences with regard to the Aristotelian system are needed for a better empirical fit with the facts of language. At the same time they repair the logical defects of the original Aristotelian system and thus improve it. The existence of this logically sound alternative to both the Aristotelian calculus and the standard Russellian system was unknown. Research continues into the intensional aspects of predicate calculus: Quantification over imagined ("intensional") objects (e.g., the fictional detective Sherlock Holmes, or mermaids, or unicorns, or mythological gods) and quantification by means of intensional predicates, i.e., predicates that do not require real existence of the argument term referents for truth, such as "be worshipped", "be famous", "be talked about". Sentences like "Some Greek gods were worshipped in that temple" cannot be handled by modern predicate calculus. Yet they occur normally in natural language and must be accounted for. The development of an empirically adequate predicate calculus that includes intensional objects and predicates is a nontrivial task.

## 10.2 Comprehension in discourse

Vonk, together with Frank, Koppen (both U. Nijmegen) and Noordman (Tilburg U.) continued a project in which a computational model is being developed to simulate reading comprehension and, in particular, knowledge activation and inference processes in the comprehension of stories. A story is considered a description of consecutive situations within a relevant knowledge domain. Each situation is characterized by propositions having truth values between zero and one. A proposition is distributively represented as values of cells that form a self-organizing map, representing the world knowledge within the domain of the story. The values are acquired on the basis of a large number of situations presented to the map. The model contains two kinds of knowledge: Knowledge about the relations between propositions determined by the map at any point in the story and model-derived knowledge about the contingency between propositions over time. This is represented in a matrix that relates the cells of the map to each other. Comprehending a story is thus the process in which the reader constructs the narrative situations from the distributed knowledge representation on the basis of the sentences in the text. In terms of propositions this implies that the comprehender constructs a representation of the propositions that are given in the text and estimates the likelihood of propositions that are not given in the text. The latter are inferences. This model was tested on several hundreds of sequences of propositions (narratives) with respect to inferencing, reading time, and recall. It was observed that the model inferred propositions that were causally implied by the text. Moreover, the reading time in the model, as reflected by the number of cycles, was longer the less connected a sentence was with the text. In addition, there was a positive correlation between processing time and the amount of inferencing. Furthermore, the retention of text propositions decreased with the retention interval and there was a positive correlation between the connectedness of propositions and their retention. It was also noted that texts containing many connections are better retained than texts with fewer connection

# 11 TECHNICAL GROUP

## 11.1 Overview

In 2001 the TG focused its efforts on continuing to provide excellent service of existing facilities while completing a number of developments to be used in the Institute's own scientific work such as the Browsable Corpus (see 11.4). All this overlapped with the additional requirements exerted by external contractual commitments.

This was a very successful year in that a number of essential goals could be met: Work was concluded on defining a metadata set for multimedia/multimodal language resources and completing the tools within the "International Standards for Language Engineering" (ISLE), allowing this technology to be released for use. The same applies to the EUDICO tool set for multimedia annotations and exploitations, stable versions of which could be provided to scientists at the Institute and contractual partners, demonstrating its sophistication and outstanding potential (see 11.4). The newest versions of the "Corpus Exploration Tool" (COREX) could benefit from this technology in the most recent distributions of the Corpus of Spoken Dutch as could the last version of the user client for the MUMIS (Multimedia Indexing and Searching) project. The new version of the "Nijmegen Experiment Setup" (NESU) software was carefully tested in real experiments in the Institute and is now available to interested external parties (see 11.6).

These various activities, especially the Institute's own research activities, resulted in an increasing strain on the Institute's storage capacity: To house all the digitized audio and video streams and also the increasing amount of neuroimaging data, the disk RAID array was extended and a new tape library was installed (see 11.2).

Special attention was also devoted to the legal and ethical problems that emerge when sensitive data such as multimedia recordings or metadata records of such data has to be made available via modern Internet-based mechanisms.

As a result of the TG's projects in 2001, members of the TG were invited to a number of workshops and several papers were accepted and presented.

## **11.2 Computer systems and networks**

In 2001 very little reorganization work was required. The central server systems (SUN Solaris and Win NT) ran with a relatively high availability and central services such as e-mail, DNS, and backup facilities also ran very smoothly. Due to the large amount of storage capacity required to centrally store all relevant resources, the available RAID system was extended to 3.5 TB and a new tape library with a storage capacity of 20 TB (extendable) was installed. It was decided to continue with AIT technology since AIT2 had already proven its reliability and the TG had had less experience with the alternative LTO technology. We are awaiting the deployment of the AIT3 tapes with a storage capacity of 100 GB per tape. An ADIC tape library was chosen because it is reliable and allows the integration of different media types.

It was decided to have the central storage components accessible through several servers in order to share the processing load efficiently and to prevent unnecessary data copying and duplication. To achieve this a fiber channel architecture was installed based on a switching fabric that now connects two SUN and 2 NT servers to the storage modules. The Quick File System (QFS) was installed to guarantee shared access, i.e., the software ensures that the file systems on all UNIX servers are synchronized. This software does not support platform-independent access to harmonize storage used by UNIX and NT. Since the new tape library was used for near-line space, Hierarchical Storage Management (HSM) software was installed. SAM-FS was selected especially for the harmonization of disk cache and tape library. HSM will go into full operation after a period of tests at the beginning of 2002. To ensure high-level data security, a second copy will be automatically generated in the tape library, which is located at a distance from the computer room. The feasibility of placing yet another copy in a separate building is under discussion.

The relatively large amount of primarily digitized data no longer being used and the simultaneous copying of archive data require suitable organization of the data and a new backup concept. All related data such as media data, metadata, transcriptions and annotations require specific methods of organization for ease of administration. By using metadata, the user is not confronted with directory paths and devices, but with a domain organized by linguistic concepts. Such data must also be excluded from the backup system to reduce the size of the backup window.

The increase in the use of notebooks has been a noticeable development. Many senior researchers have switched completely to using notebooks instead of home and office computers. For researchers who travel frequently it has become increasingly impracticable to have several machines, since version tracking of notes and documents and backup is almost impossible. As the complete switch to notebooks increases, and along with it the requirements regarding quality, capacity, installation and maintenance of notebooks, the TG has come to spend a considerable amount of time on investigating the necessary details. When connected to the local area network the notebook should behave as any local PC and the user should have immediate access to all services. When connected at home or used as a mobile station, other setups are required. In the latter case it is necessary to provide the user access to features normally reserved for system administrators. The backup problem can be solved when the user is logged into the LAN.

The speech lab, which is used for special types of speech editing (e.g., generating sound stimuli in experiments and various sorts of analysis operations), is becoming an increasing problem. Traditionally, the XWaves software was supported and extended with special functionality. Since it no longer runs smoothly on the SUN workstations, the Institute is currently investigating the possibility of adapting PRAAT to existing XWaves functionality and to transferring the remainder to PCs.

### **11.3 Information systems**

Due to the interest shown by external users in utilizing a number of the Institute's new software products, there has been a slight change in policy. Software produced by members of the Institute will remain free for academic use in the future. However, anticipating an increase in requests, the decision was made to install simpler downloading mechanisms and to change the support policy. At the start page of the Institute's web site two

entries will soon be added: Downloadable tools and MPI Corpus. The latter will give access to the metadata tree of the MPI corpus and, where access is free, to the real resources. Currently, automatic mechanisms are being developed so that users downloading the software can be included in e-mail lists providing information on bugs, new versions and other events.

An online bug report database tool was installed, which enables the user to report on bugs found in various programs and to check the status of such reports. Only developers will be authorized to change the status of bug reports. The TG expects this to make error handling more efficient. The database is available from the tools web site.

The MEID Intranet was extended by a picture and people database. The former is very useful for scientists using graphic stimuli material for designing experiments, the latter for introducing and assisting newcomers.

#### **11.4 Linguistic applications**

The most extensive achievements of the past year were made in this area. The first phase within the ISLE metadata project was completed, resulting in a fairly stable metadata set for multimedia/multimodal resources, and was named the "ISLE Metadata Initiative Set" (IMDI Set). This set was motivated by researchers from the field-linguistics and language-engineering communities. The set is more extensive than the Dublin Core set and allows the user to formulate such queries as "give me all resources where Yaminjung female speakers aged 6 were interviewed and where an audio signal, video signal and a transcription is available". Since such metadata should, in principle, be openly available, we foresee additional interest and new possibilities within the research community. This set is currently being used in the DOBES project, at the MPI and for other projects' data. In most of the IMDI set components, controlled vocabularies (such as continent or country names) have been defined, making it easier to use and providing more uniformity. The current IMDI Set will only be modified after extended practical use.

At the same time the necessary tools were updated to enable full support of the IMDI Set and controlled vocabularies. The editor is user-friendly, offers efficient reusable blocks and supports the controlled vocabularies as clickable options. When connected to the Internet, the editor can download the latest versions of the controlled vocabularies such as the Ethnologue

language codes. The browser also supports the latest version of the IMDI Set and the controlled vocabularies. It now has a locally operating search function. Since the browser works in a fully distributed scenario where IMDI-type metadata descriptions can be located anywhere on the Web, the search function will be extended in 2002. Also, a number of scripts were written to convert Excel spreadsheet data into IMDI-type XML files. In 2002 much effort will be put into improving the working efficiency when creating or modifying metadata descriptions.

This ISLE metadata work resulted in a proposal on how to map the IMDI Set to the OLAC Set, an initiative based on the Dublin Core by LDC and SIL. In 2002 interoperability will be achieved by implementing the mapping and the metadata harvesting protocol of the Open Archives Initiative. Recently, a proposal for metadata for lexica was also presented.

The use of metadata is new to the community and it will take some time before its full potential is understood. We foresee comprehensive utilization especially since the IMDI Set is the starting point of a new direction in the language-resource domain. The comprehensive tests with metadata at the MPI have furnished researchers and technicians with an excellent understanding of the requirements and problems involved. For details and the latest version we refer the reader to the IMDI web site: <http://www.mpi.nl/ISLE>.

Another important step was the release of the EUDICO tool set to our scientists and contractual partners. The EUDICO annotation tool offers easy time-alignment and annotation options for video and audio streams. Sets of annotation tiers and their attributes can be defined by users. The tool already supports input methods for various writing systems as Chinese, Cyrillic, Hebrew, and Arabic as well as IPA. With its UNICODE support and its ability to produce the powerful and XML-based EAF format, it is currently the most advanced annotation tool for multimedia signals available. It will be extended during 2002 to make it even user-friendlier and to offer input methods for other UNICODE-based writing systems. It is also planned to give it even more powerful mechanisms to allow the immediate start of speech analysis tools such as PRAAT.

The wide spectrum of different viewers (ways of presenting data to the user) will be enhanced to make EUDICO attractive to various communities dealing with media streams. With respect to its exploitation capacity, a search interface was developed and integrated, which allows the user to

define patterns associated with tiers, distances between such patterns and search for their combined occurrence in the annotations. It will respond with their positions and enables the user to immediately jump to these positions in the media stream by clicking on the hits.

A very important decision for fieldworkers is that EUDICO will fully support the SHOEBBOX file format, including interlinearized representations. EUDICO already handles a number of import formats such as relational-database tables and the well-known CHAT format from the CHILDES database. As soon as the ATLAS Interchange Format is stable and has been adapted to requirements, this format will also be supported. Many other functions are already included. For details we refer the reader to the EUDICO web site: <http://www.mpi.nl/world/tg/lapp/eudico>.

Faced with a wide variety of types of resources in legacy formats, a considerable amount of conversion had to be carried out to attain a coherent and accessible corpus. Another crucial aspect in corpus generation is linked to the UNICODE universal character representation. Researchers used numerous character representations often linked with specific fonts to represent, for example, IPA symbols. Consequently a number of converters were written encompassing different document structures/formats and character aspects. Those deserving special mention are: (1) A converter installed as a WORD module to exchange data between WORD and PRAAT, including the possibility for the user to define his own font mapping schemes; (2) A flexible converter also installed as a WORD module, which generates XML-based EAF (EUDICO Annotation Format) files from structured WORD documents. Flexibility is guaranteed by allowing the user to describe the structure of his WORD document with the help of the Annotation Description Language (ADL), a regular (Chomsky-3) grammar language, developed at the MPI; (3) A converter that allows the conversion of SHOEBBOX files into transcriber files and vice versa. XSLT technology made possible the realization of many other converters between different XML-based formats.

Finally, all the technology described so far in this section was developed to create a uniform and powerful environment for corpus generation, access and exploitation. A group was established to help researchers generate a coherent browsable corpus to include such valuable resources as a large Second Learner Corpus. Browsable and searchable hierarchies were generated incorporating the metadata descriptions, which are the browsable and searchable objects. At various levels scientifically relevant

information such as sketch grammars, lexica or field notes were integrated after conversion steps were made to insure easy retrieval. This browsable corpus should provide an ideal method for researchers to access their data.

At the same time the TG reorganized and unified such basic corpus resources as annotated media streams. These efforts were synchronized with the system management group to achieve superior archiving and backup procedures. Domain links were introduced to make these resources directly accessible from the metadata. The first phase of this corpus building was completed in 2001. However, there remains much work to be done in optimizing the existing structures, integrating remaining material and especially in making the existing metadata descriptions more useful. After this first phase of intensive work we can summarize by saying that the Institute has succeeded in achieving a well-organized and easily accessible corpus resource from a rather chaotic original corpus source. This experience has taught us that creating such an organized domain takes considerable effort and that success can only be achieved if researchers and technicians are willing to work closely together. Further manpower investment will be necessary in 2002 to complete this project.

The ethical and legal consequences resulting from a wider availability to external researchers of the Institute's metadata and other resources from the online corpus came intensively into discussion in 2001. These discussions are expected to continue in the coming months of 2002.

Another recent development should be mentioned here. In collaboration with partners from the DOBES project, the TG developed a concept for a sharable lexicon accessible to collaborating researchers via the Web. The technical solution is based on a Java client for authentication, addition of new columns, offering visualization aids and the addition or modification of records including input methods for various writing systems (such as IPA, Chinese) and on a server-based ORACLE database housing the actual lexical data. Record locking and other well-known techniques prevent data inconsistency. However, to achieve a high-quality lexicon, interaction between the researchers actively involved in the coding must take place.

## **11.5 Computer-based audio/video handling**

Efficiently operating video and audio digitization setups supporting automatic cutting by user-provided batch lists were the backbone of the

Institute's digitization efforts. MPEG1 for video including compressed MP3 encoding and uncompressed 44/48 kHz digitization for separate audio were used as standards. In a recent TG discussion involving specialists in computer media, it was concluded that the step towards higher quality video is necessary for archiving purposes. MPEG1 only offers VHS quality whereas MPEG2 offers near-to-DV quality, which is acceptable for most fieldwork recordings.

Two interesting digital formats are currently available offering competitive quality at comparable rates: Digital Video (DV) and MPEG2. Both formats include handy camcorders, which can be used in the field. The easy-to-use i-link option can transfer the digital media (DV only) data to a notebook. The TG has opted for the MPEG2 line of camcorders, which store the streams on DVD. Two comments can be made: While MPEG2 is an open standard that will be supported by various industries, DV will remain a proprietary format. The i-link option may present problems for older CPUs, since there is no guarantee that DV stream frames will be captured. The TG recommends the MPEG2 option where DVDs can be used as backup copies and for which notebook adapters are available.

The TG intends to modify the setups and check all hardware and software consequences. Compared to MPEG1, MPEG2 has bandwidth and capacity requirements 3 to 5 times larger. For many purposes (Internet services), MPEG1 still remains the only option, since the required bandwidth of MPEG2 will not be provided in many cases (ADSL broadband home-PC connection technology offers 2 Mbps, which is suitable for MPEG1). This means that, in general, two versions of media files must be provided or that it should be possible to generate an MPEG1 version easily.

It remains to be discussed whether compressed audio such as that from Minidisk or MP3 as part of MPEG streams is acceptable for archiving. To the human ear, these compression techniques do not present a loss of important information, but it must be checked with specialists as to how far such compression techniques hinder the application of typical speech processing algorithms for determining pitch contours. If appropriate algorithms are available that can operate without difficulties using compressed signals, the amount of audio data stored could be drastically reduced. It remains to be discussed whether compressed audio such as that from Minidisk or MP3 as part of MPEG streams is acceptable for archiving.

## 11.6 Experimental facilities

In addition to supporting the many experiments conducted both in-house and out-of-house, three major activities were carried out: (1) Within the Institute building new experimental facilities were set up; (2) Additional experimental facilities were created to service collaborations with the Nijmegen U. (NICI and F.C. Donders Centre for Cognitive Neuroimaging); and (3) The development of the new NESU software was completed and the product successfully tested.

The remodeling of the basement made it possible to set up a new Groups Experiment Room, providing space for experiments that can be run with up to 10 subjects simultaneously. Hardware was installed to include an extended NESU Box and electronic installations and further NESU extensions were developed. Tests are due to commence in 2002. A new Baby Lab, initiated at the Institute, was set up at the Institute of Cognition and Information (NICI). At the new F.C. Donders Centre two new labs were set up: one to measure EEGs (a replica of the Institute's existing EEG labs) and a Baby Lab including a facility to measure EEGs. All these experiments are running with the help of the NESU experiment builder and runner software.

Much development and testing work was devoted to the new NESU version (NESU 2). According to all tests conducted thus far, all real-time aspects of the software system running under Win 2000 are under control. The experiment builder was first introduced in two experimental labs in the Institute to test its accuracy and was carefully controlled to insure that the time tolerances were met and that the new software did not create erroneous results. On the basis of these successful tests the new version of the execution environment will now be implemented throughout. In addition, work on the graphic experiment builder was completed. It offers a modern and more flexible user interface with a Windows-like look and feel and is a great improvement over the old DOS, based version. Both builder and runner are available under one integrated interface. An integrated experiment browser allows the user to easily find existing building blocks from earlier experiments and to combine them in new experiments.

Special attention was given to the components responsible for fast stimulus generation. The Direct X technology was used to generate acoustic and visual stimuli. With the exception of moving images (video streams or animations) all problems were promptly solved. With respect to moving images the problem of starting sequences with minuscule time

delays was solved. However, because the video player was started on a high priority level, other system resources were blocked during play. Consequently real-time events could not be handled within the specified time guarantees. This problem remains to be solved in early 2002.

Special software and a simple electronic device were developed to test the time accuracy of the NESU software in all experimental circumstances. This tool proved especially valuable in testing the software's new features for various operating systems settings and different input/output media such as video presentation involving time-consuming decoding operations. The graphical interface quickly indicates the distribution of delays introduced by a system component. This tool can also be utilized when the user wishes to check the time accuracy at experiment run-time.

### **11.7 Electronics and audio/video facilities**

Special electronics were developed for the new Group Experiment Room so that up to 10 subjects can be run simultaneously. Each subject booth has its own individual volume control, push buttons with acoustic shielding to suppress the clicks when pressing the buttons, and special high damping closed headphones to ensure that the cross-subject effects are minimal. The two Baby Labs were equipped with special-effects electronics to attract attention and to expose the babies to stimuli.

Much effort was put into upgrading and complementing the digitization setups for audio and video. In these setups various formats (Hi8, S-VHS, DV, DVCAM) and the standard norms (NTSC, SECAM, PAL) can be supported. Conversion of such formats and norms has been made very simple to support the extensive digitization work at the Institute.

### **11.8 Other activities of the Technical Group**

As in 2000 a number of animations were created and optimized for various fieldwork situations.

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 Max Planck Institutes.

## 12 OTHER ACTIVITIES

### 12.1 Honors/Awards

Cutler delivered the Foundation Day address ("Dies-rede") 2001 for the Katholieke Universiteit Nijmegen.

The Royal Netherlands Academy of Arts and Sciences (KNAW) awarded Van Geenhoven the position of Academy researcher at the department of linguistics at the Katholieke Universiteit Nijmegen.

The KNAW appointed Meira to the position of Academy researcher at the Research School CNWS (the School of Asian, African, and Amerindian Studies), Leiden U.

The Society for the Study of the Indigenous Languages of the Americas (SSILA) awarded the 2001 Mary Haas Award to Zavala for his MPI dissertation "Inversion and other topics in the grammar of Olutec (Mixean)." He also received the National Prize of the Instituto Nacional de Antropología e historia, Mexico, for his dissertation.

### 12.2 Nijmegen Lectures

This year's Nijmegen Lectures were given by Karen Emmorey. The title of the series was "Language, cognition, and the brain: Insights from sign language research." The series included three morning lectures: "How signers and speakers talk about space: The effect of modality on spatial language," "Language and cognition: What sign language can tell us about linguistic relativity and cognitive architectures," and "The neural systems underlying language: Insights from sign language research." The

afternoon seminars were: "Mapping conceptual representations onto linguistic representations: A comparison of signed and spoken languages" (with, as discussants, Bohnemeyer and Kita, MPI Nijmegen, as moderator, Slobin, U. of California, Berkeley), "Embodied theory of meaning and sign language" (with, as discussant, Glenberg, U. of Wisconsin, Madison), and "Interpreting anaphoric expressions: Insights from sign language" (with, as discussant, Webber, U. of Edinburgh). The lectures were organized in collaboration with the Interfaculty Research Unit for Language and Speech (IWTS) of the U. Nijmegen. The series was organized by Dahan, Kita, and Mak (U. Nijmegen), with the assistance of Jonas.

### **12.3 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 2001 series were: Weiller (U. Hamburg), Rugg (U. College London), Martin (National Institute of Mental Health, Bethesda), Kanwisher (MIT Boston), and Marshall (Oxford U.).

### **12.4 Internal lectures**

During 2001, nine speakers gave lectures in the Institute's Formal Colloquium series. The speakers were Dell (U. of Illinois, Urbana-Champaign), Morgan, (Cognitive and Linguistic Sciences, Brown U.), Engberg-Pedersen (U. of Copenhagen), Goldberg (U. of Illinois, Urbana-Champaign), Tyler (Cambridge U.), Radford (U. of Essex), Campbell (U. College London) Tanenhaus, (U. of Rochester), and Habel (U. Hamburg). These lectures were organized by Enfield, Matsuo, Narasimhan and Roelofs, the Institute's colloquium committee. Many informal lectures were also presented by long-term and occasional visitors to the Institute.

### **12.5 Teaching**

Members of the Institute taught at the following institutions:

- Bowerman (U. of Copenhagen)
- Dimroth (U. Köln)
- Gretsche (U. Wien)
- Gullberg (Temple U. Japan; U. Nijmegen)

- Hagoort (Graduate School Neurosciences, Amsterdam; U. Nijmegen; Universidad de la Laguna, Tenerife)
- Indefrey (U. Nijmegen; U. Düsseldorf)
- Klein (U. Heidelberg; HU. Berlin)
- Levinson (2001 Summer Institute of the Linguistic Society of America, Santa Barbara)
- Nederstigt (U. Nijmegen)
- Petersson (4<sup>th</sup> Southern European School on Physics in Medicine, Faro; Karolinska I., Stockholm)
- Schiller (Maastricht U.)
- Senft (U. Köln; U. Nijmegen)
- Vonk ( U. Nijmegen; KH Brugge-Oostende)

## 12.6 Colloquia presented

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

- Bastiaansen (U. of Amsterdam)
- Van Berkum (U. of Amsterdam; Leiden U.)
- Bowerman (U. of Copenhagen)
- Brown, P. (U. de Poitiers - CNRS)
- Cutler (U. of Amsterdam; Yang Ming U., Taiwan; Chung Cheng U., Taiwan; U. of Melbourne)
- Dahan (U. of Dijon)
- Dimroth (U. Utrecht)
- Eisenbeiß (U. of Massachusetts, Amherst; U. Düsseldorf)
- Gretsch (U. Prague)
- Hagoort (U. Utrecht)
- Hellwig, F. (U. Köln)
- Indefrey (U. Groningen; U. Stuttgart)
- McQueen (Bowdoin College, Maine; Northeastern U., Boston)
- Schiller (Leiden U.; Maastricht U.; U. Gent; U. Genève)

- Schmiedtová (MPI for Evolutionary Anthropology, Leipzig; U. Nijmegen; Goethe-Institute, Prague).
- Senft (MPI Seewiesen; Aarhus U.; Moesgård Museum, Aarhus)
- Seuren (U. Leipzig; MPI for Evolutionary Anthropology, Leipzig; Volkshogeschool Enschede; MPI Nijmegen; Drake U.; U. of Southern California; Stanford U.; U. of California at Santa Cruz; San José State U.; U. of Amsterdam)
- Van Turenout (Institute of Neurology, London; Free U. of Brussels)
- Van Geenhoven (U. Stuttgart; UT Austin; Northwestern U.)
- Vonk (U. Nijmegen).
- Wassenaar/Kooijman, A. (Revalidatietiecentrum De Hoogstraat, Utrecht)

## 12.7 Workshops organized:

Van Alphen, Cholin, Mauth, Seyfeddinipur and Sprenger organized the 3<sup>rd</sup> Tutorials in Behavioral and Brain Sciences (TuBBS). The topic of the summer school, held August 13-17 in Berg en Dal, was: Multiple perspectives on the mental lexicon. The summer school included presentations by Caramazza (Harvard U.), Clark (Stanford U.), Cutler (MPI Nijmegen), Goldin-Meadow (U. of Chicago), Levelt (MPI Nijmegen) and Van Turenout (F.C. Donders Centre) and poster presentations by the participants (Ph.D. students from the MPI of Cognitive Neuroscience, Leipzig, MPI for Evolutionary Anthropology, Leipzig, MPI for Psychological Research, München and the MPI for Psycholinguistics, Nijmegen).

Bohnemeyer organized the workshop "Deictic Conceptualization of Space, Time, and Person" together with Lenz (Ruhr-U. Bochum) at the 23<sup>rd</sup> Annual Meeting of the German Linguistics Society (DGfS) in Leipzig, February 28 - March 2. Papers were presented by Bohnemeyer, (MPI Nijmegen) Consten (U. Jena), Diessel (MPI for Evolutionary Anthropology, Leipzig), Di Meola (Rome), Fritz (U. Passau), Hausendorf (U. Bielefeld), Helmbrecht (U. Erfurt), Jungbluth (U. Tübingen), Kita, (MPI Nijmegen), Özyürek (Koç U.), Kupfer (U. Frankfurt), Meira, (MPI Nijmegen), Mortelmans (Antwerpen), Senkerik (Berlin), and Simon (Berlin).

Broeder organized an ISLE Metadata Search workshop in Nijmegen (December 4<sup>th</sup>). Presentations were given by the following speakers: Broeder (MPI Nijmegen), Popescu (ISSCO Genève), and Wittenburg (MPI Nijmegen).

Cutler, in collaboration with Gullberg and Indefrey, organized a workshop on Multilingualism on March 14<sup>th</sup> at the Institute. Presentations were given by the following invited speakers: Baker (U. of Amsterdam), De Bot (U. Nijmegen), Dijkstra (U. Nijmegen), Franceschini (Saarland U.), Gillis (U. Antwerpen), Hulstijn (U. of Amsterdam), Kellerman (U. Nijmegen), and Perdue (U. Paris VIII).

Indefrey, in collaboration with Penke (U. Düsseldorf) organized a workshop entitled "Neurocognition of Language Processing" at the 23<sup>rd</sup> Annual Meeting of the German Linguistics Society (DGfS) in Leipzig, February 28 - March 2. Presentations were given by the following speakers: Dogil (U. Stuttgart), Hagoort (MPI Nijmegen/F.C. Donders Centre), Lleó (U. Hamburg), Piñango (Yale U.), Roehm (U. Salzburg), Schiller (MPI Nijmegen/Maastricht U.), Stowe (U. Groningen), Wassenaar (MPI Nijmegen), and Westermann (Sony Paris).

Together with Kingston (U. of Massachusetts) and Nearey (U. of Alberta), Smits organized the workshop on Speech Recognition as Pattern Classification (SPRAAC), held in Nijmegen, July 11-13. Invited talks were given by Van Alphen (MPI Nijmegen), Ashby (U. of California, Santa Barbara), Benki (U. of Michigan), De Boer (U. of Washington, Seattle), Ten Bosch (Lernout & Hauspie Speech Products), Brent (Washington U., St. Louis), Cutler (MPI Nijmegen), Furui (Tokyo Institute of Technology), Gaskell (U. of York), Guenther (Boston U.), Hermansky (OGI School of Engineering), Johnson (Ohio State U.), Jongman (U. of Kansas), Jusczyk (Johns Hopkins U.), Kingston (U. of Massachusetts), Maddox (U. of Texas, Austin), Massaro (U. of California at Santa Cruz), McQueen (MPI Nijmegen), Moore (20/20 Speech Ltd.), Nearey (U. of Alberta), Norris (MRC-CBU Cambridge), Saffran (U. of Wisconsin, Madison), Schouten (U. Utrecht), Smits (MPI Nijmegen), Van Son (U. of Amsterdam) and Swingley (MPI Nijmegen).

In cooperation with Van der Sandt and De Hoop (both U. Nijmegen) Van Geenhoven organized the Semantics Colloquium at the Philosophy Department of the University of Nijmegen.

Wittenburg, in collaboration with Brugman, organized a DOBES Workshop in Hannover (January 12-13). Presentations were given by the following speakers: Brugman (MPI Nijmegen), Dwyer (U. of Kansas), Gibbon (U. Bielefeld), Hiß (U. Mainz), Lieb/Drude (FU Berlin), Mosel (U. Kiel), Skiba (MPI Nijmegen), and Wittenburg (MPI Nijmegen).

Wittenburg, in collaboration with Declerck (DFKI Saarbrücken) and Hoenkamp (U. Nijmegen) organized a MUMIS user workshop in Nijmegen (January 19<sup>th</sup>). Presentations were given by the following speakers: Declerck (DFKI, Saarbrücken), and Wittenburg (MPI Nijmegen).

Wittenburg, in collaboration with Broeder, organized an International ISLE metadata workshop in Nijmegen (March 1-2). Presentations were given by the following speakers: Broeder (MPI Nijmegen), Budin (U. Wien), Calzolari (ILC, Pisa), Dekkers (PriceWaterhouseCoopers), Dwyer (U. of Kansas), Oltmans (U. Twente), Peters (U. of Sheffield), Suihkonen (MPI for Evolutionary Anthropology, Leipzig), and Wittenburg (MPI Nijmegen).

Wittenburg, in collaboration with Hiß (U. Mainz), Gerling (MPG, GV) organized a workshop in Munich (March 8<sup>th</sup>) on Legal and Ethical Aspects for Online Corpora. Presentations were given by the following speakers: Gerling (MPG, GV), Hiß (U. Mainz), and Katzenberger (MPI für Patentrecht, München).

Wittenburg, in collaboration with Cunningham (U. Sheffield), organized a MUMIS event specification workshop in Amsterdam (May 7<sup>th</sup>). Presentations were given by the following speakers: Saggion (U. Sheffield), and Wittenburg (MPI Nijmegen).

Wittenburg, in collaboration with Gibbon (U. Bielefeld), Mosel (U. Kiel), Dwyer (U. of Kansas) organized a DOBES workshop in Bielefeld (November 2-3). Presentations were given by the following speakers: Brugman (MPI Nijmegen), Drude (FU Berlin), Dwyer (U. of Kansas), Franchetto (U. Rio de Janeiro), Guirardello (Bristol U.), Gibbon (U. Bielefeld), Mosel (U. Kiel), Harrison (U. Yale), Lieb (FU Berlin), Rood (U. of Colorado), and Wittenburg (MPI Nijmegen).

## **12.8 Presentations at conferences, congresses, and workshops:**

Alphen, P. van "Does subphonemic variation influence lexical access?" Workshop on Speech Recognition as Pattern Classification (SPRAAC). Nijmegen, July.

Alphen, P. van "Effects of subphonemic variation depend on lexical competitor environment." [poster]. Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Alphen, P. van "Effects of subphonemic variation depend on lexical competitor environment." 142<sup>nd</sup> Meeting of the Acoustical Society of America. Fort Lauderdale, December.

Ameka, F.K. "A periphrastic progressive aspect construction in Likpe: A case of contact induced change?" 32<sup>nd</sup> Annual Conference on African Linguistics. Berkeley, CA, March.

Ameka, F.K., & Essegbey J. "Serializing languages: Verb-framed, satellite-framed or neither?" 32<sup>nd</sup> Annual Conference on African Linguistics. Berkeley, CA, March.

Ameka, F.K. "Multiverb constructions and grammaticalization in Kwa languages: Typological considerations." International Symposium on Typology of African Languages. Sankt Augustin (Germany), May.

Ameka, F.K. "Forms of secondary predication in a serializing language: Depictives in Ewe." Workshop on Depictive Secondary Predication in Crosslinguistic Perspective. Bochum, June.

Ameka, F.K. "Grammar and cultural practices: Logophoricity and triadic communication in West Africa." Seminar given at the Department of Linguistics. Aarhus, November.

Barker, J., Hald, L., & Nicol, J. "The role of suppression in the processing of subject-verb agreement." 14<sup>th</sup> Annual CUNY Conference on Human Sentence Processing. Philadelphia, March.

Bastiaansen, M.C.M., Berkum, J.J.A. van, & Hagoort, P. "Event-related theta responses in the human EEG differentiate between gender and number agreement violations during online sentence processing." Annual Meeting of the Cognitive Neuroscience Society. New York, March.

Bastiaansen, M.C.M., Berkum, J.J.A. van, & Hagoort, P. "Phasic theta increases following syntactic violations suggest a functional role of the theta rhythm in language comprehension." Annual Meeting of the Society for Human Brain Mapping. Brighton, May.

Bastiaansen, M.C.M., Posthuma, D., Groot P.F.C., & Geus, E.J.C. de "Event-related theta responses in a visuo-spatial working memory task." Annual Meeting of the Dutch Society for Psychophysiology. Groningen, June.

Bastiaansen, M.C.M., Berkum, J.J.A. van, & Hagoort, P. "Event-related theta increases during online sentence processing." Annual Meeting of the Dutch Society for Psychophysiology. Groningen, June.

Bastiaansen, M.C.M. "Sentence processing modulates the EEG theta rhythm." 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Berkum, J.J.A. van "Processing sentences in discourse: What does the brain tell us?" Workshop on From Sentence Processing to Discourse Interpretation: Crossing the Borders. Utrecht, July.

Berkum, J.J.A. van, Brown, C.M., Zwitserlood, P., Kooijman, V., & Hagoort, P. "Do listeners use discourse-level information to predict upcoming words in an unfolding sentence? An ERP study." 7<sup>th</sup> Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP-01). Saarbrücken, September.

Berkum, J.J.A. van, Brown, C.M., Zwitserlood, P., Kooijman, V., & Hagoort, P. "Anticiperen luisteraars op specifieke woorden? Een ERP experiment." 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Berkum, J.J.A. van, Zwitserlood, P., Kooijman, V., Brown, C.M., & Hagoort, P. "Sentence comprehension in a wider discourse: ERP studies on syntax, sense, and reference." 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Bohnemeyer, J. "Two ways to skin a cat: Alternative approaches to the analysis of spatial demonstratives". 23. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Leipzig, February.

Bohnemeyer, J. "Argument and event structure in Yukatek verb classes". Conference on Semantics of Under-represented Languages in the Americas (SULA). Northampton, April.

Bohnemeyer, J. "Principles of event encoding: The case of motion events". ALTIV: 4<sup>th</sup> Biennial Meeting of the Association for Linguistic Typology. Santa Barbara, CA, July.

Bohnemeyer, J., & Swift, M.D. "Default aspect: The semantic interaction of viewpoint aspect and telicity." Conference on Perspectives on aspect. Utrecht, December.

Bowerman, M. "How do young children build language-specific semantic categories? Exploring the learning mechanisms" [Keynote address]. 3<sup>rd</sup> Annual Gregynog Conference on Child Language. Gregynog (Wales), March.

Bowerman, M. "Acquiring language-specific spatial categories with a universal cognitive system". 31<sup>st</sup> Annual Meeting of the Jean Piaget Society. Berkeley, CA, May/June.

Breugel, C. van, & Kempen, G. "The Performance Grammar Workbench: A Java applet for visual-interactive grammar development." 12<sup>th</sup> Meeting of Computational Linguistics in the Netherlands. Enschede, November.

Brink, D. van den, Brown, C.M., & Hagoort, P. "Electrophysiological evidence for early contextual influences during spoken-word recognition: The N200." 8<sup>th</sup> Annual Meeting of the Cognitive Neuroscience Society (CNS-2001). New York, April.

Broeder, D. "Introduction to hierarchy/catalogue MD descriptions." International ISLE Metadata Workshop. Nijmegen, March.

Broersma, C., & Cutler, A. "Comprehension of non-native speech: Inaccurate phoneme processing and activation of lexical competitors" [poster]. Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Brown, P. "Cultural factors in learning an absolute spatial system." 31<sup>st</sup> Annual Meeting of the Jean Piaget Society. Berkeley, CA, May/June.

Brown, P. "Language, culture and development in a Mayan society." 10<sup>th</sup> European Conference on Developmental Psychology. Uppsala, August.

Brugman, H. "Annotation Tier Setups." DOBES Workshop. Hannover, January.

Budwig, N., & Narasimhan, B., "Input variation and the development of argument structure: An examination of Hindi-speaking caregiver-child discourse." Society for Research in Child Development Conference, U. of Minnesota. Minneapolis, MI, April.

Cholin, J., Schiller, N.O., & Levelt, W.J.M. "The role of the syllable at the interface of phonology and phonetics in speech production" [poster]. 7<sup>th</sup> Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP-01). Saarbrücken, September, and 8<sup>e</sup> Wintercongres

- van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.
- Clahsen, H., Eisenbeiß, S., Hadler, M., & Sonnenstuhl-Henning, I. "How regular affixes are represented in the mental lexicon: A study of German adjective inflection." Conference on the Lexicon in Linguistic Theory. Düsseldorf, August.
- Cutler, A. "Fonologisch bewustzijn en de rol van fonologische categorieën bij de verwerking van spraak" [Invited plenary address]. Nederlandse Vereniging voor Fonetische Wetenschappen. Antwerpen, March.
- Cutler, A. "Multiple perspectives on the mental Lexicon." Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.
- Cutler, A., McQueen, J.M., Norris, D.G., & Somejuan, A. "Silly ball more a foot." International Meeting on Language, Brain and Cognitive Development. Paris, May.
- Cutler, A. "Native listeners." Academia Europaea. Rotterdam, June.
- Cutler, A. "Rhythmic categories and their role in listening." Workshop on Prosody in Processing. Utrecht, July.
- Dimroth, C., & Jordens, P. "Finiteness in first and second language acquisition of Germanic Languages." Conference on Finiteness. FB 471, FB Sprachwissenschaft. Konstanz, May.
- Dimroth, C., Bast, C., Lehmann, K., & Stephany, U. "The age factor in the acquisition of German as a second language." European Second Language Association (EUROSLA). Paderborn, September.
- Dimroth, C., & Jordens, P. "Finiteness in first and second language acquisition of Dutch." Conference on the Acquisition of Verb Grammar and Verb Arguments. Zentrum für Allgemeine Sprachwissenschaft, Sprachtypologie und Universalienforschung. Berlin, November.
- Dobel, C. "Registrierung von Augenbewegungen bei Studien zur Sprachproduktion." 43. Tagung experimentell arbeitender Psychologen (TeaP2001). Regensburg, April.
- Dobel, C. "Eye tracking during the production of complex sentences." 11<sup>th</sup> European Conference on Eye Movements (ECEM 11). Turku, August.

Dobel, C. "Eye tracking studies in language production." 12<sup>th</sup> Conference of the European Society of Cognitive Psychology (ESCoP). Edinburgh, September.

Eisenbeiß, S. "The role of asymmetric relations between arguments in the acquisition of case." Conference on Asymmetry. Montreal, May.

Eisenbeiß, S. "The role of paradigms in the acquisition of German articles and adjectives." Conference on Perspectives on Morphological Processing II. Nijmegen, June.

Eisenbeiß, S., & Roeper, T. "Capturing the difference between agreement and concord." GALA Conference. Setubal (Portugal), September.

Frank, S., Koppen, M., Noordman, L.G.M., & Vonk, W. "Een model van causale/temporele inferentie." 24. Minisymposium over Lezen. Nijmegen, April.

Goudbeek, M., Smits, R., & Swingley, D. "Unsupervised learning of auditory categories" [poster]. Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August and 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Gretsch, P. "How learners anchor utterances in time." 2<sup>nd</sup> Bisontine Conference for the Conceptual and Linguistic Development in the Child Aged from 1 to 6 Years (Decolage). Besançon, March.

Gretsch, P. "The acquisition of questions" [invited talk]. Psychological Institute Prague, April.

Gretsch, P. "Finiteness and world-referencing in early German child language." and "Finiteness in first and second language acquisition of Germanic Languages." Conference on Finiteness. SFB 471, FB Sprachwissenschaft. Konstanz, May.

Gretsch, P., & Gawlitzek-Maiwald, I. "(In-)Finitheit - eine unendliche Geschichte." Konferenz zum Verhältnis von Theorie zu Empirie. Tübingen, June.

Grinevald, C., Creissels, D., & Seifart, F. "Noun classes in African and Amazonian languages: Toward a comparison." International Symposium on Typology of African Languages. Sankt Augustin (Germany), May.

Gullberg, M. "Gestures in second language acquisition" [invited talk]. The European Year of Languages 2001 Inauguration. Lund, February.

Gullberg, M. "Languages and gestures (and acquisition)" [invited talk]. The Lund Lectures in Languages and Literature. Lund, February.

Gullberg, M. "Gestures in second language acquisition: An alternative look at crosslinguistic influences and interlanguage" [invited talk]. Department of Linguistics. Copenhagen, March.

Gullberg, M. "Gestures and the second language learner. From the acquisition of gestures to gestures in acquisition" [invited talk, distinguished lecturer series]. Temple U. Japan. Tokyo, March.

Gullberg, M., & Holmqvist, K. "Visual attention towards gestures in face-to-face interaction vs. on screen." 4<sup>th</sup> International Workshop on Gesture and Sign Language based Human-Computer Interaction. London, April.

Gullberg, M. "A helping hand? Second language learners, gestures, and compensation" [invited talk]. Workshop on Language and Nonverbal Communication at the Institute for Language & Communication. Odense, May.

Gullberg, M., & Holmqvist, K. "Eye tracking and the perception of gestures in face-to-face interaction vs. on screen" [poster]. Colloque Oralité et Gestualité (ORAGE) 2001. Aix-en-Provence, June.

Gullberg, M., & Kita, S. "Fixation on gestures - visual and cognitive attention to gestures in human interaction" [poster]. 11<sup>th</sup> European Conference on Eye Movements (ECEM 11). Turku, August.

Gullberg, M. "Why gestures are relevant to issues of multilingual language use. Communicative and cognitive perspectives" [invited talk]. 3<sup>rd</sup> Annual Colloquium on Language Contact and Variation. Mannheim, December.

Hagoort, P. "How the brain solves the binding problem for language." Conference on the Genetics of Language. Tilburg, May.

Hagoort, P. "Het wetenschappelijk belang van het thema cognitie en gedrag." Meeting NWO Research strategy. Den Haag, June.

Hagoort, P. "How the brain solves the binding problem for language: A neurocomputational account of language-related ERP effects." The Neurological Basis of Language: An Interdisciplinary Conference of Aphasiological, Computational, and Neuroimaging Approaches. Groningen, July.

- Hagoort, P. "Het grensverkeer tussen hersenen en geest." U. of Amsterdam, Studium Generale. Amsterdam, October.
- Hagoort, P. "De koninklijke verloving tussen neurowetenschap en psychologie." KNAW-CGW Conference on the Cooperation between Sciences. Leusden, October.
- Hagoort, P. "De verbeelding aan de macht bij het denkende brein." Maastricht U., Studium Generale. Maastricht, November.
- Hagoort, P. "Cognitieve neurowetenschap: De koninklijke verloving tussen biologie en psychologie." NIP-Congress Biology and Psychology - Verstandshuwelijk of ware liefde? Ede, November.
- Hagoort, P. "Cognitive neurosciences and neuroimaging." 8<sup>th</sup> Benelux Congress of Zoology. Nijmegen, November.
- Hagoort, P. "Gagarin in the neural cosmos: Cognitive neuroscience beyond the image given." Lecture given for the Program Plurifaculaire on Language et Communication. Genève, December.
- Hald, L. "Investigating world-knowledge integration during on-line sentence processing." Discourse Processing Series. Utrecht, April.
- Hiss, R., & Wittenburg, P. "Access right aspects for DOBES." DOBES Workshop. Hannover, January.
- Indefrey, P. "Neuronale Korrelate syntaktischer Verarbeitung." Workshop on Neurokognition der Sprache. Bielefeld, February.
- Indefrey, P. "Workshop on Neurocognition of Language Processing." [Introduction]. 23. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Leipzig, February/March.
- Indefrey, P. "A meta-analysis of PET and fMRI experiments on syntactic parsing." 7<sup>th</sup> Annual Meeting of the Organization for Human Brain Mapping. Brighton, June.
- Indefrey, P. "De neurale architectuur van taalproductie." Boerhaave Symposium. Leiden, September.
- Indefrey, P. "The neural architecture of syntactic parsing and encoding." 39<sup>th</sup> Annual Meeting of the Academy of Aphasia. Boulder, October.

Janssen, U., Eisenbeiß, S., & Penke, M. "Agreement features in sentence processing." 14<sup>th</sup> Annual CUNY conference on Human Sentence Processing. Philadelphia, March.

Janssen, U., Eisenbeiß, S., & Penke, M. "Internal agreement." Conference of the Texas Linguistic Society. Austin, March.

Janssen, U., Eisenbeiß, S., & Penke, M. "Agreement features in sentence processing. A sentence-matching study on German noun-phrase internal agreement." Conference of the Texas Linguistic Society. Austin, March.

Kempen, G., & Harbusch, K. "Verb clusters in Performance Grammar." Workshop on Verb Clusters in German and Dutch. MPI for Evolutionary Anthropology. Leipzig, February.

Kempen, G., & Harbusch, K. "Word order scrambling as a consequence of incremental sentence production." Workshop on the Syntax-Semantics Interface. 23. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Leipzig, February/March.

Kempen, G. "The Unification Space Model of Parsing." Workshop on Parsing Technologies, U. Nijmegen, Department of Language and Speech. Nijmegen, March.

Kempen, G. "The Unification Space: A psycholinguistic model of syntactic processing." U. of Wales, School of Psychology. Bangor, March.

Kempen, G., & Harbusch, K. "Performance Grammar: A uniform topological linearization model for Dutch, English and German clauses." 12<sup>th</sup> Meeting of Computational Linguistics in the Netherlands. Enschede, November.

Klein, W. "Problems with focus particles." Workshop on the Dynamics of Learner Varieties. Nijmegen, October.

Klein W. "Das digitale Wörterbuch der deutschen Sprache des 20. Jahrhunderts." Sprachkultur und Lexikographie. Berlin, November.

Laan, B. van der "The acquisition of expletive elements in child language" [poster]. Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Lausberg, H., Kita, S., Zaidel, E., & Ptito, A. "Insight into speech production processes from the observation of nonverbal gesticulation: An investigation of patients with complete callosotomy". The Neurological

- Basis of Language: An Interdisciplinary Conference of Aphasiological, Computational, and Neuroimaging Approaches. Groningen, July.
- Levelt, W.J.M. "Verslag van een ontdekkingsreis." Rede uitgesproken voorafgaand aan de 25e Dies Natalis viering van de Universiteit Maastricht ter ere van de verlening van het eredoctoraat. Maastricht, January.
- Levelt, W.J.M. "Spoken language production." International Meeting on Language, Brain and Cognitive Development. Paris, May.
- Levelt, W.J.M. "Lexical access in speech production." Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.
- Levelt, W.J.M. "Where do spoken words come from? A meta-analysis" [invited talk]. Verein zur Förderung der biomedizinischen Wissenschaften. Dortmund, December.
- Levinson, S.C. "What it would really take - some comments on implicatures in the lab. ESF Exploratory." Workshop on Towards Experimental Pragmatics. Lyon, May.
- Levinson, S.C. "Language as cultural heritage - the sign languages of Europe." Workshop on Humanites, Research and Cultural Heritage in Europe organised by the European Commission DG Research. Brussels, October.
- Lüpke, F. "Possession and split intransitivity in Jalonke (Western Mande)." International Symposium on Typology of African Languages. Sankt Augustin (Germany), May.
- Lüpke, F. "Valence and transitivity in Jalonke (Western Mande)." 31<sup>st</sup> Colloquium on African Languages and Linguistics. Leiden, September.
- Magnuson, J.S., Tanenhaus, M.K., Aslin, R.N., & Dahan, D. "Eye movements and artificial lexicons: A paradigm for measuring real-time language processing and evaluating models." 14<sup>th</sup> Annual CUNY conference on Human Sentence Processing. Philadelphia, March.
- McQueen, J.M., Norris, D.G., & Cutler, A. "Lexical re-tuning of phonological categories." 42<sup>nd</sup> Annual Meeting of the Psychonomic Society. Orlando, FL, November.

Meeuwissen, M. "Same input, different output: the production of numerals and clock times in Dutch." *Tutorials in Behavioral and Brain Sciences 2001 (TuBBS)*. Nijmegen, August.

Meeuwissen, M., Roelofs, A., & Levelt, W.J.M. "Planning levels in spoken numeral production." *8e Wintercongres van de Nederlandse Vereniging voor Psychonomie*. Egmond aan Zee, December.

Melinger, A. & Kita, S. "Parallels in discourse style and gestural behavior: Gesture as a link between conceptual and discourse representations." *27<sup>th</sup> Annual Meeting of the Berkeley Linguistic Society*. Berkeley, CA, February.

Moscoso del Prado, M.F., Baayen, R.H., Deutsch, A., & Jong, N.H. de "Changing Places: A cross linguistic perspective on the role of word frequency and family size in Hebrew and Dutch." *Morfologiedagen 2001*. Utrecht, December.

Moscoso del Prado M.F., & Baayen, R.H. "Unsupervised grammar learning from large corpora by neural networks." *7<sup>th</sup> Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP-01)*. Saarbrücken, September.

Moscoso del Prado, M.F., & Baayen, R.H. "Unsupervised extraction of high-dimensional representations from corpora using simple recurrent networks." *Workshop on Semantic Knowledge Acquisition and Categorisation (ESLLI'01)*. Helsinki, August.

Müller, O., & Hagoort, P. "Semantic and syntactic word properties in comprehension - the LRP/N200 paradox" [poster]. *8<sup>th</sup> Annual Meeting of the Cognitive Neuroscience Society*. New York, March.

Müller, O., & Hagoort, P. "Semantic and syntactic word properties - which are first in reading?" [poster]. *Tutorials in Behavioral and Brain Sciences 2001 (TuBBS)*. Nijmegen, August.

Müller, O., & Hagoort, P. "Lexical information in language comprehension: Semantics before syntax." *8e Wintercongres van de Nederlandse Vereniging voor Psychonomie*. Egmond aan Zee, December.

Narasimhan, B., & Budwig, N. "Verb use in Hindi-speaking children's imperative constructions." *International Cognitive Linguistics Conference*. U. of California. Santa Barbara, CA, July.

Narasimhan, B., Sproat, R., & Kiraz, G. "Schwa-deletion in Hindi text-to-speech synthesis." South Asian Languages Analysis Roundtable. Konstanz, October.

Narasimhan, B., & Budwig, N. "Argument realization in Hindi child-caregiver discourse." South Asian Languages Analysis Roundtable. Konstanz, October.

Narasimhan, B. "Bose Memorial Lecture by Noam Chomsky" [discussant]. Delhi, November.

Noordman, L.G.M., & Vonk, W. "Causal relations and text comprehension." 12<sup>th</sup> Conference of the European Society of Cognitive Psychology (ESCoP). Edinburgh, September.

Norris, D.G., McQueen, J.M., & Cutler, A. "Bias and automatic components in rhyme priming." 42<sup>nd</sup> Annual Meeting of the Psychonomic Society. Orlando, FL, November.

Petrovic, P., Carlsson, K., Petersson, K.M., Hansson, P., & Ingvar, M. "Context dependent amygdala deactivation during pain." 7<sup>th</sup> Annual Meeting of the Organization for Human Brain Mapping. Brighton, June.

Roelofs, A. "Discreteness and interactivity in spoken word production by normal and aphasic speakers." 19<sup>th</sup> European Workshop on Cognitive Neuropsychology. Bressanone, January.

Roelofs, A. "Prosody, modularity, and lexical access in planning simple utterances." Workshop on Prosody in Processing. Utrecht, July.

Roelofs, A. "Discreteness and interactivity in spoken word production by aphasic and nonaphasic speakers." The Neurological Basis of Language: An Interdisciplinary Conference of Aphasiological, Computational, and Neuroimaging Approaches. Groningen, July.

Roelofs, A. "How does attention help select verbal actions?" 4<sup>th</sup> Annual Meeting of the German Research Foundation (DFG). Initiative on Language production: The transfer of information in natural language. Berlin, September.

Roelofs, A. "Attentional control of verbal action." 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Salverda, A.P., Dahan, D., & McQueen, J.M. "Tracking the lexical activation of onset-embedded words" [poster]. 42<sup>nd</sup> Annual Meeting of the Psychonomic Society. Orlando, FL, November.

Salverda, A.P., Dahan, D., & McQueen, J.M. "Effects of segment duration on the lexical activation of onset-embedded words" [poster]. 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Schiller, N.O., & Schmitt, B.M. "The time course of phonological encoding during speech production estimated from event related brain potentials." 23. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Leipzig, February/March.

Schiller, N.O., & Schmitt, B.M. "The time course of phonological encoding during speech production estimated from event related potentials" [poster]. 8<sup>th</sup> Annual Meeting of the Cognitive Neuroscience Society. New York, March and The Neurological Basis of Language: An Interdisciplinary Conference of Aphasiological, Computational, and Neuroimaging Approaches. Groningen, July.

Schiller, N.O. "The onset effect in word and picture naming." 43. Tagung experimentell arbeitender Psychologen (TeaP2001). Regensburg, April.

Schiller, N.O. "The onset effect in word and picture naming" [poster]. 12<sup>th</sup> Conference of the European Society of Cognitive Psychology (ESCoP). Edinburgh, September.

Schiller, N.O., & Caramazza, A. "The selection of grammatical features during speech production." 12<sup>th</sup> Conference of the European Society of Cognitive Psychology (ESCoP). Edinburgh, September.

Schiller, N.O. "Metrical encoding for words with regular and irregular stress." 7<sup>th</sup> Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP-01). Saarbrücken, September.

Schiller, N.O. "Metrical encoding during speech production." 42<sup>nd</sup> Annual Meeting of the Psychonomic Society. Orlando, FL, November.

Schiller, N.O. "Phonologisches und phonetisches Enkodieren bei der Sprachproduktion" [invited talk]. 72. Jahrestagung der Deutschen Gesellschaft für Sprach- und Stimmheilkunde e. V. Rostock. Rostock, June.

Schiller, N.O., Schmitt, B.M., Peters, J., & Levelt, W.J.M. "Phonological encoding of stress: The time course of metrical encoding in polysyllabic words." 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Schmiedtová, B. "Second language acquisition of temporality" [poster]. 31<sup>st</sup> Annual Meeting of the Jean Piaget Society. Berkeley, CS, May/June.

Schmiedtová, B. "Temporality in second language acquisition: The case of simultaneity" [poster]. Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Schmiedtová, B. "Second language acquisition of temporality: The case of simultaneity." 11<sup>th</sup> Annual Conference of The European Second Language Association. Paderborn, September.

Schwichtenberg, B., & Schiller, N.O. "Semantic gender assignment regularities in German" [poster]. 7<sup>th</sup> Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP-01). Saarbrücken, September.

Seifart, F. "Nominal classification in Miraña." Annual meeting of SSILA and WAIL. Santa Barbara, CA, July.

Seifart, F. "Concordancia en clases nominales: entre la sintáxis y lo léxico." Workshop on Nominal Classification at the CELIA/CNRS. Paris, November.

Seifart, F. "Nominal classification in Miraña from a typological perspective." Table ronde classification nominale amazonienne, Laboratoire Dynamique du Langage (CNRS). Lyon, December.

Senft, G. "What do we really know about serial verb constructions in Austronesian and Papuan languages?" 3<sup>rd</sup> European Meeting on Oceanic Linguistics (LACITO-CNRS). Paris, March.

Sereno, J.A., Smits, R., & Jongman, A. "Auditory category learning." Workshop on Speech Recognition as Pattern Classification (SPRAAC). Nijmegen, July.

Seuren, P. "Dutch and German V-clusters." Colloquium on Dutch and German V-clusters, MPI for Evolutionary Anthropology. Leipzig, February.

Seuren, P. "The cognitive factor in language study" [presidential address]. Annual Meeting of Societas Linguistica Europaea. Leuven, August.

Seuren, P. "Aristotelian Predicate Calculus revisited." Biennial Meeting Georgian Logic Society. Tbilisi, September.

Seyfeddinipur, M., & Kita, S. "Gestures and speech disfluencies" [poster]. Colloque Oralité et Gestualité (ORAGE) 2001. Aix-en-Provence, June.

Seyfeddinipur, M., & Kita, S. "Gestures and speech disfluencies." 27<sup>th</sup> Conference of the Berkeley Linguistic Society (BLS). Berkeley, February and Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Seyfeddinipur, M., & Kita, S. "Gesture as an indicator of early error detection in self-monitoring of speech." Tutorial and Research Workshop of the International Speech Communication Association (ISCA). Edinburgh, August.

Shatzman, K.B., & Schiller, N.O. "The word frequency effect in picture naming: Contrasting two hypotheses using homophone pictures" [poster]. 8e Wintercongres van de Nederlandse Vereniging voor Psychonomie. Egmond aan Zee, December.

Slobin, D.I., & Hoiting, N. "The Berkeley Sign Language Transcription System." Taal op 't spoor: Minisymposium Mgr. J.C. van Overbeek-stichting ter gelegenheid van haar 35-jarig jubileum. Instituut voor Doven H.D. Guyot. Sint-Michielsgestel, September.

Slobin, D.I. "Spoken and signed languages: Two different types of signed languages." Congress on Invoering tweetalig dovenonderwijs. Instituut voor Doven H. D. Guyot. Groningen, November.

Slobin, D.I. "How people talk about motion events: Some cognitive and communicative consequences of linguistic typology." SFB Mehrsprachigkeit. Hamburg, November.

Slobin, D.I., & Hoiting, N. "Variations in child-directed speech as a guide to language form and use." SFB Mehrsprachigkeit. Hamburg, November.

Slobin, D.I., & Hoiting, N. "New developments in sign language linguistics: From gestures to conventional signs." SFB Mehrsprachigkeit. Hamburg, November.

Slobin, D.I., & Hoiting, N. "Sign language transcription at the level of meaning components: The Berkeley Transcription System (BTS)." Institut für Deutsche Gebärdensprache. Hamburg, November.

Smits, R. "How listeners and other pattern classifiers might recognize coarticulated phonemes." Workshop on Speech Recognition as Pattern Classification (SPRAAC). Nijmegen, July.

Spinelli, E., McQueen, J.M., & Cutler, A. "Processing resyllabified words in French." 12<sup>th</sup> Conference of the European Society of Cognitive Psychology (ESCoP). Edinburgh, September.

Sprenger, S.A., Levelt, W.J.M., & Kempen, G. "The production of fixed expressions". 1<sup>st</sup> BPS Exeter-Birmingham Language Production Workshop on Sentence Production. Birmingham, January.

Sprenger, S.A., Levelt, W.J.M., & Kempen, G. "The superlemma theory of idiom production" [poster]. Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Sprenger, S.A., Levelt, W.J.M., & Kempen, G. "The activity of literal word meaning during the production of idioms" [poster]. 7<sup>th</sup> Annual Conference on Architectures and Mechanisms for Language Processing (AMLaP-01). Saarbrücken, September.

Sprenger, S.A., Levelt, W.J.M., & Kempen, G. "Tracking the time course of literal word meanings during the production of idioms." 12<sup>th</sup> Conference of the European Society of Cognitive Psychology (ESCoP). Edinburgh, September.

Swingle, D. "Word recognition in the second year: What develops?" Biennial Meeting of the Society for Research in Child Development. Minneapolis, April.

Swingle, D. "What might infants use phonemes for?" Workshop on Speech Recognition as Pattern Classification (SPRAAC). Nijmegen, July.

Swingle, D. "Word-form learning and the developing lexicon." Workshop on Early Phonological Acquisition. Carry-le-Rouet (France), October.

Swingle, D. "Phonetic representation in the developing lexicon." Symposium on Early Lexicon Acquisition: Normal and Pathological Development. Lyon, December.

Turennot, M. van, Bielamowicz, L., & Martin, A. "Modulation of cortical activity in the object naming system: Massed versus spaced practice" [poster]. 8<sup>th</sup> Annual Meeting of the Cognitive Neuroscience Society (CNS-2001). New York, April.

Turenout, M. van, & Martin, A. "Neural mechanisms underlying long-lasting repetition priming." International Society for Behavioral Neuroscience. Marrakech, May.

Turenout, M. van, & Martin, A. "Cortical plasticity in the object naming system." Annual Meeting of the Dutch Society for Psychophysiology. Groningen, June.

Turenout, M. van "Neuroimaging of language." Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Turenout, M. van "Taal: Van begripsvorming tot communicatie." Studium Generale lecture series on "Kernthema's van de Psychologie". Amsterdam, October.

Turenout, M. van "Taal in de hersenen: Functioneel MRI onderzoek naar neurale activiteit tijdens spreken." De vlag uit voor taal: Symposium ter gelegenheid van 50 jaar diagnostiek, onderwijs, en behandeling van kinderen en jongeren met auditieve en communicatieve beperkingen. Eindhoven, October.

Turenout, M. van "Searching for the neural correlates of object priming." Open dag F.C. Donders Centre for Cognitive Neuroimaging. Nijmegen, December.

Van Geenhoven, V. "For-adverbials, pluractionality, and properties." Conference on Semantics of Under-represented Languages in the Americas (SULA). Northampton, April.

Van Geenhoven, V. " Habits are unbounded plur(action)als." Workshop on Genericity. Jerusalem, June.

Van Geenhoven, V. " Frequency and habituality as distributed iterativity." 17<sup>th</sup> Annual Meeting of the Israel Association of Theoretical Linguistics (IATL). Jerusalem, June.

Van Geenhoven, V. "Aspect, Pluractionality and Adverbial Quantification" Conference on Perspectives on Aspect. Utrecht, December.

Vonk, W. "Zin in tekst." Rede uitgesproken bij de aanvaarding van het ambt van hoogleraar in de Psycholinguïstiek aan de Faculteit der Letteren van de Katholieke Universiteit Nijmegen. Nijmegen, May.

Vonk, W. "Information structure and animacy in the processing of sentences in text." Workshop on From Sentence Processing to Discourse Interpretation: Crossing the Borders. Utrecht, July.

Vonk, W., & Cozijn, R. "Forward reading time and saccade inclusion: A case study in inference research." 11<sup>th</sup> European Conference on Eye Movements (ECEM). Turku, August.

Warner, N., & Arai, T. "Accentual phrase rises as a cue to word boundaries with." Annual Meeting of the Linguistic Society of America. Washington, January.

Warner, N., Jongman, A., Cutler, A., & Mücke, D. "The phonological status of schwa insertion in Dutch: An EMA study" [poster]. 4<sup>th</sup> International Speech Motor Conference. Nijmegen, June.

Wassenaar, M., Hagoort, P., & Brown, C.M. "Sentence-picture matching in agrammatic comprehenders: An ERP study." 23. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Leipzig, February/March.

Wassenaar, M., & Hagoort, P. "Het matchen van zinnen bij plaatjes door Broca afasiepatiënten: Een ERP studie." Stichting Afasie Nederland - Wetenschapsdag. Groningen, June.

Wassenaar, M., Hagoort, P., & Brown, C.M. "Sentence-picture matching in agrammatic comprehenders: An ERP-study" [poster]. The Neurological Basis of Language: An Interdisciplinary Conference of Aphasiological, Computational, and Neuroimaging Approaches. Groningen, July and Tutorials in Behavioral and Brain Sciences 2001 (TuBBS). Nijmegen, August.

Wittenburg, P. "Metadata issues for DOBES." DOBES Workshop. Hannover, January.

Wittenburg, P. "The ISLE metadata initiative: Results and showcase." Official opening of the European Year of the Languages. Lund, February.

Wittenburg, P. "Technological perspectives for the linguistics discipline." Official opening of the European Year of the Languages. Lund, February.

Wittenburg, P. "Multimedia/multimodal language corpora." Lund Lectures in Languages and Literature. Lund, February.

Wittenburg, P. "Metadata vision and the semantic web." International ISLE Metadata Workshop. Nijmegen, March.

Wittenburg, P. "Presentation of the IMDI set for session descriptions." International ISLE Metadata Workshop. Nijmegen, March.

Wittenburg, P. "Mapping the IMDI metadata set to the DC set." International ISLE Metadata Workshop. Nijmegen, March.

Wittenburg, P. "The ISLE metadata set and tools." Workshop on the digitization of language: The need for standards. Santa Barbara, CA, June.

Wittenburg, P. "Ethical and legal aspects in the DOBES project." Panel on ethics and legal aspects. Workshop on the digitization of language: The need for standards. Santa Barbara, CA, June.

Wittenburg, P. "Overview about lexical structures." DOBES Workshop. Bielefeld, November.

Wittenburg, P. "Legal and ethics issues within DOBES." DOBES Workshop. Bielefeld, November.

# Publications

- Adank, P., Hout, R. van, & Smits, R. (2001). A comparison between human vowel normalization strategies and acoustic vowel transformation techniques. In P. Dalsgaard, B. Lindberg, H. Benner, & Z.-H. Tan (Eds.), *Proceedings of EUROSPEECH 2001* (pp. 481-484). Aalborg: Kommunik Grafiske Løsninger A/S.
- Alibali, M., Kita, S., Bigelow, L., Wolfman, C., & Klein, S. (2001). Gesture plays a role in thinking for speaking. In C. Cavé, I. Guaïtella, & S. Santi (Eds.), *Oralité et gesturalité: Interactions et comportements multimodaux dans la communication* (pp. 431-434). Paris: L'Harmattan.
- Alphen, P. van, & McQueen, J.M. (2001). The time-limited influence of sentential context on function word identification. *Journal of Experimental Psychology: Human Perception and Performance*, 27, 1057-1071.
- Ameka, F.K. (2001). Ewe. In J. Gary & C. Rubino (Eds.), *Facts about the world's languages: An encyclopedia of the major languages of the world, past and present* (pp. 207-213). New York: New England Publishing Associates.
- Ameka, F. K. (2001). Ideophones and the nature of the adjective class in Ewe. In E.F.K. Voeltz & C. Kilian-Hatz (Eds.), *Ideophones* (pp. 25-48). Typological Studies in Language 44. Amsterdam: John Benjamins.
- Arai, T., Greenberg, S., & Warner, N. (2001). Analysis of spontaneous Japanese in OGI multi-language telephone-speech corpus. *Proceedings of the Acoustical Society of Japan*, Vol. 1 (pp. 361-362).

- Bastiaansen, M.C.M., Berkum, J.J.A. van, & Hagoort, P. (2001). Phasic theta increases following syntactic violations suggest a functional role of the theta rhythm in language comprehension. *NeuroImage*, 13(6), S501.
- Bastiaansen, M.C.M., Böcker, K.B.E., Brunia, C.H.M., Munck, J.C. de, & Spekreijse, H. (2001). Event-related desynchronization during anticipatory attention for an upcoming stimulus: A comparative EEG/MEG study. *Clinical Neurophysiology*, 112, 393-403.
- Bastiaansen, M.C.M., & Brunia, C.H.M. (2001). Anticipatory attention: An event-related desynchronization approach. *International Journal of Psychophysiology*, 43, 91-107.
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- Böttner, M. (2001). Multigrade extension of relational grammar. *Information Sciences*, 129, 221-231.
- Bowerman, M., & Levinson, S.C. (Eds.) (2001). *Language acquisition and conceptual development*. Cambridge: Cambridge University Press.
- Bowerman, M., & Choi, S. (2001). Shaping meanings for language: Universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S.C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 475-511). Cambridge: Cambridge University Press.
- Bowerman, M., & Levinson, S.C. (2001). Introduction. In M. Bowerman & S.C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 1-16). Cambridge: Cambridge University Press.
- Brink, D. van den, Brown, C.M., & Hagoort, P. (2001). Electrophysiological evidence for early contextual influences during spoken-word recognition: The N200 versus N400 effects. *Journal of Cognitive Neuroscience*, 13, 967-985.

- Broeder, D., Brugman, H., & Wittenburg, P. (2001). Aspects of modern multi-modal/multi-media corpora exploitation environments. In P. Dalsgaard, B. Lindberg, H. Benner, & Z.-H. Tan (Eds.), *Proceedings of EUROSPEECH 2001* (pp. 1529-1532). Aalborg: Kommunik Grafiske Løsninger A/S.
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- Essays in honor of Jacques Mehler* (pp. 209-226). Cambridge, MA: MIT Press.
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