

ANNUAL REPORT 10

1989

Max-Planck-Institut für Psycholinguistik

ANNUAL REPORT 10

1989

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Preface

When in December 1985, the Institute moved to its present premises, it was not to be expected that the new robe, specifically tailored for the needs of the Institute, would soon be too tight again. But the increasing number of research projects and researchers, on the one hand, and the need to install some new experimental facilities, on the other, made an extension soon inevitable. Our proposal to add a new wing to the already existing wing on the third floor was generously supported by the president and the General Administration of the Max-Planck-Society, and in November 1989, 16 additional offices and a small conference room became available. The entire rebuilding had taken only a few – quite turbulent – months, since the building's original design easily allowed for an extension of the third floor. No further extension of this sort is technically possible – should we consider this to be sign that the period of growth has come to a definite end?

In December 1989, the president of the Max-Planck-Society appointed Uli Frauenfelder as the head of a “Nachwuchsgruppe” – a small and relatively independent junior research group within the Institute. Beginning March 1st, 1990, he and his research associates will work for five years on “Lexical processing in language comprehension”.

Wolfgang Klein

Organization of the Institute in 1989

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Research in Progress

1. Language Production

In the Institute's new project organization, language production research is largely concentrated in three projects. Firstly, the project on lexical access in production is involved with questions of how lexical items are selected from the lexicon, how their phonological forms are retrieved, and how the process of phonological encoding is organized. Secondly, the project on reference (see also section 3.2) includes the production work on the expression of temporal and spatial concepts. And thirdly, there is the aphasia project, which includes work on spontaneous production in agrammatism and paragrammatism. In the present section the first two types of production research are summarized. The aphasia work will appear in section 4.

1.1 Lexical Access in Production

1.1.1 Semantically driven access

A. Roelofs, G.A.M. Kempen (U. Nijmegen), W.J.M. Levelt, and M. Bierwisch (Academy of Science, Berlin, GDR, and MPI für Psycholinguistik) continued their work on a computational model of lexical access in speaking. Their starting point was the so-called hypernym problem (Levelt, 1989). If the semantic conditions of a lexical item (e.g., *dog*) are met, then those of its hypernyms (e.g., *animal*) are also satisfied. How then, in accessing a word, is it prevented that all of its hypernyms are also retrieved?

A simulation model with a built-in 'veto' mechanism was

developed. The most specific semantic conditions of a term connect to all of a term's hyponyms, vetoing their activation. The model was applied to a number of data sets from the literature that were obtained with a 'Stroop-like' paradigm. Typically, a subject has to name a picture, read a word aloud, give a hypernym of the name of a picture, or give a hypernym of a word read. Right before, simultaneous with, or immediately after the presentation of the target picture or word, a 'distracter' picture or word is given. Depending on the semantic relation between target and distracter, its modality (picture, word), and on the relative timing of the presentation, one finds inhibition or facilitation of the naming response. There was a promising similarity in shape between the response curves predicted by the model and those reported in the literature.

For a few crucial predictions of the model no data are available. These predictions concern the effect of hypernym and hyponym distracters on picture naming. In preparation of an experimental test of these predictions, five pilot experiments were conducted.

1.1.2 Lexical access in the composition of noun phrases

H. Schriefers started a series of experiments, again using the picture-word interference paradigm, investigating the time course of the production of simple referential noun phrases (e.g., the red house). In these experiments, subjects named simple line drawings of colored objects. Dutch knows two different definite articles, *de* for masculine and feminine nouns, and *het* for neuter nouns. If an NP is produced with the definite article (e.g., *het rode huis*, 'the red house', or *de rode kerk*, 'the red church'), then the information about the noun's gender must be available before the utterance can be started. If

the corresponding NPs are produced without the definite article, then gender is marked by an inflectional suffix on the adjective (e.g., *rood huis*. 'red house', vs. *rod-e kerk*, 'red church'). The main results can be summarized as follows.

A distracter belonging to the same semantic category as the to-be-produced noun (e.g., picture: (*the*) *red table*, distracter: *chair*) leads to prolongation of naming latencies (as measured against a condition with unrelated nouns as distracters) if the NP has to be produced with the definite article than without the definite article. These interference effects show up with Stimulus Onset Asynchronies (SOAs) from -200 ms to $+200$ ms for NPs without the definite article, and from -200 to $+400$ ms for NPs with the definite article. At SOA -200 ms, identical color words (e.g., picture: *red table*, distracter: *red*), in contrast, lead to substantial facilitation if the NPs are produced without the definite article, but have much less effect if the NPs are produced with the definite article.

Together with the results from additional experiments, the results indicate that lexical access to both the adjective and the noun proceeds at least partially in parallel. Despite the fact, however, that for both utterance formats (with and without definite article) the information about the noun's gender is crucial for the whole utterance, and that this information has to be derived from the lexical entry of the noun, the influence of a semantically related noun as distracter is more pronounced if the first item to be produced explicitly marks gender (as in utterances with the definite article). This suggests that parallel access to adjective and noun are not the only processes involved. Rather, the point in the utterance at which the gender information is needed appears to have an additional influence on the time course of the planning processes. Currently, additional experiments are carried out to

investigate in detail these additional aspects of the planning process.

1.1.3 Phonological encoding

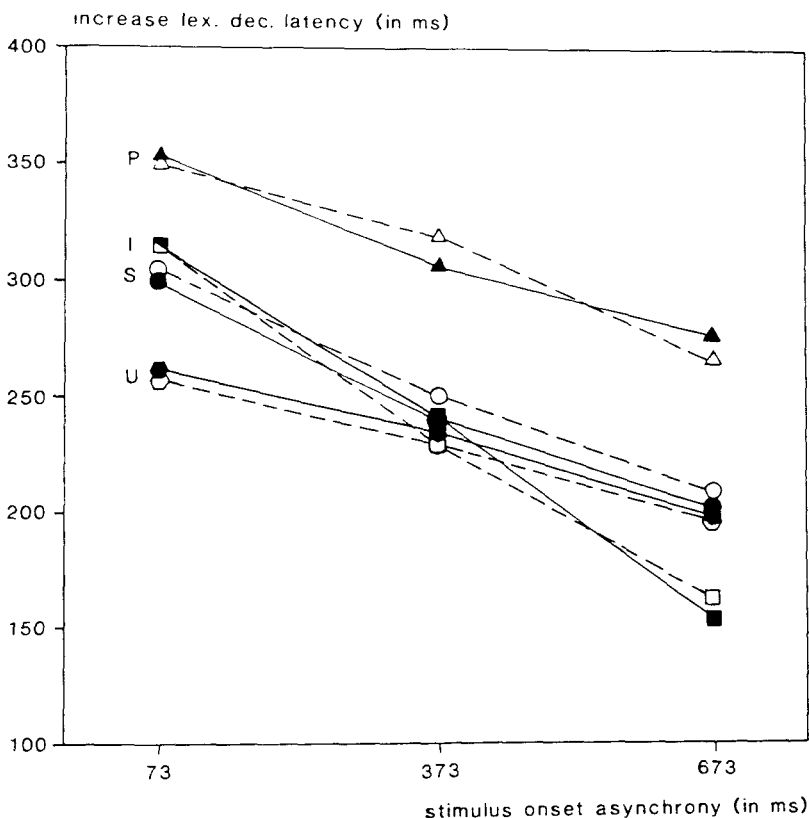
A.S. Meyer and Schriefers addressed the question of the time course of phonological encoding in the production of single words using a picture-word interference paradigm. Subjects had to name line-drawings of simple objects while they were in addition presented auditorily with distracter words which either shared the onset of the picture names (e.g., picture: *cat*, distracter: *cap*) or its rhyme (picture: *cat*, distracter: *mat*). The distracters were presented with different SOAs, either shortly before picture onset (negative SOAs), simultaneously with picture onset (SOA 0), or shortly after picture onset (positive SOAs). A first set of experiments showed that onset distracters facilitate picture naming at positive SOAs, whereas rhyme distracters lead to no or much weaker facilitation. This pattern suggests that phonological encoding proceeds in a left-to-right manner. This proposal is investigated further at the moment for the production of single words and for the production of simple noun phrases.

1.1.4 The time course of lexical access

During 1989 the project on the time course of lexical access (Levelt, Schriefers, Meyer) was completed. The aim of the project had been to determine how the two constituent processes in lexical access, lexical selection and phonological encoding, are temporally related. On one view – the two-stage model – phonological encoding strictly follows lexical selection. In a picture naming task, for instance, only the selected lexical item (the picture's appropriate name) will be phonologically

encoded; semantically coactivated alternative items will not undergo phonological encoding. On the other view – which is most explicit in activation-spreading theories – all simultaneously activated lexical candidates will also be phonologically activated to some degree. Upon selection of the appropriate target item, the alternatives will gradually lose their phonological activation. Only on this latter view is there temporal overlap of semantic activation (leading to selection) and phonological activation (leading to articulation).

A first experimental technique to approach this issue was one in which subjects performed acoustic lexical decision during object naming at different stimulus onset asynchronies (SOAs), which allowed us to measure the time course of semantic and of phonological activation of a target item. So, for instance, if the object to be named is a sheep, the lexical decision probe could be *goat* (semantic probe), *sheet* (phonological probe), or *house* (neutral probe). We also used the identical probe (e.g., *sheep*). In a pre-session of the experiment the same lexical decision task was performed without concurrent picture naming. The lexical decision latencies of this experiment (for the pre-session and three SOAs) are depicted in the figure (drawn lines). D. Vorberg (Philipps U., Marburg) together with J. Havinga (U. Nijmegen) contributed to this project by producing a mathematical rendering of the two-stage model (see 1.4.2). The dotted lines show the model's (near-perfect) fit to the experimental data.



It is, however, not excluded that the alternative theory could produce a similar good fit. Therefore, further experiments using the same task were designed in order to test whether semantic alternatives to the target item would display phonological activation. For instance, if *sheep* is the target, *goat* could be a semantic alternative, and *goal* could be a probe for testing the phonological activation of *goat*. Three different experiments showed no evidence whatsoever for such phonological activation of semantic alternatives. For the time

being, therefore, we can conclude that the two-stage model is the more viable one.

This conclusion was further confirmed by a series of naming latency experiments where an acoustic distracter stimulus was presented at different SOAs. The distracter stimulus could entertain a semantic or a phonological relation to the target item but should be ignored by the subject. However, it affected the naming latencies in a way predicted by the two-stage model. These experiments were reported in the previous Annual Report.

1.2 The Reference Project: The Expression of Space and Time

1.2.1 Aims and organization

Based on earlier research and ongoing work on the expression of space and time in language (see Annual Report, 1988), an integrating project has been started under the coordination of M. Bierwisch that brings together theoretical, descriptive, crosslinguistic, and developmental studies (see 3.2) dealing with problems of reference to spatial and temporal structures. The project has two natural branches each comprising a number of subprojects concerned with space and time, respectively. The considerations underlying the organization of the overall project are threefold:

1. General background: Space and time are not only basic structures of conceptual organization underlying all aspects of linguistic knowledge and its use, they are also characteristically related to particular grammatical and lexical means and mechanisms. Developments in formal logic and theoretical linguistics provide interesting possibilities to clarify general

structures and principles governing both domains and their respective specificities. These possibilities will not only guide the attempts dealing with various specific issues in the different subprojects; they will also be examined and elaborated in view of particular empirical facts and problems.

2. Crosslinguistic variation: Despite the general underlying structure, space and time are articulated in different languages in highly specific ways with respect to both lexical distinctions and grammatical devices. Systematic studies of particular phenomena in different languages will clarify the nature both of the idiosyncratic differences and the common principles determining the expression of space and time. Particular emphasis will be on the question whether the differences in question are restricted to lexical and grammatical structures or involve also differences in conceptual organization.

3. Compositional integration: A particular concern interrelating the different subprojects is the attempt to clarify the interaction of the various aspects involved. This concerns the interaction of lexical, grammatical and contextual devices as well as the interdependence between spatial and temporal reference. The way in which the interpretation of locative or temporal prepositions depends on their objects illustrates this general problems just as well as the interaction of tense and aspect with temporal and spatial adverbials.

Guided by these considerations, a number of specific topics have been sorted out for more detailed descriptive or developmental study, with emphasis either on theoretical or crosslinguistic aspects. Among these topics is the interaction of tense, aspect, and temporal adverbials, locative and directional prepositions, grammatical, lexical, and contextual factors in temporal organization.

Besides work conducted within the different subprojects to be reported below, joint efforts were made in two directions. First, a number of basic concepts necessarily involved in the analysis of the phenomena in question have been identified in order to articulate the framework within which the different studies can be related and their findings are to be accounted for. Secondly, some specific facts were selected for detailed exploration in order to specify the concrete problems the general framework must be able to account for.

The exploration of basic concepts concerned two types of issues: (a) The underlying conceptual structure (the “common sense ontology”) of space and time, in particular the topological, dimensional and metrical properties of spatial and temporal domains, the nature of basic entities (places and time intervals), orientations, and the role of functional concepts such as “support”, “proximal”, “container”, as opposed to topological ones. (b) The basic elements and structures of spatial situations and temporal arrangements in terms of which spatial and temporal structures appear to be lexicalized or grammaticalized. Basic components of this sort seem to be theme and relatum, source state and target state, state and event, time of state or event, place of object or state of affairs.

The aim of these explorations is first to evaluate various proposals that have been made in the literature and to clarify their mutual compatibility, and secondly to develop a conceptual apparatus that is in line with general theoretical insights and appropriate to the fairly diverse empirical problems and findings coming from the different subprojects. Attempts in these directions will be continued as the project proceeds.

Specific facts explored with respect to these general issues included problems of locative prepositions in different languages and aspects of the tense system of English and German.

Further details are to be found in the different subprojects below.

1.2.2 The integration of tense, temporal, and locative adverbials

Bierwisch investigated the compositional integration of tense, temporal, and locative adverbials. A paradigmatic case belonging to the problem of compositional interaction of different grammatical factors involved in the expression of time is illustrated by the following examples:

- (1)(a) He came yesterday.
- (b) He came today.
- (c) *He came tomorrow.
- (2)(a) *He will come yesterday.
- (b) He will come today.
- (c) He will come tomorrow.

The almost trivial observation related to these examples is that past tense is incompatible with *tomorrow*, future tense is incompatible with *yesterday*, while both tenses are compatible with *today*. An explicit account of these observations has to deal with (a) the semantics of tenses, (b) the semantics of time adverbials, and (c) the way in which both are combined with the verb.

Concerning the latter problem, Bierwisch has adapted in a number of publications the proposal made by Davidson and developed subsequently in a number of ways that verbs characteristically involve reference to events (or states). According to Bierwisch's proposal, this reference is based on an event variable *e* coming with the semantic form of verbs and bound by a specific referential argument position ultimately bound by the complementizer of the clause. Technically, the event vari-

able instantiates the proposition specified by the verb together with its complements. Formally, this can be represented by means of an instantiation operator INST that relates a proposition to possible instantiations. Thus a verb like *come* will have a lexical representation like (3):

- (3) /come/; [+V, -N]; $\hat{x} \hat{e} [e \text{ INST } [\text{BECOME}[\text{LOC } x \subset \text{PROX } z]]]$

The event to which *e* can refer instantiates a change of state resulting in the location of *x* in the proximal environment of some (contextually determined) entity *z*.

Given this type of analysis, the variable *e* can be specified by means of conditions expressed by tense markers on the one hand, and time adverbials on the other hand, provided appropriate semantic and syntactic analyses can be given. This leads to problems (a) and (b).

Ignoring important details that are irrelevant in the present respect, tense markers can be given lexical representations as in (4) and (5):

- (4) /-ed/; [+Fin]; $\hat{v} \hat{e} [T \text{ e BEFORE } T \text{ u} : v \text{ e}]$

- (5) /will/; [+Fin]; $\hat{v} \hat{e} [T \text{ e AFTER } T \text{ u} : v \text{ e}]$

Here *T* represents a function that assigns a time interval to an event, and *u* indicates the indexically determined event of an utterance. Syntactically, both (4) and (5) are realizations of the INFL-constituent, *-ed* being a proper affix, *will* an auxiliary. As a consequence of their syntactic role, the details of which cannot be discussed here, both (4) and (5) combine with the semantic form of the verb occurring in their complement by means of functional composition. The result can be illustrated as follows:

- (6) /will come/; [+V, -N, +Fin];
 $\hat{x} \hat{e} [T \ e \text{ BEFORE } T \ u : [e \text{ INST } [\text{BECOME}[\text{LOC } x \subset \text{PROX } z]]]]]$

Thus the tense information specifies a temporal condition on the choice of the event *e* instantiating the event of *x*'s coming.

Turning next to the temporal adverbials, their syntactic status as adjuncts to the verb (or rather the VP headed by it) induces the semantic combination of modifiers with their heads. Pending a more general theory of modification, the following claim about restrictive modifiers is to be made: (Restrictive) modifiers are one-place predicates, the argument position of which is unified with the referential argument position of the modified head. Unification of argument positions results in logical conjunction of the pertinent predicates. More formally:

- (7) If $\hat{x} [P \ x]$ is a modifier of $\dots \hat{y} [Q \ y]$, where \hat{y} is the referential argument position, the resulting interpretation is $\dots \hat{y} [Q \ y : P \ y]$.

Given this preliminary account of modification, the interpretation of *will come tomorrow* will be that of (6) with the additional condition TOMORROW *e*, assuming the following entry for *tomorrow*:

- (8) /tomorrow/; [-V, -N]; $\hat{x} [\text{TOMORROW } x]$

In order to account for the phenomena illustrated in (1) and (2), TOMORROW must be replaced by a more explicit analysis, which captures both its indexical and relational character. The following entries indicate the type of analysis needed:

- (9) /today/; [-V, -N]; $\hat{x} [\text{DAY } w : w \supset T \ x : w \supset T \ u]$

- (10) /tomorrow/; $[-V, -N]$;
 x [DAY w : DAY w' : w DAFTER w' : $w \supset T x$: $w' \supset T u$]

DAFTER abbreviates the relation “directly after”. Thus *today* places both the event x and the utterance event u within the same time interval w of the length of a day, while *tomorrow* places x within the day w directly following w' containing u . As *yesterday* simply imposes a different ordering on w and w' , these entries, together with (4), (5) and (7), correctly account for the patterns in (1) and (2). Notice that *today* is compatible with both past and future tense, as it allows the event of coming both to precede and to follow the utterance time, restricting merely the permissible interval to the same day.

The theory of modification indicated in (7) provides a starting point also for the compositional interpretation of locative and directional adverbials. Assuming the following type of entries for locative and directional prepositions, where LOC is, as before, a function assigning a place to an entity, while FIN is a function that turns a spatial unit into a path and picks out its final part, we derive properties of places and paths as indicated in (13) and (14):

- (11) /in/; $[-V, -N]$; $\hat{x} \hat{y}$ [LOC $y \subset$ LOC x]
(12) /into/; $[-V, -N]$; $\hat{x} \hat{y}$ [FIN[LOC y] \subset LOC x]
(13) /in the room/; $[-V, -N]$; \hat{y} [LOC $y \subset$ LOC [THE ROOM]]
(14) /into the room/; $[-V, -N]$; \hat{y} [FIN[LOC y] \subset LOC [THE ROOM]]

Thus (14) represents the property of a path y specified by the condition that its final part is located in the place of the object identified by THE ROOM. Assuming that (14) occurs as an adjunct of *come*, we get the following interpretation by means of (7):

- (15) come into the room/;
 $\hat{x} \hat{e} [e \text{ INST}[\text{BECOME}[\text{LOC } x \subset \text{PROX } z]] : [\text{FIN}$
 $[\text{LOC } e] \subset \text{LOC}[\text{THE ROOM}]]]$

(15) correctly requires e to instantiate an event of x 's change of location the final part of which is located in the room and has x in the proximity of some contextually determined z .

Notice that on this account *sleep in the room* is interpreted as desired (the event taking place in the room), while *sleep into the room* is deviant, unless the event of *sleeping* were interpreted as some sort of motion occupying a special area the final part of which is located in the room.

While the interaction of spatial and temporal conditions on the event instantiating a proposition can naturally be accounted for along these lines, a number of questions immediately arises. To indicate just one of them, while temporal adverbials like *today*, *in the following week* combine freely with different types of events, durational adverbials exhibit crucial restrictions:

- (16) (a) He slept for three hours.
 (b) He came for three hours.

In (16a), *for three hours* specifies the duration of the event of his sleeping. In (16b), it cannot modify the event of his coming, but only the time of the resulting state. While the details of the analysis necessary to account for such facts are

anything but trivial, it seems obvious that recourse to the internal structure of different event types is necessary. Problems of this sort abound if an explicit analysis of the interaction of different factors specifying temporal, locative, and other conditions on events is to be given. The next step to be taken to this effect is a formal representation of different structures of states, processes, events and their subtypes based, among others, on concepts of the algebra of events proposed by Bach and others.

1.2.3 Spatial and temporal deixis

V. Ehrich continued her project on deixis. She developed a theoretical approach analyzing reference to space and reference to time in an integrated framework. The basis concept of this framework are Reichenbach's notion of **Reference Time** (RT) and its application to space in the notion of **Reference Location** (RL).

Ehrich distinguishes deictic tenses like German Present Tense and Present Perfect, where RT is bound to the speaking time, and anaphoric tenses, where RT is bound to an antecedent time provided by previous utterances within connected discourse (see Annual Report, 1988).

German Past Tense is analyzed as anaphoric, gaining its RT from either the event time of the antecedent event ($RT_i = ET_{i-n}$, cf. 1) or the event time of the state resulting from the antecedent event ($RT_i = ET_{i-n}/res$, cf. 2). Where there is no antecedent event mentioned (like in isolated sentences or in introductory passages of a discourse), RT must be directly established by temporal adverbs ($RT_i = R_{ADVB_i}$, cf. 3).

- (1) Hans saß im Sofa (ET_1) und las (ET_2)
 (Hans was sitting on the sofa and reading)

$$(RT_2 = ET_1 \wedge RT_2 \supseteq ET_2)$$

- (2) Hans setzte sich ins Sofa (ET_1) und las (ET_2)
 (Hans sat down on the sofa and read)
 $(RT_2 = ET_1/res \wedge RT_2 \supseteq ET_2)$
- (3) Während des Gewitters gestern_{TADV} saß Hans im Sofa (ET_1)
 (During the thunderstorm yesterday Hans was sitting on the sofa)
 $(TADV = RT_1 \wedge RT_1 \supseteq ET_1)$

The distinction between deictic and anaphoric tenses has consequences for the assignment of spatial locations to the events encoded by different tenses:

- (4) a. Es regnet (It is raining)
 b. Hier regnet es (Here, it is raining)
- (5) a. Es hat geregnet (It has been raining)
 b. Hier hat es geregnet (Here, it has been raining)
- (6) a. Es regnete (It was raining)
 b. Hier regnete es (Here, it was raining)

Deictic tenses like the Present Tense and the Present Perfect binding the event time to the utterance time as RT also bind the event location to the utterance location as RL. Therefore (4a) and (5a) are **by default** interpreted as situating the rain in the speaker's actual environment. In terms of spatial reference (4b) and (5b) are equivalent to the respective a-sentences, accordingly. The corresponding Past Tense sentence (5a), on the other hand, is not, even by default, interpreted as situating the rain at the speaker's actual place. The

event may be located anywhere depending on previous discourse. If there is no antecedent event mentioned providing RT and RL, the utterance remains referentially incomplete. Even the addition of *hier* (6b) does not help in such a case. Whereas *hier* must be interpreted as a strictly deictic element if it combines with a deictic tense, it may be interpreted as a fictitious deixis (**Deixis am Phantasma** in Bühler's sense) if it combines with the anaphoric Past Tense. In this case the *hier* itself must be bound to an antecedent place as its RL like in, for instance, (7):

- (7) Am 5. Januar kam Casanova in Florenz an.
Hier regnete es.
(On January 5th Casanova arrived in Florence.
Here it was raining.)

The examples discussed show the interdependence of temporal and spatial reference and motivate the application of tense semantics concepts to spatial semantics.

1.2.4 Cross-linguistic studies of spatial relations

U. Bartels continued her dissertation research on meaning and mental representation of topological prepositions in German and Dutch.

A corpus analysis (German/Dutch) was carried out to compare the use of topological prepositions within and across these languages, to study their meanings, and to look for (situational and sentence) context conditions affecting their use.

Generally, all topological prepositions can be differentiated with the help of typological relationships like inclusion, proximity and surface-contact. And it is a fact that there are many correspondences with respect to this between translation equivalents of German and Dutch. However, there are

also differences between these two closely related languages that are worth investigating more deeply. The contrast pairs *an/auf* in German and *aan/op* in Dutch are typical examples in this context. There are sentences where it is impossible or at least unusual to use the closely related translation equivalents (*an=aan*, *auf=op*), as in

Siehst du die Farbkleckse **an**/?**auf** der Wand?
Zie je de vervlekken **op**/***aan** de muur?
(Do you see the colour spots **on** the wall?)

Sie wartet **an**/?**auf** der Ecke.
Ze wacht **op**/***aan** de hoek.
(She is waiting **at** the corner.)

Er ist **auf**/***an** beiden **ohren** taub.
Hij is **aan**/***op** beide oren doof.
(He is deaf **at** both ears.)

Instances like these cannot be explained just with the help of typological terms. There are other relationships responsible for the use of a particular topological preposition, namely functional ones like containment, support or adhesion. Mostly these functional relationships are to be viewed as additional to the typological ones. They concern typical uses and so called canonical positions of the objects involved. Within this context one has to consider the properties of the (conceptualized, not always concrete) Theme and/or Relatum (shape, size and orientation), because they also can be important factors for the use of special prepositions.

Moreover, verbs play an important role in connection with prepositions. So, for example, *hängen/hangen* requires *an/aan* and *liegen/liggen* requires *auf/op*:

Der Hut **hängt an** der Garderobe.
De hoed **hangt aan** de kapstok.
(The hat is **hanging on** the peg.)

Der Hut **liegt auf** der Garderobe.
De hoed **ligt op** de kapstok.
(The hat is **lying on** the peg.)

With the same preposition but varied verb a sentence gets two different interpretations:

Die Perle **liegt in** der Tasse.(i.e, on the inner bottom of the cup)
De parel **ligt in** het kopje.
(The pearl is **lying in** the cup.)

Die Perle **steckt in** der Tasse.(i.e., in the material the cup is made of)
De parel **zit in** het kopje.
(The pearl is **fixed in** the cup.)

Based on these findings, we plan to run some experiments to test possible factors responsible for the use of particular prepositions and how they are distributed across German and Dutch.

1.3 The Pupil's Response During Speech Production

This project, which had been asleep for some time, was reactivated (B. Hoeks and W.J.M. Levelt) during 1989. Mental effort is known to produce a pupillary response. A speaker's pupil size might, therefore, be an indicator of the ongoing

mental effort in the planning and production of speech. In an exploratory study the pupil's response during spontaneous speech was registered. Eight five-minute samples (from four subjects) were analyzed with respect to such psycholinguistic variables as sentence beginning and end, surface/deep clause beginning and end, beginning of function and content words, beginning and end of filled/unfilled pauses, the position of main sentence accent, etc. For each of these we evaluated the average pupillary response from -4 to $+4$ seconds around the event. The only results that are consistent between and within subjects are those for sentence beginning and for the end of a filled pause. The pupil starts increasing from one second before the beginning of a sentence, reaching a peak at sentence beginning, followed by a slow drop extending over two seconds. The pupil shows a gradual increase from 2 seconds before the end of a filled pause, reaching a maximum where speech sets in, which is immediately followed by a steep drop.

The main problem with such data is to reconstruct the moment of the mental event(s) that caused the pupillary change. This requires a method of deconvolution, which is now being developed. To apply such a method correctly, it is important to know whether the pupillary system is linear (within the range of measurement). It can, moreover, be linear with respect to pupil diameter or to pupil area. In order to test the linearity of the system and the method of deconvolution, an experiment was run in which the pupil's response to pairs of stimuli was recorded. The two acoustic or visual stimuli were presented either 0.5 or 1.5 seconds apart, and the subject either gave simple push button responses to both stimuli, or no response. The data are now being analyzed.

1.4 Other Research

1.4.1 Subject-verb agreement in German

H. Schriefers, A.D. Friederici, and K. Bock (Michigan U.) started research on number agreement between subject and verb in German. The experiment was based on previous experiments by Bock on agreement in English. In these experiments, subjects are auditorily presented with short beginning fragments of sentences (e.g., *the baby on the blankets*). The subjects then repeat this fragment and complete it to form a full sentence. Bock's results show, among other things, that a fragment like *the baby on the blankets* elicits significantly more agreement errors (e.g., *the baby on the blankets were ...*) than a fragment like *the baby on the blanket*. The experiment in German was specifically designed to test whether these errors can be attributed to mistaking the noun directly preceding the verb (e.g., *blankets*) for the subject. In German, a plural noun in a prepositional phrase with an accusative preposition has the same article and inflection as the nominative plural (e.g., *der Brief an die Mütter*, 'the letter to the mothers'). In the case of a dative preposition, by contrast, article and inflection differ from the nominative plural (e.g., *der Brief von den Müttern*, 'the letter from the mothers'). The results show that, for beginning fragments with singular subject nouns, prepositional phrases with a plural noun in accusative elicit more agreement errors (i.e., plural verb-forms in the completion of the fragment) than prepositional phrases with a plural noun in dative. Furthermore, number agreement errors are more frequent when the singular subject noun is feminine. In this case, the article of the singular subject noun (*die*) is the same as the corresponding nominative plural article. These results suggest that the agreement errors in this experiment are due

to a coalition of two factors, namely that the article of the subject noun is also a potential nominative plural article (i.e., the marking of the subject noun being singular is only by means of inflection), and that the noun in the prepositional phrase is not only a plural, but that this plural form is not distinct from the nominative plural form (as in the case of accusative prepositions).

1.4.2 Foundations of reaction time measurement and modeling

During his stay at the Institute D. Vorberg (Philipps U., Marburg) worked on theoretical research into the foundations of reaction time measurement and modeling. This research led to (a) an incompatibility result between the Rasch model in psychometrics and most parallel and serial information processing models, (b) a new relationship between parallel processing models and random utility models for choices and ranking and (c) the derivation of reaction time predictions for SOA functions from double stimulation experiments for a large class of models with interacting parallel channels. Models of this type were applied to data from experiments on lexical decisions (see 1.1.4) and picture naming and on grapheme-phoneme identification.

2. Language Comprehension

Much of the research activity in the Language Comprehension Group has again been in the context of large scale projects that involve collaborative efforts among researchers within and outside the group. The core project, and one which helped set the stage for the institute-wide reorganization of research activities, is the Interface Project. Building on success in recent years, work continued on issues such as the acoustic-phonetic input to the lexicon, the structural constraints that the phonological system imposes on the input, and the kinds of syntactic and semantic properties of words that are important during processing. Interesting results have also emerged from a project devoted to investigating the structure of the mental lexicon by integrating data from computerized lexical databases, computational modeling, and psycholinguistic experimentation. Work continued on the use of inference depending on knowledge during reading. The previous year also witnessed the culmination of several years of foundation-building research on the use event-related potentials: three grant proposals were submitted, and all three were funded, enabling the development of a new and exciting line of psycholinguistic research to complement the existing activities in language comprehension.

2.1 Interfaces in Language Comprehension

Work within this project concentrated on the phonetics-lexical interface (Lahiri, Jongman, Sereno), the lexical-syntax inter-

face (Bayer, Bierwisch), and the lexical-semantics interface (Flores d'Arcais, R. Meyer).

A major effort to integrate different structural aspects focused on the intricate phenomena clustering around the boundary between lexical and phrasal units. These problems constituted the objective of an international workshop "When words happen to be phrases..." held from December 18-20. The papers and discussions of this workshop were concerned with structural principles operating both within simple words and across words in phrases. Although the diversity of phenomena of this sort, e.g. separable prefixes of Germanic languages, syntactic principles in derivational morphology, or strategies determining parsing of compounds, were not expected to lead to simple and uniform explanations, interesting generalizations became apparent. A rather provisional summary of these generalizations could be stated as follows:

Incongruities between different aspects of representation are best accounted for in terms of organizing principles, such as lexical storage vs. productive generation, and functional composition vs. functional application, rather than fixed structural units.

2.1.1 Representation in the mental lexicon

A. Lahiri and W.D. Marslen-Wilson (MRC, Cambridge) continued their empirical investigation on the nature of the representation of lexical items in the mental lexicon. In earlier research on the representation of nasality, listeners' performance indicated that they interpreted surface nasality with respect to an abstract and underspecified lexicon. In a recent study, a gating task was conducted to investigate how Bengali listeners would interpret a duration feature, specifically

closure duration which is the predominant cue for geminate consonants. The question asked was whether listeners would interpret a melodic feature like nasality in the same way as duration, or rather, as a function of cues to the structural organization of the word being heard. Geminate consonants and nongeminate consonants contrast only in intervocalic position. In terms of quality they have the same representation – they differ in terms of whether they are linked to two timing units or a single unit. Thus phonologically the length distinction is not marked as a quality difference like nasality. If length is represented in the mental lexicon as assumed above, then unlike nasality, the listeners' interpretation of surface duration will depend not on the lexically marked status of the feature, but on the listeners assessment of the segment slots in the language.

The contrasting segments in the word pairs chosen as stimuli were nasals or liquids so that the period of consonantal closure would not be silent. Each word had exactly six gates, differing in length at the third gate which was set at the end of the closure (geminate having twice as much closure duration as nongeminates), before any release information was present. It is at this gate where listeners hear a closure whose duration far exceeds the duration of any closure associated with a nongeminate consonant that one may expect geminate responses if listeners were sensitive to duration alone. Results showed overwhelmingly that listeners disregarded the duration information and preferred to interpret the consonant as a singly linked segment. Only after the release information of the second consonant was available – approximately 25 msec more information – did listeners interpret the information as a dually linked geminate.

2.1.2 Syntactic form class and lexical processing

J.A. Sereno and A. Jongman have conducted a series of experiments investigating the representation and processing of lexical items. In a first experiment, Sereno and Jongman examined processing differences due to syntactic form class membership, in particular, differences between nouns and verbs. Preliminary results suggest that reaction times to nouns are faster than those to verbs.

One possible explanation for these results may be the nature of the lexical representations of nouns and verbs. In English, the base form of nouns (the singular form) makes up about 75% of the total noun frequency while the base form of verbs (infinitive, 1st and 2nd person singular, plural) makes up only 30% of the total verb frequency.

Further experiments were then conducted to investigate the influence of base frequency in access processes. High and low frequency base forms of nouns and verbs were contrasted. Experiments were run using only nouns since they have the unique quality that high frequency base form words such as *river* have, by default, a low inflected frequency (*rivers*) whereas low base form words such as *window* have a high inflected frequency (*windows*). In one experiment, only singular nouns were presented, with high base form nouns contrasted to low base form nouns. In a second experiment, the same words were used except that they were pluralized. If access for morphologically complex words is conducted via the base form, then the pattern of results for the plural forms should be identical to that found for the singular forms. If access is instead dependent on the frequency of the presented form, then the pattern of results for the plural nouns should be the mirror image of the first experiment, with reaction times to low base form plurals faster than reaction times to high base form plu-

rals.

A second series of experiments was also conducted investigating noun/verb ambiguous items. Syntactically ambiguous items (e.g., *answer*) were contrasted to syntactically and semantically ambiguous lexical items (e.g., *season*, *tire*). A biasing context was also used to determine whether lexical access could be restricted.

The data are currently being analyzed. In sum, the present set of experiments uses token frequency counts to test the role of morphological structure in word recognition.

2.1.3 Past tense formation in Dutch: Toward an account of voicing

Jongman has been working on a coherent account of the interaction of the processes of devoicing, regressive and progressive assimilation, and past tense formation in Dutch. The phenomena of Dutch voicing assimilation can be illustrated by the following examples with medial obstruent clusters:

stop+stop

- (i) opdoen /ɔp# dun/ [ɔbdun] 'put on'
- (ii) bloedkoraal /blud# kɔral/ [blutkɔral] 'red coral'

fricative+stop

- (iii) afdoen /ɔf# dun/ [ɔvdun] 'take off'
- (iv) kaaspers /kaz# pɛrs/ [kaspɛrs] 'cheese press'

stop+fricative

- (v) opzeggen /ɔp# zɛxən/ [ɔpsɛxən] 'terminate'
- (vi) ribfluweel /rɪb# flüwel/ [rɪpflüwel] 'corduroy'

fricative+fricative

- (vii) afzeggen /ɔf# zɛxən/ [ɔfsɛxən] 'cancel'
- (viii) lijfsieraad /lɛɪv# sirad/ [lɛɪfsirat] 'jewelry'

It is clear that assimilation processes can be bi-directional:

- (a) regressive: right to left ((i) – (iv)), in which the left member of the obstruent cluster takes on the voicing status of the right member;
- (b) progressive: left to right ((v) – (viii)), in which the right member of the obstruent cluster takes on the voicing status of the left member.

With regressive assimilation, the second segment is always a stop consonant, and with progressive assimilation the second segment is always a fricative. As illustrated in (vi) and (viii), syllable-final devoicing interacts with progressive assimilation to always yield voiceless obstruent clusters when the right cluster member is a fricative. The following rule order accounts for this behavior:

- (1) Syllable-final devoicing

$$[-\text{SON}] \longrightarrow [-\text{VOICE}]/ __\#$$

Progressive assimilation ('Fricative rule')

$$\begin{bmatrix} -\text{SON} \\ +\text{CONT} \end{bmatrix} \longrightarrow [-\text{VOICE}]/ \begin{bmatrix} -\text{SON} \\ -\text{VOICE} \end{bmatrix} (\#) ___$$

Regressive assimilation

$$[-\text{SON}] \longrightarrow [+ \text{VOICE}]/ __\# \begin{bmatrix} -\text{SON} \\ +\text{VOICE} \end{bmatrix}$$

Additional evidence in support of the progressive assimilation rule is typically provided by Dutch past-tense formation. Consider these past tense forms of Dutch verbs:

(2) Infinitive Past tense

krabben	krabde	'scratch'
[krʌbən]	[krʌbdə]	

kloppen	klopte	'knock'
[klɒpən]	[klɒptə]	

hozen	hoosde	'scoop'
[hɔzən]	[hɔzdə]	

hossen	hoste	'jig'
[hɒsən]	[hɒstə]	

According to Trommelen and Zonneveld (1979), past-tense formation involves a process of progressive assimilation. In order to claim this, they have to assume that the past tense suffix underlyingly starts with a fricative. This assumption stems from the different way in which fricatives and plosives behave with respect to voicing assimilation in obstruent clusters. Under this analysis, the underlying representation of the past tense suffix is therefore / $\delta\theta$ /. For past tense forms, then, progressive assimilation changes [δ] into [θ] following voiceless obstruents, and does not apply following voiced obstruents. A past tense rule then applies to change [δ] and [θ] into [d] and [t], respectively.

Under Trommelen and Zonneveld's analysis, in which de-voicing precedes progressive and regressive assimilation, the input to the rule of progressive assimilation would be the same for stems ending in a voiced or a voiceless obstruent. Consequently, this analysis incorrectly predicts that all past tense forms of verbs ending in a voiced or voiceless obstruent will surface with voiceless obstruent clusters (see (2)). Jongman,

therefore, proposes an alternative analysis for past-tense formation.

Jongman's solution captures the fact that it is the presence of voicing in the stem-final obstruent that prevents devoicing of the past tense suffix. The following rule expresses these facts:

(3) /d/- Devoicing

$$\begin{array}{ccc}
 \begin{array}{c} \text{C} \\ | \\ [+COR] \\ | \\ [+VOICE] \end{array} & \longrightarrow & \begin{array}{c} \text{C} \\ | \\ [+COR] \end{array} \quad / \quad \begin{array}{c} \text{C} \\ | \\ [-VOICE] \end{array} \quad \text{---}
 \end{array}$$

In this formulation, the underlying form of the past tense suffix begins with /d/. The morphological rule in (3) simply deletes the voicing of the past tense suffix when it is preceded by a voiceless consonant. Being a morphological rule, /d/-Devoicing applies before the lexical rules of Devoicing and Assimilation.

One characteristic of this analysis – in light of current developments in phonological theory – is that it permits [d] to surface following all segments except [–voice] segments. This suggests that in Dutch [–voice] segments form a natural class. The fact that, at some point in the derivation, the feature value [–voice] plays a role argues against recent theories of privative voicing, according to which only [+voice] is universally specified in all languages (Mester and Ito, 1989). The evidence provided by Dutch past-tense formation thus seriously weakens Mester and Ito's case for **universal** underspecification of [voice]. More importantly, Jongman's analysis of past-tense formation allows for a unified account of Dutch voicing.

2.1.4 Lexical knowledge in parsing

In collaboration with Jongman and Sereno, J. Bayer developed materials for a study of parsing long distance WH-dependencies in German. The question that lead to this is that most of these studies are carried out in English. The essential difference between English and comparable German clauses, however, is that the verb comes at the very end of the clause in German. One expectation is that this may have an important effect on gap-detection. Compare the following two clauses:

- (1) This is the student **who** we thought that Bill should invite for lunch
- (2) Das ist der Student, **den** wir dachten, daß Bill zum Essen einladen sollte

Lexical knowledge signals to the parser to hypothesize and bind a gap once the transitive verb (*invite/einladen*) is perceived. In German, however, the gap would have to be hypothesized **before** the verb is perceived. As shown by various studies on English, speakers exhibit an antecedent priming effect at the place where the gap occurs. This effect is presumably triggered by the information of the verb, a lexical governor selecting a complement of the appropriate type. If it turns out that speakers of German do not have such an effect at the gap's position or a weaker effect, this would be a theoretically very significant result. It could help explain why German (and Dutch) does not allow for so-called WH-island violations, while English does. (See section 2.1.5 below).

2.1.5 Theoretical linguistics

Bayer has completed a study in which certain syntactic differences between English and German are investigated. It is a

well-known fact that English shows the so-called “that-trace” effect, while German (and Dutch and many other verb-second languages) does not. Bayer tries to derive this difference from the vacuous movement hypothesis according to which WH-subjects do not move in English in the syntax, but only at the level of Logical Form, while WH-subjects always move visibly in German. Another difference between these two languages is the fact that English (marginally) permits WH-island violations while German does not:

(1) ?**What** did Mary wonder how Fred would repair ?

(2) ***Was** wollte Maria wissen wie Fred repariert ?

The extracted WH-word cannot locally bind its gap in the embedded clause, because there is a closer binder in the embedded clause, namely *how/wie*. Why can English still achieve a binding relation, while German does not? The conjecture is that English can resort to a form of lexical government that German cannot. It is argued that the inefficiency of lexical government in German is due to the word order that makes the gap only “visible” when the entire clause is processed.

In collaboration with J. Kornfilt (Syracuse U. and MIT), Bayer worked on syntactic restructuring effects in German, in particular infinitival constructions which undergo extraposition while leaving arguments behind. This syntactic process is triggered by a certain class of verbs. Roughly the same set of verbs also allows for “long passives” and the possibility of clustering matrix-verb and embedded verb together. Examples of all three phenomena are given in (1) through (3):

- (1) daß Hans seinen Freunden den Wagen vergessen
 that Hans his friends the car forgotten
 (that Hans had forgotten to show the car to his friends)

- | | | | | | | | | |
|--|-------|----|--------|--|--|--|--|--|
| | hatte | zu | zeigen | | | | | |
| | had | to | show | | | | | |
- (2) daß der Wagen vergessen wurde zu reparieren
 that the car forgotten was to repair
 (that it was forgotten to repair the car)
- (3) Zu reparieren vergessen hätte er den Wagen nie
 to repair forgotten had he the car never
 (He would never have forgotten to repair the car)

All of these constructions seem to violate otherwise valid locality constraints. On the other hand, they cannot be cases of ordinary verb raising. The “zu”-clauses are arguably full clausal projections which persist in the syntactic derivation. Bayer and Kornfilt show where a movement analysis fails. They propose that there is a class of (control) verbs in German (actually also in Italian, Turkish, Norwegian, Spanish and many others) which allow their complements to be “visible” at the immediately dominating VP. This mechanism enables the passing up of government features into the next higher clause. Thus, an embedded verb can govern its complement, say an NP, in the next higher clause. This looks like a GPSG-type slash mechanism, but is actually confined to a lexically induced process similar to but not equivalent to verb-raising. Thus, it is unsurprising that (1) through (3) are sharply ungrammatical when a non-restructuring matrix verb is chosen such as *bedauern* (‘regret’).

Bayer also worked on negative concord in Bavarian. The descriptive account chosen gives a simple and rather straightforward solution to the absorption of the negation inherent in a negative quantifier. The fact is that negative concord applies to objects but not to subjects unless the latter are adjacent to the verb. From the analysis given it follows that OSV-order in

the German clause cannot be the result of a movement transformation that leaves a trace behind. This result is interesting with respect to linguistic theory as well as with respect to predictions about linguistic processing. If non-canonical constituent order (“scrambling” effects) does not arise by virtue of an application of a transformational rule, then one can also not expect filler-gap dependencies or reconstruction effects. Interlinguistic as well as processing results conspire in favor of this conclusion.

2.1.6 Lexical representation and argument structure

Earlier work by M. Bierwisch (Academy of Science, Berlin, GDR) on the organization of lexical entries and especially on argument structure as one of their essential components has shown argument positions – or Theta roles – of lexical items to be representable by lambda operators that bind appropriate variables within the semantic representation of lexical items, as illustrated in the following example:

- (1) /in/; $[-V, -N]$; $\lambda x \lambda y [[LOC\ y] \subset [LOC\ x]]$

Under this conception of Theta roles, Theta marking can be construed as a functional application, with an appropriate syntactic argument providing the value for the variable bound by the pertinent lambda operator.

Extending this notion of argument position of a lexical item to lexical entries for affixes, it could be shown that characteristic properties of affixation, especially the intricate phenomena of inheritance of argument positions, can be derived from the assumption that affixes provide an argument position which must be satisfied by functional composition rather than functional application. Thus the following entry would combine with a (transitive) verb stem turning it into an adjective

representing a one-place predicate that inherits the argument position of the object of the verb:

(2) /able/; [+V, +N]; λv [POSS [v x]]

(For details see Bierwisch (1989).) A rough generalization emerging from this work is the following: Argument positions that must be saturated by stems, i.e., intralexically, give rise to functional composition, while argument positions that must be saturated by phrasal categories, i.e., extralexically, give rise to functional application. More generally: The canonical way to saturate an argument position is functional composition inside lexical items and functional application otherwise.

Under this perspective, auxiliaries can be construed as types of semi-affixes, that is lexical entries that, although they are not proper affixes, combine with their complement by means of functional composition. This is most obvious for temporal auxiliaries which – in many languages – behave like pseudo-affixes, sharing the property of argument structure inheritance with proper affixes, while exhibiting properties of proper lexical items in other respects. A rough illustration is given in (3):

(3) /will/; [+FIN]; λv [TIME v AFTER TIME u]

where u is a variable indexically specified by the event of utterance.

Based on these considerations, a number of intriguing properties of so-called coherent infinitival constructions of German can be explained as a consequence of the nature of auxiliaries participating in both intra- and extra-lexical processes. The crucial phenomenon is the verb-cluster information as illustrated in the following examples:

- (4) (a) weil er (gesehen werden wollte)
 (because he wanted to be seen)
- (b) weil er ihr nicht (helfen lassen durfte)
 (because he was not allowed to let (someone) help
 her)
- (c) weil er noch nicht (gegessen haben soll)
 (because he is supposed to have not eaten yet)

The verb clusters, marked by parentheses, behave like verbal compounds in a number of respects, while they are transparent to at least one characteristic syntactic process, viz. verb shift, generating the characteristic verb second structure of German main clauses:

- (5) Er soll_i noch nicht (gegessen haben e_i)

The most characteristic properties that verb clusters share with complex lexical items are (a) verb clusters have compound stress, and (b) verb clusters possess a unified argument structure. Both of these properties, from which a number of other can be derived, follow from an analysis that accounts for the semi-affixal nature of verbs forming coherent infinitival constructions. (6)-(8) illustrate the type of lexical entries that account for this quasi-affixal nature of the verbs in question:

(6) /woll/; [+V, -N]; $\lambda v \lambda x [x \text{ INTEND } [v \ x]]$

(7) /soll/; [+V, -N]; $\lambda v \lambda x [z \text{ INTEND } [v \ x]]$

(8) /lass/; [+V, -N]; $\lambda v \lambda x [x \text{ CAUSE } [v \ (y)]]$

The modal verbs *wollen* ('to want') and *sollen* ('should') behave like control- and raising-verbs, respectively, as *wollen* identifies the subject position of its complement with that of the modal verb, while *sollen* turns the embedded subject into that of the modal verb. Semantically, this amounts to the different specification of the "intender", who is identified with the subject of the complement of *wollen*, but left implicit for *sollen*.

While *wollen* and *sollen* relate the subject position of the matrix verb to that of the complement – albeit in different ways – the causative auxiliary introduces a new variable *x* bound by the subject position of the matrix verb. Hence *lassen* ('to let'), but not the modal verbs, will enrich the resulting argument structure. On the other hand, *lassen* may (but need not) absorb the argument position of the complement subject (an option expressed by the parenthesized variable (*y*)). If the option is chosen, the effect is that of a kind of implicit passivization, as illustrated in (9) as opposed to (10):

(9) weil er den Arzt holen ließ
(because he let (someone) call the doctor)

(10) weil er den Arzt kommen ließ
(because he let the doctor come)

The formation of coherent verb structures sketched so far is related to an important morphological condition called Status government by G. Bech. Status government is somewhat analogous to Case government. It consists in the fact that the matrix verb imposes a morphological condition on its complement. Bech proposes three types of Status as illustrated in (11):

(11)	1. Status	2. Status	3. Status
	schlafen	zu schlafen	geschlafen
	(sleep)	(to sleep)	(slept)
	$\begin{bmatrix} -\text{Zu} \\ -\text{Ge} \end{bmatrix}$	$\begin{bmatrix} +\text{Zu} \\ -\text{Ge} \end{bmatrix}$	$\begin{bmatrix} -\text{Zu} \\ +\text{Ge} \end{bmatrix}$

(11) indicates a tentative feature characterization of the three types of non-finite verb forms. These features allow us to capture two interesting generalizations about German infinitival constructions: (1) verbs governing $[-\text{Zu}]$ -complements normally induce coherent constructions. (2) $[\text{+Zu}]$ -complements are the unmarked case of infinitival complements. These generalizations can directly be incorporated into the lexical entries in question: If the argument position to be saturated by an infinitival complement is lexically associated with the feature $[-\text{Zu}]$, the verb behaves as an affixal verb forming verb clusters. Other verbs governing infinitival complements need not be marked for the status they require, but now coherent constructions are exceptional (*scheinen* ('to appear'), *drohen* ('to threaten'), and a few others being cases in point). In general, then, the borderline status of affixal verbs in German can naturally be reduced to morphological idiosyncracies, reflecting the above generalization concerning the range of functional application and functional composition.

2.1.7 Processing of clitics in Italian

Within the Interface Project, G.B. Flores d'Arcais, together with A. Zanetti (U. Pavia), carried out a series of experiments on the recognition of cliticized words in Italian. First, ratings for ease of use of proclitics (e.g., *Lo prendi*, 'you take it/him') vs. enclitics (e.g., *prendilo*, 'you take it/him') showed a strong preference for enclitics. Given the characteristics of the clitics, which have at the same time a syntactic function and a mor-

phological structure, one can make different hypotheses concerning the extent to which clitics are perceptually attached to the host word. A series of experiments tried to determine whether clitics are perceptually more easily detachable from the host word than suffixes of the same form and length. These experiments involved speeded identification of the host word in a cliticized form, and rhyme monitoring of the host word following another word. Clitics seem to behave very similarly to suffixes, when words are presented in isolation, but seem to have a slightly higher autonomy from the host word when presented in sentences.

2.1.8 The representation and processing of idiomatic expressions

Within the Interface Project, Flores d'Arcais continued research on the comprehension and on the semantic interpretation of idiomatic phrases. Together with C. Cacciari (U. Bologna), he has investigated whether there are segmental differences in idiomatic expressions, as compared to the same phrases in a non-idiomatic context, which could signal to the listener the existence of an idiomatic meaning of the phrase. No differences were found in the duration of the phrase when produced in an idiomatic or in a literal sense, nor were there signals of difference in pauses following or preceding the idiomatic phrase as compared to the same phrase used to convey literal meaning.

Another study tried to determine to what extent there might be differences in processing difficulty at the point at which a phrase is uniquely identified as an idiom, which could be called the point of idiom identification. For familiar idiomatic phrases there seems to be no difficulty associated with the comprehension of the idiom, while for unfamiliar ones the

point of idiom identification seems to require some additional effort, as measured by slowing down of the pace of reading in a word by word self-paced reading task.

R. Meyer started his dissertation research on the relationship between the semantic form of novel German nominal compounds and the conceptual structure. Nominal compounds are ambiguous in isolation, with relations possible between the extensions of the constituents of the compound. Furthermore, it is also possible that nouns do not only map onto one extension (or concept) but onto a set of concepts which are related to each other. For example, the novel compound *Stadtbaum* ('town tree') may be a tree located in a town or a tree donated by a town council.

On the other hand, everybody is able to comprehend these highly ambiguous compounds in their special meaning. A formal model will be build up which explains the influence of discourse knowledge and general world knowledge on the interpretation of novel nominal compounds.

2.2 Computational Models of Lexical Representation and Process Project

This project aims at characterizing the structure of the human mental lexicon and the processes that access and exploit the information that it stores. It combines three different approaches: lexical statistics, computational modeling, and psychological experiments. The integration of these three approaches through the systematic confrontation of the respective data sources lies at the heart of the project. Simulation data produced by computational models and experimental results are compared to test the models and generate new experiments. These data interact with the statistical analyses of

the lexicon in similar fashion.

2.2.1 Statistical lexical database research

There is a growing consensus that the recognition of spoken and written words depends both upon properties of the target word (e.g., its length and frequency) and upon similar properties of its lexical competitors. Statistical analyses of large lexical databases provide a major source of information about the nature of the lexical competitor set or the **similarity neighborhoods** of target words and the way in which these neighborhoods vary as a function of specific properties of the target words.

Using the CELEX database, U.H. Frauenfelder, F. Hellwig, W.D. Marslen-Wilson (MRC, Cambridge), G. Peeters, and R. Schreuder (U. Nijmegen) examined the relationship between the frequency of words and two properties of their similarity neighborhoods: **neighborhood density** – the number of neighbors – and **neighborhood frequency** – the frequency of the neighbors. They started with the simple “n-count” definition of similarity neighborhoods: neighbors are all words differing from the target by one letter or phoneme in any position. Their analysis of both English and Dutch phonological and orthographic neighborhoods was conducted on the entire frequency range of target words. Figure X presents the results of this neighborhood analysis for English stem targets four phonemes in length.

PHONOLOGY: ENGLISH STEMS
length 4

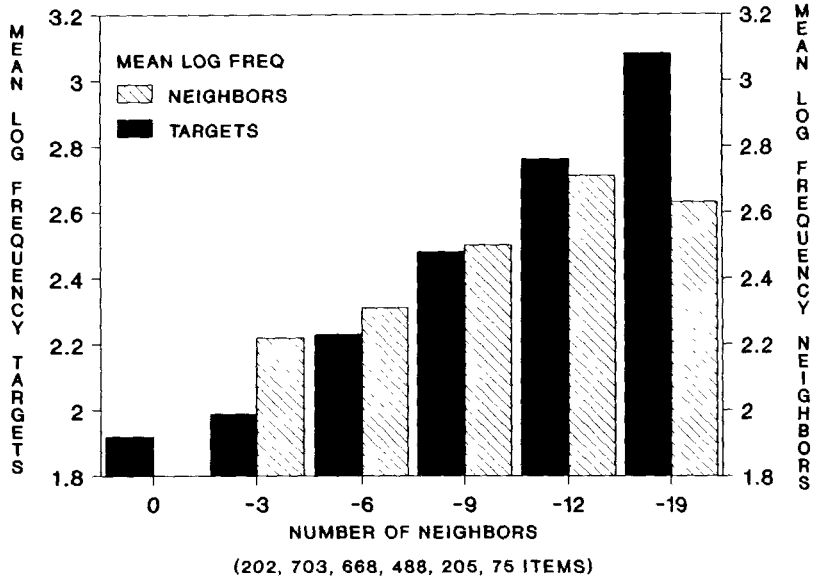


Figure X The mean log frequency of four phoneme English targets and of their neighbors as a function of targets' neighborhood density.

This Figure reveals a regular pattern that is remarkably consistent for English orthographic and phonological targets. As the density of the lexical neighborhood increases, so does the frequency of the targets and that of the neighbors making up that neighborhood. This distributional pattern of words in their neighborhoods was obtained not only for the other word lengths (three to six characters) examined, thereby extending previous results of Landauer and Streeter to a larger cross-section of English words, but also for Dutch phonological and

orthographic forms across the same word lengths.

These results are difficult to reconcile with the existence of word frequency effects. According to most accounts of word recognition, the speed with which a given word can be recognized is a function of how easily it can be discriminated from its neighbors. This discrimination should depend upon the number and frequency of the word's neighbors; the more neighbors and the more frequent these neighbors, the slower and more difficult the recognition process should be. The above analysis of lexical space leads to the incorrect prediction of an inverse frequency effect with easier recognition of low than high frequency words. Further lexical analyses were conducted to better understand this distribution of words in lexical space and to resolve this apparent paradox.

One analysis involved contrasting the phoneme and letter make-up of words and their CV structure as a function of word frequency. The results of the CV structure analysis were informative in that they showed a relationship between the frequency and CV structure of words for some structures. For example, the percentage of words with CVCV phonological structure decreased with increasing word frequency, whereas the opposite was true for CCVC words. This relation between the frequency and CV structure of words provides a partial explanation for the neighborhood frequency result; words with the same CV structure are more likely to be neighbors and to have similar frequencies. The observed pattern of neighborhood density can also be attributed, at least in part, to differences in the CV structure of words. The strength of the phonotactic constraints holding within words depends upon their CV structure. Thus, the inventory of phonemes that can appear in words with CCVC structure – and more specifically in the complex onset – is much more restricted than

that for CVCV words. In general, as the space of phonotactically legal possibilities for a particular CV structure is more restricted, the chances that words with this structure are neighbors increases. This tendency, taken together with the relationship between frequency and CV structure, partially accounts for the neighborhood density results. Further analyses are in progress to determine quantitatively how CV structure and segmental make-up of words contribute in determining the neighborhood density and frequency and to assess the generality of this contribution across word length, modality and language.

The above analyses were based upon a simple *n*-count definition of lexical neighborhoods which suffers from several defects, especially for the analysis of phonological neighborhoods. Further analyses of the CELEX database currently in progress have begun to examine alternative characterizations of lexical neighborhoods which assume a sequential or cohort-like definition of neighbors and which take the confusability of letters or phonemes into account.

2.2.2 Computational modeling

Frauenfelder and Peeters continued their computational modeling of word recognition. One major objective was to relate simulation data to the findings about lexical density and lexical space. In a series of simulations using the interactive activation model, TRACE (McClelland and Elman, 1986), they focussed upon the influence of lexical neighbors upon the recognition of spoken target words. This research involved relating the moment at which TRACE recognized a set of words to diverse characterizations of the lexical competitor set of these words. A good fit ($\text{RMSD} = 2.96$ for an average recognition point of 57.44 processing cycles) was obtained be-

tween the simulated recognition durations and the predicted recognition points based upon the position of the uniqueness point (UP), the point at which a given target word becomes unique in its beginning with respect to all the other words in the lexicon. An even better fit ($\text{RMSD} = 2.33$) was found for other lexical measures which reflected not only when the competitor set became empty (i.e., the UP), but also how the size of this set evolved across time. Figure Y shows this fit – obtained using the STEPIT parameter fitting program.

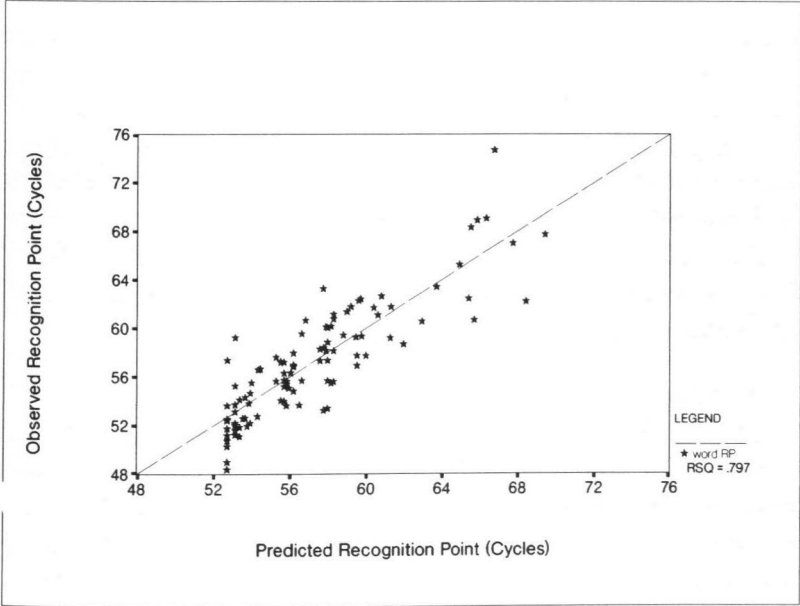


Figure Y The fit between simulated recognition point and predicted recognition point based upon log cohort size.

Peeters finished his MA thesis in which he investigated some other aspects of the word recognition behavior of the TRACE model. He showed that several predictions of the model were not confirmed by human performance data; in particular, TRACE incorrectly produced large and early top-down lexical effects upon the recognition of word and non-word initial phonemes as well as lexically mediated inhibition (word-to-phoneme excitation and phoneme-to-phoneme inhibition). Peeters also began work on his dissertation by comparing different types of representations found in connectionist networks. An important aim of this work was to discover ways of expressing phonological similarity in the shape of words using a network representation of the lexicon. In some preliminary simulations, the feasibility of using tensor products was explored. Furthermore, Peeters examined additional ways of representing time since sequentiality constitutes one of the major challenges in spoken word recognition research. Using the Rochester Connectionist Simulator, he has begun to test recurrent connections in back propagation networks.

During his two week stay at the Institute, D. Massaro (U. California, Santa Cruz) presented his research testing between process and connectionist models of speech perception and reading. The tests centered around the integration of bottom-up and top-down information. He described how one could test connectionist models against actual results, rather than simply simulating them. Massaro also introduced the STEPIT program that carries out parameter estimation in the tests of models against data.

2.2.3 Psychological experiments

Together with Schreuder and M. Fleischeuers (U. Nijmegen), Frauenfelder began evaluating different definitions of lexical space empirically to determine how neighborhood density and frequency influence word recognition. The experimental literature shows a surprising lack of a consensus concerning the nature (facilitatory or inhibitory) of this influence. The experiments compared subjects' recognition performance on written words occupying different lexical neighborhoods using the lexical decision and progressive demasking tasks. The Dutch stimuli were selected with the CELEX database such that the low frequency targets had varying numbers of higher frequency neighbors and the high frequency targets had varying number of lower frequency neighbors. Preliminary lexical decision results for the low frequency targets point to facilitatory effects of neighbors with faster RTs to words with more neighbors. Research in progress involves replicating these experiments with even tighter control over bigram frequency and with more refined definitions of lexical space that take into consideration letter confusion data. This research has been coordinated with that conducted in France by J. Segui and J. Grainger (CNRS, Paris).

2.3 Phonological Theory

The organization of features has always been of special interest in phonological theory. One controversy in feature theory concerns classifying consonants and vowels by a single set of features. In one approach, the vowel features are subsumed under tongue body features along with the consonants articulated by the back of the tongue. An alternative view argues that consonants and vowels are represented by a unified set

of features. The latter approach has been advocated by A. Lahiri in earlier research with particular reference to the feature 'coronal'. In recent research Lahiri and V. Evers have proposed an account of various palatalization processes which makes crucial reference to a unitary set of features for consonants and vowels, where the primary place features are dominated by an articulator node while the traditional vowel height features are dominated by a separate node. Such a representation easily captures the natural grouping of the familiar coronal segments like dental, alveolar and palatoalveolar consonants with the front vowels and the palatal glide [j]. This allows for a coherent account of palatalizations which lead to major place changes as well as those which add a secondary palatal articulation.

2.4 Acoustic/Phonetic Analyses

A. Jongman and J.A. Sereno, in collaboration with M. Fourakis (Central Institute for the Deaf, St. Louis), investigated the vowel spaces of Greek and German, and the distribution of common vowels across these languages as a function of vowel density. Greek has a simple five-vowel inventory (the most common inventory among the world's languages) while German has a complex 15-vowel inventory, with both tense and lax, and rounded and unrounded vowels.

Measurements of the fundamental frequency and the first three formants were made for each vowel token. These measurements were then transformed into log frequency ratios to yield the coordinates x ($\log (F_3/F_2)$), y ($\log (F_1/SR)$), and z ($\log (F_2/F_1)$), where SR is a reference frequency which is shifted slightly by the average spectrum of the current speaker. In this way, each vowel token could be plotted as a point in a

three-dimensional auditory-perceptual space. Each vowel token was thus represented by one point and points corresponding to each vowel category were enclosed in three-dimensional target zones.

All Greek data points could be enclosed by distinct, non-overlapping zones, leaving much space unoccupied. The German vowel space obviously was much more crowded but the present approach yielded good separation along the front-back and tense-lax dimensions. In addition, by taking a third dimension (F3) into account as an independent dimension, the overlap traditionally found between front rounded and front unrounded vowels was substantially reduced.

Moreover, the auditory-perceptual space (APS) affords a way to represent and compare the vowels of all languages in a vowel space that is defined independently of vowel inventory. As an example, the three vowels common to Greek, German, and American English ([i, a, u]) were plotted in APS. These common vowels occupied similar regions in APS, but their location did vary as a function of the vowel inventory of each individual language. In general, it seems that the larger the vowel inventory, the more peripheral the location of the extreme vowels as compared to vowels of languages with smaller inventories. This approach may thus provide insights not only into the language-specific organization of vowel systems, but also into cross-language comparisons.

2.5 Temporal Aspects of Syntactic Processing

J. Bayer has pursued research on the processing of German clauses which consist of subject, object and verb. Previous research, in collaboration with W.D. Marslen-Wilson (MRC,

Cambridge) has investigated SOV-clauses, i.e., embedded constructions such as

(1) ...(COMP) NP1 NP2 V AUX # ...

The goal was to find out at which point in time the processor makes decisions about the status of the NPs involved. German allows not only for the unmarked subject/object order, but also for the marked object/subject order. The finding of the Bayer and Marslen-Wilson study was largely that irrespective of the presence of a context that invites an OSV-interpretation, speakers of German tend to have problems deriving such an interpretation. This showed up both in reading time delays and in SOV-interpretations that go against pragmatic plausibility.

The present study investigated the same materials on the basis of verb-second clauses, i.e., the German format for main clauses. In this condition, (1) changes into:

(2) ...# NP1 AUX NP2 V # ...

The essential syntactic difference between embedded OSV-sentences (i.e., type (1)) and main clause OVS-sentences (i.e., type (2)) is that the former requires an operation of so-called “scrambling”, while the latter requires a form of “variable binding”. The result of the new study is that speakers are much more able to parse a main clause with marked ($O < S$) order than a corresponding embedded clause. The time course of parsing (reading frame by frame) a clause in OVS-order is significantly more delayed after encountering the second NP (NP2 of (2)). This can be interpreted as a response to the complexity that arises from binding a gap (an empty element) in the underlying position of the object-NP.

2.6 Semantic Activation During Recognition of Chinese Characters

During 1989 G.B. Flores d'Arcais continued his project on the recognition of complex Chinese characters in Chinese and Japanese, with a series of experiments carried out in Peking and Nagoya in Japan. The results of a series of experiments on semantic categorization, in which subjects have to decide whether two characters refer to concepts sharing the same category or being semantically related have shown that during recognition of a complex character, which includes as an opaque component a character not related in meaning to the meaning of the whole character, the opaque component is to some extent activated. Thus, for example, the complex character STONE contains as a component the character MOUTH, which is not related in meaning to STONE. The experiments have shown clearly that during recognition of STONE also the meaning of MOUTH is automatically available and produces interference effects in the semantic categorization task: when a Japanese or a Chinese reader is presented with the pair STONE and EYE, for which the correct semantic categorization response is NO, the presence of the opaque component MOUTH in STONE seems to produce interference – the activation of the opaque component MOUTH induces a tendency to answer YES, and this results in longer latencies and a larger number of error responses.

Chinese characters are written with a very rigorous order of strokes, which Japanese and Chinese children learn through long practice. Flores d'Arcais has proposed that this order is encoded in semantic memory as important information and can be used in retrieval of the characters. This hypothesis has been tested in a series of experiments in which “early” or

“late” strokes of a complex character were given as primes in a part-whole paradigm (the reader is first presented with a fragment of a character, which could be an early or a late stroke, and some 60 or 80 msec later the character is completed, and the reader has to name the character as fast as possible). The results so far have given support to the hypothesis.

A third series of experiments was concerned with the time course of the activation process of the figural and semantic information available in the characters during the process of recognition. The paradigm used involved again a part-whole priming technique. The results showed early contribution of the figural elements (every component or fragment of a character affects recognition at about 60 or 80 msec SOA between fragment and whole character) and a later contribution of semantic information (at about 180 msec SOA a character which is a component of a complex character facilitates recognition of a semantically related one but makes more difficult the recognition of a semantically unrelated one).

2.7 Inferential Processes in Text Comprehension

W. Vonk, together with L.G.M. Noordman (U. Tilburg) and W.H.G. Simons (U. Nijmegen), continued research on the question to what extent inference processes during reading depend on readers' knowledge of the topic of the text. On the basis of several elicitation and verification experiments, the knowledge representations of experts and novices in the domain of economics was described (see Annual Report, 1988). Texts were constructed on the basis of the expert knowledge structures. Novices do know the concepts mentioned in the texts, but they don't have available the (causal) links between the concepts.

These texts contained a target-sentence of the form "Y is the case, because X leads to Z", e.g., *The American export has been suffering a decline in the last few months, because the rising inflation has produced a harmful effect on the competitive position of the U.S.A.* in a text about trade gaps. The conjunction *because* in these sentences was intended to be an explicit signal to make an inference. On the basis of the target sentence one can infer a statement of the form "Z leads to Y", e.g., *An impaired competitive position leads to a decline in export*, or the less specific "Z influences Y", e.g., *Generally speaking the competitive position of a country has a strong influence on the volume of its export*. The latter kind of inference was in one condition explicitly stated in the text before the target sentence, and in the other condition it was not.

The reading time of the target sentences appeared to be shorter in the explicit condition than in the implicit condition for the expert readers, but there was no difference between conditions for the non-experts. Together with results on reaction times for the verification of the explicit information this outcome is interpreted to indicate that experts do make this kind of inference during reading, while non-experts do not. The results support the hypothesis that knowledge is controlling on-line inference processes.

A more specific question is whether the knowledge of the expert-readers is indeed activated at the moment that the inference can be made. Experiments are in progress to investigate this issue.

2.8 Topic-Structure Markers in Discourse Processing

In a project on the function of topic-markers in the comprehension of text W. Vonk, together with L.G.M. Hustinx (U. Nijmegen), investigated the effect of the specificity of anaphoric devices. It was investigated whether, if a referring expression is more specific than what one would expect on the basis of an unambiguous identification of a referent, the anaphoric expression functions as a marker in constructing the topic-structure representation of the text. In previously conducted production experiments it was established that an overspecifying referring expression (e.g., a proper name instead of a pronoun) is used to indicate a topic shift.

The assumption is that when a new topic is introduced, the representation of the information of the preceding sentences becomes less available than when the same topic was continued. In the first case the information in the new sentence has to be integrated with information at a far distance, in the latter case with information of the preceding sentence(s). The hypothesis is that the overspecifying anaphor not only identifies the referent, but also indicates the start of another topic by locating the point in the preceding discourse to hook the new information to.

Expository texts were constructed that consisted of several topics, but concerned one single protagonist, in order that no ambiguity could arise even if a non-specific device, such as a pronoun, was used. At a particular place in the text the next sentence introduced a new topic or continued on the same topic. Referring expressions, that differed in specificity, were used in these sentences to refer to the protagonist: a proper name plus apposition or a pronoun.

Results from a recognition experiment showed that the recognition time for a word from a previous sentence was longer when the sentence introduced a new topic than when the sentence continued on the same topic. When, in case of no topic change, a proper name is used to refer to the protagonist, the recognition time of the word from the previous sentence was longer than when a pronoun is used, just as was the case – both for proper name and pronoun – after a topic change. This decrease of availability was measured at the end of the sentence containing the anaphoric device, but also in the beginning of the sentence, right after the anaphor. The results indicate that the specificity of referring has a function in constructing the topic structure in text understanding.

2.9 Psychophysiology of Language Comprehension

C.M. Brown and P. Hagoort wrote three grant proposals to acquire funds that would enable continuing the event related potential (ERP) research they began in 1987. The two following three-year research proposals were submitted to the Dutch Science Foundation (NWO): “Electrophysiological correlates of semantic processing” (submitted by R. Schreuder), and “Using ERPs in search of the functional locus of comprehension deficits in aphasia” (submitted by W.J.M. Levelt). The third three-year research proposal (“A neurocognitive approach to normal and disordered language comprehension: Brain potentials related to syntactic and semantic processing”) was submitted to the Volkswagen-Stiftung by Brown, Hagoort and Levelt. All three research grants were awarded. The three research projects are headed by Brown and Hagoort, and will start on June 1st, 1990. Together they form the nucleus for

the coming three years of the Institute's project "Psychophysiology of Language Processing". The three research grants provide funds for 5 full-time research positions, and one half-time position for a programmer.

In addition, Brown and Hagoort continued their research on the sensitivity of the N400 to masked priming (see Annual Report, 1988). They replicated their previous results indicating that the N400 does not reflect automatic lexical access, but is sensitive to post-lexical semantic processing. These results were presented at EPIC IX, Noordwijk, The Netherlands, 1989.

A short visit by H. Neville (Salk Institute, San Diego) was instrumental in the planning of further research on ERPs and visual masked priming. Extensive exchange of ideas has continued with M. Kutas (U. California, San Diego), who will be on the board of scientific advisers of the ERP-project, together with L. Frazier (U. Massachusetts, Amherst) and D. Ploog (former director of the MPI für Psychiatrie, München).

2.10 Morphological and Syllabic Structure

P. Zwitserlood, in collaboration with E. Drews (Philipps U., Marburg), continued work on the effects of syllabic and morphological structure during word processing. Two monitoring experiments were prepared, one in Dutch and one in German, to address the following issues. Data from experiments in the visual domain in German (Drews, 1989) show that for inflected verb forms, stem morphemes are a more suitable access unit than first syllables. In contrast, results from Dutch using the same experimental technique (Schreuder et al., 1989) suggest that morphological structure does not guide lexical access. Experiments in Dutch and German, with the same conditions and

comparable materials, will clarify whether language-specific structures are responsible for these conflicting results.

A second issue concerns the processing of separable complex verbs in Dutch and German, consisting of a verb stem and a separable particle. Semantically, these verbs fall into two categories: compositional verbs, whose meaning is derived from the combined meaning of verb stem plus particle (*opvangen*, *auffangen*, 'to catch'), and non-compositional verbs, where there is no relationship between the meaning of the complex verb and its component parts (*aanvangen*, *anfangen*, 'to begin'). A similar distinction can be made with respect to nominal compounds, where the first component either specifies the meaning of the second (*Gästezimmer*, 'guest room'), or where this is not the case (*Frauenzimmer*, 'woman'). Using a priming paradigm, the following questions will be tested. Does the verb stem prime both types of separable complex verbs, or is priming obtained only for compositional verbs? With nominal compounds, does the second component prime both semantically distinct types of compound? Moreover, the separable complex verbs will be used in a crossmodal priming experiment with verbs embedded in sentence contexts, where the verb stem will be heard earlier in the sentence than the particle. The question here is whether the compositional and the non-compositional meanings are both activated upon hearing the verb stem, and whether contextual information influences the pattern of activation. The results from these experiments will become available in the course of 1990.

2.11 Guest Research

M. de Vega (U. de la Laguna, Tenerife) explored the time course of mental model building and updating during text

reading. In an experiment conducted in the University of La Laguna (Spain) de Vega and J. Diaz showed that the reading times for for-sentence texts increased when the first sentence involved an scenario-inducing word (e.g., *He sat in the pilot seat comfortably*) as compared with a non-inducing word (e.g., *he sat in the main seat comfortably*). The reading time increased not only for the first sentence but also for the next two filler sentences suggesting that both the foundation of a scenario and the integration of new elements to it are resource demanding activities. Furthermore, the fast reading under the non-inducing condition suggests that readers do not try to elaborate any scenario on-line but use a strategy of wait-and-see. Some new studies were designed by de Vega during his stay at the Institute in order to analyze whether the latter strategy is a task demand feature or a general trend in reading text segments with indeterminate referents.

C. Gussenhoven (U. Nijmegen) investigated the relationship between argument structure and intonation. Two direct connections of this kind were found where accentuation is concerned. First, strings of words like *New York to Boston* form single phonological phrases when they instantiate a single argument (*He flew from NEW York to BOSon*), but separate phonological phrases when spread over two arguments (*He awarded New YORK to BOSon*), where the operation of the phonological rhythm rule is taken as criterial for the phonological phrase. Second, the well-known pattern of unaccented predicate plus accented argument (*The QUEEN has abdicated* etc.) was seen to hold for embedded sentential arguments and their (higher) predicates in a wide variety of constructions. A report is forthcoming.

Dutch clitic formation was studied from the point of L. Selkirk's edge-based theory of prosodification. This research,

which is carried out in collaboration with A. Lahiri, is still in progress, but would so far appear to confirm the edge-based theory.

C. Cacciari (U. Bologna, Italy) has been investigating the processing and interpretative processes underlying idiom comprehension (Cacciari & Tabossi, 1988; Cacciari, 1989; Cacciari & Glucksberg, in press). Idioms pose several interesting questions concerning how people comprehend them, e.g., how we pass from the literal meaning assigned to constituents to the phrasal interpretation of the string, as an idiom and what is the interplay between these two 'levels'. Several cues seem to operate in spoken language as to allow or facilitate the recognition of what is heard as an idiom. One of these, according to a current hypothesis, is connected with some acoustic/phonetic properties differentiating idioms from literal sentences, e.g., their durations, pausing, melting of constituents. If this information is available, it should be explored by the listener as a cue to understanding. It is likely that this information is functionally more useful when other cues are absent or less available. Thus it can be assumed that (1) Prosodic cues will be more effective for the listener with a) unfamiliar idioms, b) when idioms are presented in a neutral context. (2) The point of idiom recognition should be modified by the manipulation of acoustic/phonetic cues. Cacciari and G.B. Flores d'Arcais planned a set of experiments in order to investigate the role of these factors in idiom recognition. It is part of a more general research project aiming at investigating the psycholinguistic properties differentiating figurative language from literal language.

J. Kornfilt (Syracuse U., N.Y.), in collaboration with U.H. Frauenfelder, prepared word phrase lists, made recordings and

transcriptions for future comprehension experiments, to be carried out in further collaboration with J. Hankamer (U. California, Santa Cruz) and S. Özsoy (Bogaziçi U., Istanbul, Turkey). One aim of the research is to find out whether native speakers parse morphologically complex words as unanalyzed units or according to sub-word morphemes. In order to test this question, minimal pairs have been prepared consisting of complex words, whereby one member of the pair has an existing stem, the other a phonologically well-formed but "non-sense" stem. Suffixation was kept constant. The recordings were analyzed and will be used for comprehension experiments which will take place in late Spring 1990 at Bogazici University.

Further questions that will be investigated (and for which preliminary recordings have been made) are: perception of violations of morpheme orders, phonological rules, and Case assignment by verbs and postpositions to their objects.

H. Günther (U. München) pursued his research on oblique word forms and morphological complexity in German. In a visual lexical decision task using German verb forms, he introduced 5 variables: (1) syntactic prime vs. neutral prime, (2) SOA 500, 200, 0, -100 between prime and target, (3) base form (infinitive) vs. oblique form (3.ps.sg. present or past tense), (4) weak vs. irregular verbs, (5) high vs. low frequency. Results show that a small but highly significant effect of syntactic priming is found; however, it shows up only with SOAs 500 and 200. In these two conditions, no interaction with any of the remaining variables (3-5) is observed. This is seen as evidence for two independent processes in lexical decision, one establishing the syntactic form of the item processed, the other determining its lexical identity. On the other hand, the lexical factors regularity and frequency interact both with word

form; i.e., regular high frequency base forms of verbs are processed faster than low frequency irregular past tense oblique forms, with several other combinations in between. This is taken as further evidence supporting the word and paradigm model proposed by Günther 1988.

L. Frazier (U. Massachusetts, Amherst) continued work with Flores d'Arcais examining the appropriateness of various syntactic theories in contributing to an adequate definition of the processing complexity of sentences containing filler-gap dependencies. In conjunction with J. Henstra, Frazier and Flores d'Arcais also begun a new series of experiments on processing pronouns in Dutch. The main emphasis of this work is to distinguish representations of the referent of antecedents from linguistic representations of antecedents (e.g., the phrase used to introduce the antecedent in the discourse).

Frazier also served as an outside consultant on the evoked potentials project of C.M. Brown and P. Hagoort.

3. Language Acquisition

The main research interests of the acquisition group remain the acquisition of syntactic structure, viewed from a sentential and discourse perspective, and the acquisition and expression of spatial and temporal concepts. Within these areas, the acquisition of many (first and second) languages are investigated in an attempt to distinguish phenomena specific to one target language from more generalizable phenomena in the acquisition process.

3.1 The Acquisition of Syntax and Morphology

3.1.1 Cross-linguistic studies in developing syntax: French, German, Hebrew comparison

J. Weissenborn, in collaboration with R. Berman (Tel Aviv U.) and the assistance of M. Verrips, D. Adone-Resch and J. Guichard continued his studies on early syntactic development in French, German and Hebrew. This research is supported by grants from the German-Israeli Foundation for Scientific Research and Development (GIF) and the Deutsche Forschungsgemeinschaft (DFG). The work based on longitudinal and experimental data focussed on the development of functional categories, mainly complementisers (COMP), and auxiliaries (INFL) and specifically their relation to the development of the syntax of subjects, verbs, questions, topicalization, and embedded clauses. So far the findings indicate that contrary to

the development of English there seems to be no clear stage in the development of French or German where verbal elements are present but functional categories are absent. This leads to the conclusion that early child language is more differentiated as assumed hitherto in terms of syntactic structure as determined by X-bar theory and the principles and operations that are defined on these structures like the constraints on empty categories and movement. Additional support for this claim comes from the observation that there are syntactic domains like embedded finite clauses that show much less non-adultlike variation than matrix clauses thus indicating the availability of particular constraints.

The study of negation in the three languages yields further evidence for the structural principles underlying early child language and the learning mechanisms determining its development. This study is based on an assumption of current linguistic and acquisition theories, namely that certain categories (determiners, negation) occupy a fixed syntactic position. Thus, their position relative to other elements shows whether or not those elements move. In French and German main clauses, the position of negation correlates with verb finiteness: [NEG] [-fin] vs. [+fin] [NEG]. All verbs are base-generated in [-fin] position; [+fin] verbs move leftwards over NEG. Strikingly, children's data basically follow this pattern from the moment NEG and verbs cooccur, i.e. starting as early as 18 months. The conclusion is that children, too, have finiteness based verb movement and the functional category required by it, INFL. These findings contradict several claims. First, mastery of the finiteness distinction and consistent verb movement cannot, as has been claimed, depend on the child's prior mastery of subject-verb agreement since subject-verb agreement emerges only later. Further, parameter-setting and

maturation accounts depend, partly, on early unfilled INFL to explain incorrect null subjects in languages like German and French. The present finding that verbs are already moved into INFL when subjects are still missing in these languages challenges certain assumptions of these theories. The conclusion that adult-like verb movement and finiteness are available early supports a “strong continuity” view of acquisition for French and German, and raises the question of how to account for cross-linguistic differences like the one with English where functional categories like INFL develop relatively late.

3.1.2 Word order development in Dutch

In his research on the acquisition of verb placement, P. Jordens (Free U., Amsterdam) continued his investigation of the acquisition of verb fronting in L1 Dutch. Acquisition of verb fronting means that verb forms can occur in first/second and in final position. In order to investigate the acquisition of verb fronting a corpus of utterances of a Dutch girl was studied at two points in time, i.e., when she was 2 and 2,5 years of age. The analysis of the data showed that the acquisition of verb fronting is not a sudden process at all. For a rather long period of time there is a distributional, lexically-learned difference between a small class of verbal elements in first/second position (e.g., *lus(t)* ‘like, likes’; *lukt* ‘works’; *hoort* ‘belongs’; *heet* ‘is called’; *past* ‘fits’; *val(t)* ‘fall(s)’; *schrik(t)* ‘startle(s)’; *staat* ‘stands’; *zit* ‘sits’; *vangt* ‘catches’; *drink* ‘drink’; *pak* ‘get’) versus a large class of verbal elements in final position. There is minimal overlap between the verb forms used in both positions. Verb fronting is discovered after the acquisition of modals and auxiliaries. However, as opposed to the acquisition of modals and auxiliaries, the acquisition of verb fronting is a rather slow developmental process. For a long time the

child is using two structures that are typically used as substitutes for verb fronting: *doe(t)* ('do(es)') + Vnf and *gaat* ('goes') + Vnf. It is hypothesized that the child uses *doet* and *gaat* as an analytic means of expressing finiteness. The slow nature of the acquisition of verb fronting is due to the problem that children initially have in using one verb form that has the meaning of the main verb and the feature 'finite'.

3.1.3 Utterance structure in second language acquisition

Continuing his work on utterance structure in adult learner varieties, C. Perdue further investigated the interaction of two types of factors determining acquisition: Source language (SL) influence, and the communicative potential and limitations at any given time of a learner variety in use ("use" factors). This work arises out of the "Utterance Structure" study of the ESF project: For details see Annual Report 1987. The corpus consisted of retellings of a film, repeated three times at approximately ten months' intervals, by a total of twenty learners of target languages (TLs) Dutch, English, French and German. An additional study had the aim of evaluating the developmental sequence for the expression of third person anaphor obtained from the film retelling task (Annual Report, 1987), by comparison with another text type – spontaneous conversation.

After the first stages of acquisition, almost all learners achieved an initial systematicity, or "basic learner variety" (Klein & Perdue, 1989, see publication list) containing a basic pattern referred to as A:

A. NP – V – (NP)

Two infrequent patterns were also attested: V – NP, a pattern for one-argument verbs in contexts described in the 1987 Annual Report, and a second pattern (pattern B for ease of reference):

B. NP – NP – V

which was only developed by Turkish learners of Dutch and Punjabi learners of English (with a variant B' developed by Spanish-speaking learners of French, as set out below). Analysis concentrated on the longitudinal distribution of B, and the relation of this distribution to that of A.

At first blush, the appearance, non-appearance and disappearance of B can be explained by an appeal to the source language expectations of the learners providing a more or less successful analysis of the TL input. For Turks and Moroccans learning Dutch: the standard classification of Turkish as verb-final, and of Moroccan as verb-second, would account for the fact that Turkish learners of Dutch use B very frequently at the outset, whereas A dominates in the production of Moroccan learners. For Italians and Punjabis learning English; although Italian has a variant:

B' NP – oblique pronoun – V

which is formally similar to pattern B above, with the restriction that the immediately pre-verbal referring expression must be a clitic pronoun, Italian is usually said to be verb-second, and B is totally absent from the Italian learners' production. On the other hand, B is attested early, if infrequently, in the production of Punjabi learners, whose SL is verb final. B can be said to be an initial hypothesis, which is partly confirmed in TL Dutch input where the non-finite verb is final, so B

is maintained, co-existing with A in the production of Turkish learners. B is however not confirmed in input from TL English; its existence is ephemeral, as the Punjabi learners rapidly adopt A.

However, SL influence does not explain why both A and B co-exist for a time in the production of Turkish and Punjabi learners. It seems that in these initial stages of acquisition, the learners have not yet developed systematic use of determiners: in connected narrative discourse, specific reference is achieved by use of a bare noun – N – whose value is ‘definite’ in pre-verbal context, and ‘indefinite’ in post-verbal context. Thus A and B can be used to provide a functional contrast, as in the following minimal pair produced by one Punjabi learner of English, where a referent *a loaf of bread* is introduced in A, while reference is maintained to the loaf of bread in B:

A. girl stealing bread

B. girl bread stealing

The disappearance of B from Punjabi learner production can thereafter be related to the development of definite and indefinite article use. For Turkish learners of Dutch, the initial use of A and B has been attributed by Jordens (this year’s Annual Report) to their use of a finite verb in A, and a non-finite verb in B. Given the data examined here, an alternative hypothesis to be explored would be that the development of finite and non-finite verb components in the pattern:

NP – V_{fin} – NP – V_{inf}

(see Annual Report, 1987) occurs once the position of an NP is less crucial for signalling its referential status, i.e., once explicit determiners are available.

The second study analysed the conversations of one Spanish-speaking learner, recorded at approximately four-month intervals from her 6th to her 24th month of residence in France.

The generalisations for third person anaphor from the film-retelling task are repeated here: (i) definitely referring N or Det+N are used earlier than overt pronouns; (ii) nominative pronouns appear earlier than oblique pronouns; (iii) singular anaphoric pronoun reference appears earlier than plural; (iv) human appears earlier than inanimate.

In this learner's spontaneous production, the nominative forms [il], [el] were used from the outset for singular human referents (gender agreement was not TL-like); in all other respects, she followed the above sequence. As with other informants, the development of the nominative/oblique distinction for pronouns could be attributed to this learner's attempts to maintain reference in the 'Topik' component of her utterances (see Klein & v. Stutterheim, Annual Report, 1986) while at the same time signalling a discontinuity in the semantic roles of NPs denoting the same referent across utterances. The pattern that she acquired containing an oblique pronoun:

B' NP – oblique pronoun – V

(for example, *monsieur la regarde*, 'monsieur her look-at') is shared by SL-Spanish and TL-French. But it is a relatively late development; reference is maintained prior to this development by a definite post-verbal NP in pattern A.

Putting these two studies together, it can be seen that the interaction of SL and 'use' factors is complex. If B/B' can be said to represent a potential hypothesis from the SL with a subjective confirmation 'success' potential in the TL (i.e., a pattern that can become 'critical' in Klein's sense, see Annual Report, 1983), then it is applied early and successfully by

Turkish learners of Dutch, early and unsuccessfully by Punjabi learners of English, late and successfully by Hispanic learners of French (in accordance with other studies), and not applied by Italian learners of English. However, B/B' occurs in similar contexts of use in the productions of those learners who do use it, i.e., in contexts of referential continuity with the immediately pre-verbal expression being reference-maintaining. The use of this pattern in this context depends on the availability or unavailability of other means to fulfill this referential function at any given time.

3.1.4 Verb-argument structure

J.H. Randall (Northeastern U., Boston) in collaboration with M. Bowerman, continued her work on the acquisition of verb-argument structure. In earlier work on the question of retreat from overgeneralizations, Randall developed a theory of how an overgeneral English dative rule, leading to sentences like **He reported the police the accident*, could be inhibited, based on the interaction of two elements: a principle of grammar and positive data (see Annual Report, 1987). Now, a schematic analysis reveals that the principle resembles a Catapult (Figure 1): if A then not B. A are incoming data; B are overgeneralizations. When A is found to be true, B is abandoned.



Under this theory, since many principles of grammar take the shape of a Catapult, any of them is a potential grammar-

based tool for rescuing the learner from errors. The Attachment Principle, for example, will allow the learner to retreat from a common error (often cited by Bowerman and others), of misclassifying an adjunct as an argument and then allowing argument alternations to apply to it.

The Attachment Principle: If a constituent X is separated from its head, H, by an optional adjunct, Y, then X is not an argument.

Input data of the form H Y X will lead the child to reanalyze X as an adjunct and the errors will cease. The Catapult Hypothesis puts this logic forward as a general mechanism for retreat, whereby principles of the adult grammar are used by the learner in acquisition, eliminating the need for additional, separate learning strategies. In addition, the Catapult Hypothesis makes empirical predictions about how erroneous verb argument structures could be unlearned. Research to test these predictions has begun.

A puzzle in many retreat accounts is how learners manage to contain their reanalyses to incorrectly analyzed elements only. Overly large changes would require certain items to be changed back, but again the question is, which ones? To avoid a **Pendulum Problem**, at each grammar-changing point principles must tell learners how large their revisions should be. Again, a hypothesis draws on the adult grammar. **The Domain Condition** uses the modularity of the grammar's distinct lexical and syntactic domains to determine the size of a change. Revision in the lexical domain must apply to specific lexical items; revision in the syntax across categories. The Pendulum Problem will be avoided.

3.1.5 The acquisition of Spanish “se”

V.C. Gathercole (U. Florida), in collaboration with M. Bowerman, studied the acquisition of *se* by Spanish-speaking children. *Se* is a multifunctional form that is used as a reflexive, as a reciprocal, as a middle, as a passive, as an impersonal, and as a “spurious dative” marker, and as a form linked lexically with particular verbs. Elicited production and comprehension data that had previously been collected in Spain (under a Spain Research Fellowship, Council for the International Exchange of Scholars) were analyzed. Subjects were native Spanish speakers between the ages of 3,5 and 12. Data were examined both in the light of Karmiloff-Smith’s theory regarding the acquisition of multi-functional words and for their relevance to a Binding Theory approach to the acquisition of the reflexive uses of *se*. Results are still in the process of being analyzed. However, they suggest that children enjoy an early facility with most uses of *se*, especially in its reflexive and lexical uses, although there may be some early confusion of *se* with the indirect object clitic *le*. Results so far also appear consistent with the developmental patterns hypothesized by Karmiloff-Smith for the acquisition of multi-functional forms, yet they admit of alternative explanations. In addition, the differential facility with reflexive vs. reciprocal *se* and the facility with both anaphoric and non-anaphoric uses of *se* pose problems for a BT approach to the acquisition of *se*.

3.1.6 The acquisition of German noun declension

P. Indefrey began his dissertation research on the acquisition of German noun declension classes. Besides initial search through existing data corpora the study will mainly rely on experiments eliciting productive use of inflected nouns. While

it is known that children by age 3 make use of natural gender and phonological cues (i.e., word-final Schwa) to assign grammatical gender it is not known whether these cues (or other cues such as grammatical gender) are also used for the classification of 'strong' declension (*Mann*, 'man') vs. 'weak' declension (*Junge*, 'boy') nouns. One purpose of the study will be to determine whether a 'competition' approach (Bates and MacWhinney) or a rule-based approach is more appropriate to account for the acquisition of the competence to assign declension class membership of nouns.

3.2 The Reference Project: The Expression of Space and Time

3.2.1 Space

Cross-linguistic studies of the acquisition of spatial categories.

M. Bowerman has continued her cross-linguistic research on the acquisition of spatial categories in first language development. This research investigates the structure and origin of the semantic categories children initially identify with the spatial morphemes of their language, exploring (1) the relative influence of nonlinguistic cognitive development vs. experience with the categories of the input language, and (2) the process by which language-specific categorization principles are discovered.

The main focus in 1989 was the extension of work begun in 1988 with S. Choi (San Diego State U.) comparing the spatial semantic systems of English and Korean, and investigating how children acquiring these languages initially express spatial relationships. Earlier (see Annual Report, 1988), Bowerman and Choi examined the semantic categories asso-

ciated with words for spatial manipulations of objects, such as (in English) (*put*) *in/on/together*, *take out/off/apart*, and *open/close*, which are classified according to strikingly different semantic principles in the two languages. Counter to the prevalent assumption that spatial terms and other words are initially used in accordance with nonlinguistic, presumably universal concepts established during the sensorimotor period of development (e.g., possibly “containment” for *in*), Bowerman and Choi found that young English- and Korean-speaking children extend spatial words to familiar and novel situations on the basis of profoundly different and language-specific spatial categories by at least as early as 20 months, the youngest age for which spontaneous speech data in Korean were available. In 1989 this research was extended in three ways.

a. First, longitudinal spontaneous speech samples were collected from several younger Korean children (from 15 months), and their utterances expressing spatial meanings were compared with those from similar-age English-speaking children in an effort to pinpoint the onset of sensitivity to language-specific principles of semantic categorization. Words such as *on*, *off*, *in*, *out*, and *open* and *close* begin to appear in the speech of English-speaking children at about 15 months; at the same age, the words *ppayta* and *kkita* (‘remove from/bring into a relationship of tight fit or attachment’; see Annual Report, 1988) are acquired by Korean children. Although at 15-18 months children learning the two languages are more similar in the way they use these words than they are at 20 months, they are not identical: the categorization system of the input language has clearly already begun to have an effect.

Especially interesting in this respect is the way in which children overextend words – that is, use them for situations

for which adults would use another word (e.g., *open* for taking the leg off a doll, pulling pop-beads apart, or turning on the television). Traditionally, overextensions have been regarded as strong evidence for children's initial reliance on their own concepts – i.e., principles of categorization that arise independently of the linguistic input. However, analyzing overextensions in cross-linguistic perspective, Bowerman and Choi found that the unconventional ways in which children use spatial words is conditioned by the semantic structure of the input language. That is, although overextensions necessarily occur along lines of similarity across situations to which children are spontaneously sensitive (since they have not heard adults use the words in this way), the precise kinds of similarities that children “select” to attend to in extending words to new situations are influenced by the meanings of those words, and of semantically similar words, in the adult language. These results indicate that children are far more attentive to the way adults implicitly categorize situations with their use of words than current theories of early lexical development allow for. Already in the one-word stage of development, children are analyzing the input and extracting semantic regularities – different for different languages – in the contexts across which given lexical items are heard.

b. To extend these findings and to trace in more detail the process by which children construct language-specific semantic categories, Bowerman and Choi have set up an experimental project comparing what one- to four-year-old children learning English, Korean, and Dutch know about the categorization of spatial manipulations in their language. (The decision to add Dutch subjects to the English-Korean comparison has grown out of previous work by Bowerman and D. Gentner (U. Illinois) comparing how children learning Dutch

and English acquire prepositions for static spatial configurations.) In 1989, elicited production data were collected from English- and Dutch-speaking children in connection with a standardized set of spatial manipulations designed to test key semantic contrasts among the three languages in how causal change-of-location situations are encoded. Comparable Korean data will be collected in 1990, the three data sets will be analyzed and compared, and a comparative comprehension study of the same semantic contrasts will be begun.

c. Bowerman and Choi have also extended the scope of their linguistic analyses of the spatial systems of English and Korean, and have begun to explore the effects of semantic-grammatical differences between these two languages on the syntax of early sentences expressing motion. Of specific interest are the lexical conflation patterns for motion events in English and Korean, i.e., the way in which the meaning components of motion events are combined and expressed in a single morpheme, or kept separate and expressed by distinct constituents. Based on Talmy's typology of conflation, their analysis shows that the two languages are typologically different in their lexicalization patterns, and that Korean, unlike English, has distinct conflation patterns for intransitive sentences (expressing spontaneous motion) and transitive sentences (expressing caused motion).

According to Talmy, the meaning components of a motion event include the Figure or moving object, the Ground or object with respect to which it moves, the Path along which it moves, the fact of Motion itself, and, optionally, the Manner or Cause of the motion; to this set, deixis may also be added. English typically expresses Path with prepositions/particles such as *in*, *out*, *on*, and *off* and conflates Motion optionally with Manner or Cause, or with deictic meanings in the main

verb. This pattern is consistent across both intransitive and transitive constructions, e.g., *John came/went/danced/rolled into the room* (intrans.), *John took/brought/put/threw/rolled the ball in(to) the room*. Many of the morphemes that express Path in spontaneous and caused motion events can also be used to express static Paths (locations), e.g., *John was in the room*.

Korean differs from English first in that all major meaning components of a motion event are expressed by verbs; there is nothing corresponding to the English preposition/particles. In intransitive sentences, the main (rightmost) verb **obligatorily** expresses deixis (analogous to *come* vs. *go*). A separate verb expressing Path precedes it. Thus, in Korean, *John came into the room* would be (in rough approximation): *John room enter came*. Manner verbs can optionally precede the Path verb, as suggested by *John room dance enter came* (= *John came dancing into the room*). Notice that in this intransitive pattern, each meaning component is expressed separately (except for deixis, which is conflated with motion in the main verb). In contrast, in causative transitive sentences expressing motion events, multiple meaning components are conflated into the main verb, including Motion, Path, and perhaps Ground (in the sense that the verb denotes the bringing about or reversal of a certain spatial relationship between a named Figure and a Ground which may remain unnamed, but which must have the physical properties required by the verb). Unlike in intransitive sentences, Path is not expressed by a separate verb, and deixis is not expressed at all. Typical transitive motion verbs in Korean include *kkita* and *ppayta* ('put-in/on/together with a tight-fitting base'; 'take-out/off/apart from a tight-fitting base'). The expression of static location involves still other construction patterns: most importantly in the present con-

text, the Path verbs that appear in intransitive sentences cannot be used for static Paths (unlike *in*, *on*, etc. in English); they are inherently dynamic.

Bowerman and Choi have examined spontaneous speech data from Korean and English-speaking children to determine how these language-specific lexicalization patterns are acquired. They have found significant language-related differences from the time of early word combinations. Well before two years of age, their English-speaking subjects used Path markers like *in*, *out*, *on*, *off*, *up*, *down*, and *back* to express both caused motion (e.g., *ball in*, while putting a ball in a bag) and spontaneous motion (e.g., *baby in*, while getting into the bathtub), and also for static location (*cereal in*, looking into a box of cereal). In contrast, during the comparable age period, Korean children used *kkita/ppayta* only for agentively caused motions such as putting a cassette in a cassette case or taking it out; they never overextended these transitive verbs to spontaneous movements by the children themselves or by others, or to static locations (e.g., *kkita* to express the state of a cassette in a cassette case). Furthermore, across all the children, several transitive verbs were productive before intransitive verbs (e.g., *kata/ota*, 'go/come') began to appear. At an age at which the English-speaking children expressed their desire to get up, down, in, out, etc. with Path particles, the Korean children said nothing, and expressions of static Path (comparable to *cereal in*) were extremely delayed, relative to the speech of children learning English. This suggests that the lack of all-purpose Path markers in Korean slows Korean children's recognition of Path as an independent category: Path is initially expressed only conflated with other meaning elements in transitive verbs.

These differences between the early two-word sentences

of Korean and English-speaking children present a challenge to current theorizing about early syntactic development. At present, both functional and formal accounts of grammar acquisition depend on the assumption that the relational meanings that underlie early word combinations arise in the child nonlinguistically and are the same across children learning different languages. However, these data indicate that children's early relational categories are not, in fact, independent of the semantic/grammatical structure of the input language.

The static-dynamic distinction

L.A. Weeks continued her dissertation work on the acquisition of Dutch and English. In the past, the overwhelming number of studies have addressed the meanings associated with specific forms and not the combinatorial principles associated with prepositions and prepositional phrases.

In the initial analyses for her longitudinal study of the acquisition of **place** and **path** expressions in Dutch and English, Weeks showed children as young as 2;0 to recognize the (virtually obligatory) need to provide a prepositional object in Dutch. The two Dutch children studied by Weeks were also shown to errorlessly position this information relative to the adposition: when the prepositional object was pronominalized, children accurately reordered the phrase (e.g., *hij legde de pen in de doos* \Rightarrow *hij legde de pen daar in*, 'he put the pen in the box \Rightarrow he put the pen in there'). The question of whether children produce such objects in conjunction with the relevant adpositions earlier in Dutch than in English, where the object information is more often optional, is currently being considered.

How children acquire the auxiliary alternation associated with the expression of **motion** and **location** in Dutch will also

be considered. While Dutch and English clearly resemble each other in that they both are Germanic languages, both call upon prepositions, and both make use of order information, the auxiliaries employed in the expression of motion and location clearly differ. The question here is whether Dutch children are (a) aware of the auxiliary alternation associated with the expression of motion and location in Dutch, and (b) aware of the very abstract extension of this alternation to transitive contexts in Dutch. It is expected that the Dutch children's utterances will be formulated along these language-specific lines rather than the putatively universal semantic lines assumed by Slobin (1973, 1985), for example, to motivate children's early acquisition of grammar.

3.2.2 Temporal reference and verbal markings

B. Kaiser continued her dissertation work on the acquisition of temporality in French. The work is based on spontaneous speech of several French children, sampled regularly between 1;8 and 3;8 years of age. Three corpora were analyzed in order to figure out developmental stages of the ability to express temporal relations in language. What emerges from the data is that children refer to past and future situations from the outset, but adopt different strategies to do so: the "analytic child" pays attention to modals and auxiliaries from the beginning, referring to non-present events by periphrastic constructions; the "synthetic child" concentrates more on verbal inflection and builds up an initial system based on the formal contrast between infinitives, present tense forms and participles. Consequently, irregular forms of participles play a major role for the latter, while on the other hand subject clitics emerge earlier in the former.

H. Behrens started her dissertation research on first language acquisition of temporality in German. The analysis will be primarily based on the longitudinal diary study carried out by Clara and William Stern. Because these recordings start with the birth of the three children it will be possible to trace the development of the children from the very beginnings of language production. The attempt is to find out how the children construct a system for temporal reference. This includes the use of temporal features of the verb phrase (tense, aspect and 'Aktionsart') as well as lexical means. Special emphasis will be laid on the interaction of cognitive and linguistic development.

Li Ping has completed his dissertation research on the interaction of aspect and Aktionsart in the acquisition of Chinese. This research asks whether and how the child's knowledge of the inherent temporal properties of verb meanings interacts with his understanding and use of aspect markers. Two relevant theoretical hypotheses are examined: (1) Basic Child Grammar, proposed by Slobin (1985), which claims that "Result" and "Process" are members of a 'privileged' set of semantic notions that are present prior to the child's linguistic experience, and that initially serve as the core meanings with which children associate tense-aspect markers; (2) the Language Bioprogram Hypothesis, proposed by Bickerton (1981), which claims that the State-Process and Punctual-Nonpunctual distinctions are innately bioprogrammed, and so are marked early in the development of tense-aspect systems.

Three experiments were conducted in order to test these hypotheses: comprehension, production, and imitation of aspect markers by Chinese-speaking children of 3 to 6 years of age. Results from the comprehension experiment show that children understand the perfective aspect marker *-le* better

with resultative and telic verbs than with process, punctual and stative verbs, and, conversely, that they understand the progressive aspect marker *zai* better with process and punctual verbs than with resultative and telic verbs. Their comprehension of aspect markers is thus influenced by whether or not the verb incorporates the meaning of endpoint or result. In contrast, their comprehension is not significantly affected by whether or not the verb includes a meaning of stativity or punctuality. Results from the production experiment are consistent with those from the comprehension experiment: there is a strong association between perfective aspect and resultative/telic verbs and between imperfective aspect and process and punctual verbs in children's productive speech, but children's use of aspect markers does not differ as a function of whether the verb is stative or processive or whether it is punctual or durative. Finally, children's imitations of grammatical vs. ungrammatical sentences with different verbs and aspect markers reveal that the inherent verb meaning of result is very salient to children, as shown by the high percentage of errors on imitations of the ungrammatical combination of *zai* with a resultative verb. In contrast, children are not particularly sensitive to inherent stativity since they imitate both grammatical and ungrammatical combinations of aspect markers with stative verbs with equal success.

The results of these experiments are consistent with cross-linguistic findings from English (Bloom et al., 1980), Italian (Antinucci & Miller, 1976), and Modern Greek (Stephany, 1981) in showing that aktionsart features influence children's acquisition of tense-aspect markers. The importance of resultativity, in particular, confirms Slobin's (1985) emphasis on result in his hypothesized Basic Child Grammar. In contrast, the present results provide no support for the Lan-

guage Bioprogram Hypothesis (Bickerton, 1981) claim that the State-Process and Punctual-Nonpunctual distinctions are inborn. Finally, an examination of empirical studies of input and mother-child interactions suggests that associations between aktionsart and tense-aspect marking in children's language acquisition can be better accounted for by reference to patterns in the linguistic input than by invoking innate semantic categories.

3.2.3 Person deixis in Polish

During her stay at the Institute, made possible by a fellowship from the Alexander Humboldt Foundation, M. Smoczynska (U. Krakow), worked on a project on language acquisition in Polish children, which focuses on the reorganizations of the basic linguistic system taking place after the age of two. The data base consisted of longitudinal data from 5 Polish children which have been coded according to the CHILDES format.

One of the areas studied was the acquisition of person deixis. For most children, in the early phases, there is no person distinction in utterances they produce. The technique of neutralizing person distinctions, usually introduced by parents, consists in using proper nouns when referring to the speaker and addressee and, accordingly, third person form of verbs. The child can thus learn the bases of syntax and morphology without having to take into account the shifting person reference and the diversity of verbal and pronominal forms. At this stage all NPs are just nouns, verbs do not have to be conjugated for person and the child can concentrate on the acquisition of morphological categories of case, and tense/aspect, which provide the scaffold for morphological paradigms.

When the first and second person forms appear in child

utterances, they do not replace the old forms at once. There is a period of several months when 1st and 2nd person reference competes with the old strategy. The purpose of the study is to determine the nature of the difficulty. It can be established that the use of nouns vs. pronouns (when referring to speaker and addressee) depends on syntactic position of the referents as well as on syntactic complexity of the structures involved. Sometimes there is "no span left" to perform the operation of substitution, which causes the child to produce hybrid forms, where both the old 3rd person reference and the new 1st or 2nd person reference are used, e.g., *Jas would have to buy a new pram with my money*, where Jas is the speaker. It seems that for the child the problem is not so much in discovering rules of deictic reference but in applying them smoothly in utterance production. The primary technique of referring by names was easy to learn. Referring by pronouns (or zero forms) is handier, but at this precise point it is a nuisance. The child needs some time to include and automatize the necessary operations into the production process, and to eliminate the automatic habits of third person reference. A detailed analysis of forms produced can shed light on the child's online processing of linguistic information in the production of speech, which takes place within the acquisition process.

3.2.4 The Stern-project: The development of possession

W. Deutsch (U. Braunschweig), in cooperation with Behrens, C. Bittner, T. Brants, T. Fricke, P. Kolodziej, M. Schüling, W. Seidenbiedel and K. Wild-Losse, continued the Stern-project in which the diaries of Clara and William Stern are being transcribed and reanalyzed. 1989 saw the completion of the transcription. The diaries are now available as computerized

observational corpora. They became part of the CHILDES data bank. Moreover, the reanalysis concentrated on the identification of the phases in Hilde, Günther and Eva Sterns' development of possession. The results showed that all three children focussed initially on the dynamic functions of possession. They used simple linguistic means like single nouns, pronouns or imperative verb forms to initiate object-transfer. This transfer is only unidirectional: from another person as the source towards the child as the goal. Later, the dynamic functions are still prevalent, while the linguistic expressions become more differentiated and approximate the standards of the target language German. Children's first expressions of the static functions of possession (ownership relations) include mainly genitive constructions in which a single person is marked as an owner of an object. These functions and forms appear after the children already have developed a differentiated repertoire of dynamic functions. The final step in the linguistic development of possession involves the discovery of the "deictic nature" of pronouns which were previously used in connection with the dynamic aspects of possession. On the basis of the Stern diaries the linguistic development of possession is completed before children enter school.

3.3 Discourse Organization: Referent Introduction and Reference Maintenance in Speaker Narratives

M. Hickmann completed some crosslinguistic analyses focusing on the given/new distinction in children's narratives (cf. Annual Reports, 1987 and 1988 for partial results). This research is part of her ongoing project on the development of discourse cohesion in English, German, French, and Mandarin Chinese,

carried out in collaboration with J.C.P. Liang (U. Leiden), Z.Y. Xu and F.S. Ye (U. Peking), with the assistance of H. Hendriks, F. Roland, and M. van Crevel. Particular attention was placed on the positions of the NP's used for the introduction of new referents and for reference maintenance. The aim of these analyses was to determine the extent to which adults and 4- to 10-year-old children rely on word order versus NP types to mark information status, given the following differences across the four languages: (a) NP's are more complex in the three I-E languages (obligatory definite/indefinite determiners; morphological distinctions) than in Chinese (optional determiners, e.g., numeral ones for new information; no morphology); (b) the languages present different structural variations, as well as obligatory versus optional constraints on NP positions, some of which are directly related to information status and/or relative NP "leanness", e.g., referent introductions must be postverbal in Chinese, clitic pronouns must be preverbal in French.

Overall, the narratives show a clear relation between word order and information status, which is reflected by an interaction between NP types and positions, although differences across ages and languages also occur. Roughly, the leaner NP's are preverbal, the fuller ones are postverbal. Thus, in the adults' narratives of all language groups, postverbal position is preferred for referent introductions and preverbal position for reference maintenance, particularly for pronominals. The magnitude of this interaction also varies across languages: it is almost maximal in Chinese, weakest in English, intermediary in French and German. The children in all language groups gradually learn to mark information status by means of both NP types and positions, although their reliance on one or the other varies across languages. Among other differences, NP

position is clearly less related to information status in English and German than in French and Chinese.

Children's referent introductions illustrate this pattern. With increasing age, children in all language groups produce more NP forms that mark newness in postverbal position. However, at all ages the English-speaking children (like the adults) do not systematically use postverbal NP's for new information, regardless of whether they have mastered indefinite determiners, position being mostly determined by semantic/structural properties of the clauses (e.g., (1)). In German, the children's narratives contain mostly postverbal NP's at all ages, regardless of form and/or information status, differing from the adult's narratives in this respect because of (a) fewer subordinate clauses (verb-final word order) and (b) more utterance-initial devices that provide (temporal/aspectual/locative) anchors in discourse and that result in subject-verb inversions (e.g., (2)). When introducing referents, the French children at first use frequent preverbal definite NP's (e.g., (3)), including dislocated ones (e.g., (4)), before they have mastered indefinite determiners. Thereafter, they clearly associate postverbal position with indefinite forms (e.g., (3)). Similarly, the Chinese children at first use frequent preverbal bare nominals (i.e., definite NP's such as (6)), then they clearly associate postverbal position with numeral NP's (e.g., (7)). However, they do not use postverbal numeral NP's as much as the adults, still producing (incorrect) preverbal ones (e.g., (8)).

(1) *A cat/the cat comes.*

(2) *Und da kommt eine/die Katze, dann klettert sie hoch.*

(3) *Le chat arrive.*

- (4) *Le chat il arrive.*
- (5) *Y'a un chat qui/il arrive.*
- (6) *mao1 lai2-le* 'The cat comes'
cat come-PCL
- (7) *lai2-le yi1-zhi1 mao1* '[(There) comes a cat'
come-PCL one-CL cat
- (8) *yi1-zhi1 mao1 lai2-le* 'A cat comes'
one-CL cat come-PCL

These results indicate that, despite similar developmental progressions across languages, some language-specific factors affect how children learn to organize given and new information in discourse. Children's associations between forms and positions in part reflect the degree to which NP's interact with word order in the language to be acquired, i.e., the strongest associations occur in languages that grammaticalize aspects of the given/new distinction (French, Chinese), whereas position is mostly determined by other factors in the other languages (English, German). However, the Chinese children do not associate forms and positions as much as expected: they use the relatively simple distinction between numeral NP's for newness versus other NP's (bare nominals, pronominals) for givenness, and tend to reserve the more complex positional variations for semantic/structural distinctions. Further analyses focus on differences which were found across ages and languages in the uses of lean versus full forms to mark finer distinctions in reference maintenance, such as the promotion and maintenance of topics as function of coreference in discourse.

Hickmann and M. Kail (CNRS, Paris V) continued their joint project on the effects of mutual knowledge on children's narrative organization (also see Annual Reports, 1987, 1988). The data base consists of narratives elicited from French and Spanish children between 3 and 11 years with a picture book in two situations: (a) the children and their interlocutor were looking at the picture book together, so that mutual knowledge was possible (MK); (b) the children narrated the story to a blindfolded interlocutor, so that there was no mutual knowledge (NMK). Previous analyses of the French narratives between 6 and 11 years had shown significant differences in children's referent introductions as a function of both age and situations. Further analyses, carried out in collaboration with F. Roland (Paris V), also showed significant effects of both factors on reference maintenance. Among other results, variations were found in children's overall productivity and in their uses of linguistic devices.

First, the 9/11-year-olds, but not the 6 year-olds, produce more explicit narratives in NMK than in MK. For example, they produce more clausal units and mention the main protagonist more often in NMK than in MK. Second, the following two factors affect the extent to which children presuppose the identity of this main protagonist in reference maintenance: (a) local coreference across clauses in the linguistic context and (b) the frame-by-frame structure of the story in the nonlinguistic context. Overall, children use more pronominals in coreferential contexts, but more nominals in noncoreferential ones. Overall, they also use more nominals across frame boundaries, i.e., to mark a shift from one picture to the next, but more pronominals to maintain reference within frames after such a shift. Age differences were also found across situations. For example, the uses of dislocations (e.g., *Le garçon i court*, 'the

boy he runs') to mark discontinuities change with age: the 9/11 year-olds use more dislocations within frames in NMK than in MK, whereas the 6-year-olds use them across frame boundaries, regardless of situation. The older children, then, use these devices to mark discontinuities in linguistic and non-linguistic context, whereas the younger ones mostly use them deictically in relation to nonlinguistic context. Other analyses focused on semantic/structural aspects of clause structure, such as transitivity. Future analyses will focus on the corpus of narratives produced by the preschool children (3 to 5 years). The Spanish corpus has also been transcribed and partly coded for comparative analyses.

3.4 The Input Project

A number of experimental studies were carried out during the first year of the Input Project, in which the following researchers participated: P. Zwitserlood, W. Klein, B. Wenk, C. Perdue, J. Liang (Leiden U.), and E. Kellerman (U. Nijmegen). The aim of the project is to study the role of input factors in second language acquisition. Three main domains of studies were formulated: 1) the segmentation of the acoustic input and the acquisition of phonology and phonotactic knowledge, 2) the early development of meaning, and 3) the development of elementary syntax. The first of these issues was addressed in a series of pilot experiments. The main aim of these studies was to establish whether on-line reaction time techniques, commonly used with adult native speakers to test aspects of their fully developed language comprehension system, could also be applied during the earliest stages of second-language acquisition. Native speakers of Dutch were presented with Chinese input via video tape, showing a speaker of Chi-

nese telling two simple stories which, on the same display, were illustrated in a cartoon-like fashion. The duration of the tape was approximately 15 minutes. After the input phase, the subjects were taken to a group experiment room, where three separate tasks were performed: a word-recognition task, a 'Possible Word decision' task, and a identity test for word pairs. First, the results show that these types of tasks can successfully be used with as little input as 15 minutes. On all tasks, performance was clearly above chance level. Subjects were capable of recognising words they had heard during the input phase, with only a small advantage for words which were repeatedly presented, the high-frequency words, over the low-frequency words. The Possible Word task, where the subject has to decide whether the presented stimulus could be a word of Chinese, revealed that subjects perform at chance level for stimuli containing segments that are illegal in Chinese, but they consistently reject stimuli which contain legal Chinese segments in illegal distribution within the syllable. In the third task, subjects had to indicate whether two spoken stimuli, presented with a short 500 ms interstimulus interval, were identical or not. In half of the material the stimuli were identical, in the other half, two segments (in the same position in the two stimuli) differed with respect to one or two distinctive features. The results showed that the subjects heavily rely on what is distinctive in their native language. In Chinese, aspiration on stops distinguishes between two segments; in Dutch it does not. Consequently, the stimuli containing this contrast were considered by the subjects to be identical. When, however, a one-feature difference creates segments which Dutch does not have (the feature 'retroflex', for example), then the difference was reliably detected.

3.5 The Acquisition of Sound Structure

January 1st, 1989, a new project started financed by the DFG: the Infant Speech Perception project, coordinated by A.D. Friederici, with J.M.I. Wessels and P.J.C.M. Embregts as participating researchers and in collaboration with P. Jusczyk (U. Oregon).

The project focuses on the infant's acquisition of the sound structure of the native language. In particular, when do infants recognize whether a particular sound pattern could be a potential word in their native language as opposed to a word in a foreign language?

Research in infant speech perception so far primarily focusses on the discrimination of speech units presented in isolation. The goal of this project, however, is to investigate how relevant speech units are extracted from the speech continuum. Two basic questions were formulated both referring to different paradigms:

- 1) At what age are perceptual cues or markers detected by the infant, which are known to play an important role in the segmentation process. This question is investigated by using a discrimination task.
- 2) At what age is the infant capable of using this information to recognize syllable sized units, words, in running speech. To answer this question a recognition task is used.

Experiments are designed that systematically vary certain parameters like phonotactic information, stress and prosody. The target groups are infants varying in age from four-and-a-half to 9 months. The technique suitable for these tasks and commonly used for this specific age group, is the preferential looking procedure called Head Turning: here the infant sits

on mother's lap and listens to speech samples played through loudspeakers either on the left or the right side. Preferences are measured by monitoring both the direction and the duration of the infants headturn to both sides.

In collaboration with Jusczyk a number of experiments were conducted to investigate infants' sensitivity for phonotactic discrepancies. To explore this issue, lists of low frequency abstract words in both Dutch and English were prepared. The lists were spoken by a bilingual Dutch/English talker and recorded for presentation to infants. Each list contained a number of words that were inadmissible as potential words in the other language, either because they contained a phonetic segment that does not appear in the other language or because they violated phonotactic constraints on the possible sequences of segments that could occur within the same syllable. For example, although both languages have an /r/ in their inventories, they are pronounced very differently in English and in Dutch. Similarly, the ordering constraints on segments differ so that whereas Dutch allows sequences like /zw/ to begin a word, English does not. Infants were tested on their sensitivity to such features by measuring how long they listened to lists of words from each language using the Head Turning procedure mentioned above. The Dutch lists were played on one side of the room and the English ones on the opposite side.

The results of the experiments indicate that 9 month olds infants, in contrast to 6 month olds, are sensitive to language specific phonotactic information. American infants clearly prefer those speech samples in the phonotactics match their input language, that is American English words. For Dutch infants only a marginally significant effect was found in favour of the Dutch phonotactics. It could be the case that Dutch

infants are more familiar with the English language due to various sources of input through the media. Control experiments are planned to test this hypothesis.

A second set of experiments is designed to investigate infants' sensitivity for specific phonotactic constraints within their mother language. The speech samples for these experiments consist of lists of nonwords which were constructed such that legal phonotactic clusters in Dutch appear in legal or illegal word positions (begin/end). In the first experiment these nonwords will be presented in isolation. In the experiments that follow, these nonwords will appear in context and stress will be used as an extra cue.

3.6 Language Acquisition Data Base

Thanks to the efforts of H. Feldweg and C. Perdue, the European Science Foundation's Second Language Data Bank became fully operational in 1989. Feldweg, W. Klein and Perdue started the process of familiarising non-ESF-project researchers with the data by organising a one-week workshop for representatives of European laboratories which are active in investigating situations where more than one language is involved. The participants were A.-Cl. Berthoud (Lausanne), E. Gülich (Bielefeld), J. Lalleman (Leiden), P. Meara (London), A. Ramat (Pavia), O. Santos (Porto), S. Schlyter (Stockholm), I. Vila (Barcelona).

Feldweg continued his work on maintaining the institute's language acquisition data bases. New data could be added to the European Science Foundation Second Language Databank from the British and German ex-teams of the ESF project (see previous Annual Reports). The Child Language Data Exchange System (CHILDES) saw the addition of the first Dutch

data, a longitudinal study of a boy aged 2;3-2;11, contributed by F. Wijnen (U. Utrecht), bilingual data (German/English) contributed by H. Wode (U. Kiel) and the 'Dortmund corpus', a collection of full-day recordings of spontaneous child speech provided by K. Wagner (U. Dortmund).

Data distribution is now facilitated by means of a file server: a computer program running permanently on one of the institute's computers is waiting for incoming (electronic) mails and messages containing requests for data files, data analysis programs, or documentation. Once it encounters a valid request, the program reacts by sending the requested data to the sender of the message. Interested readers may try to get into contact with the server by sending the word HELP (as an interactive message or as e-mail) to:

PSYLI@HNYMPI51.BITNET.

Computer aided data analysis of language acquisition data is moving more and more from searches for specific words or patterns to more complex retrieval tasks involving searchers across linguistic categories. Together with B. MacWhinney (Carnegie-Mellon U.) and Y. Neeman (Tel Aviv U.), Feldweg developed a general-purpose coding system based on scoped codes split in multiple tiers according to different linguistic categories (see Annual Report, 1988), which will be added to the CHILDES transcript conventions.

3.7 Field Linguistics: Language Change and Creolization

S. Romaine (Oxford U.) continued her work on the project "Language acquisition, change and creolization in Tok Pisin".

The data which have already been transcribed and concordanced come from 482 children from nine of the eleven rural and urban areas visited in 1986-7 and comprise a total of 705,121 words.

The results show that a variety of changes in phonology, syntax and lexicon are underway in the younger generation of speakers in both rural and urban areas. For instance, the use of predicate marking was once more extensive both before and after tense, mood and aspect markers. In urban areas, this feature is being lost. Other syntactic features such as the use of preverbal future markers appear to be on the increase by comparison with earlier reports, but this does not seem to be tied specifically to creolization, which is largely an urban phenomenon. Relative clauses, which are a new construction in Tok Pisin, show an increase in explicit marking tied with age. Through a comparison of the lexical items used to encode several semantic fields in rural and urban areas, Romaine was able to show how borrowing from English is leading to a restructuring of the lexicon and making it less iconic.

3.8 Other Research

3.8.1 The acquisition of modality

During her stay at the Institute M. Smoczynska (U. Krakow) investigated also the acquisition of modality in Polish children. Modalizing propositions is one of the elaboration processes which takes place after the acquisition of the basic system. The data of mood forms and modal verbs were analyzed. The result shows a discrepancy between two developments. Whereas the acquisition of modal verbs by Polish children does not differ from that in other languages (order of acquisition, almost exclusively deontic modality etc.), the ac-

quisition of the conditional mood seems relatively precocious. From the age of 2 on, Polish children build full hypothetical conditional sentences and use them adequately and frequently enough to exclude the hypothesis of rote learned expressions. The finding can be partly explained by the properties of the input language. Polish makes no distinction between subjunctive and conditional, which are both expressed by similar, very clear and unique, structure. The subjunctive is widely used in nonfactive clauses (complement or adverbial purpose clauses), where English would rather use infinitival constructions. These types of utterances including subjunctive forms – unlike true hypotheticals – are used very often by parents in everyday conversations, and they appear relatively early in child's productions. It seems that the early acquisition of the subjunctive provides the child with the means to express cognitively complex meanings of hypotheticality.

3.8.2 Linguistic knowledge in second language acquisition

In his research on the relevance of linguistic knowledge in second language acquisition, P. Jordens (Free U., Amsterdam) investigated the ability of L2 learners to distinguish between sentences that are grammatical and sentences that are not. It has been found that Dutch learners of English are able to discriminate correctly between sentences with subject and object extraction as in

**(a)* Who do you think that EC saw Mary?

(b) What do you suppose that Mary will do EC?

This seems remarkable because in the L1 Dutch the equivalents of *(a)* and *(b)* are both correct. In order to investigate

the origins of these L2 intuitions on the “that-trace” effect, Jordens carried out an experiment in L1 Dutch in which subjects were forced to indicate their preference with respect to test sentence types as in (c), (d), (e) and (f).

- (c) Wie hoop je dat hij/hem benoemt?
(who do you hope that he/him appoints?)
- (d) Wie zeg je dat hem/hij zal bezoeken?
(who do you say that him/he will see?)
- (e) Wie denk je dat hij/hem gezien heeft?
(who do you think that he/him saw?)
- (f) Wie verwacht je dat hem/hij een geschenk geeft?
(who do you think that him/he is giving a present to?)

From the results of this experiment it can be concluded that L1 speakers of Dutch have a clear preference for the nominative *hij* (‘he’): type (c) 87,5%, type (d) 81,2%, type (e) 66,4%, type (f) 66,4%. This means that the first reading that subjects come up with, is the one with object extraction. On the basis of these results it can be argued that it is wrong to assume that L2 learners using their L1 knowledge should necessarily identify L2 sentences to be correct or incorrect in agreement with what is linguistically correct or incorrect in their L1. Sentences that need more processing to be judged grammatical in the L1 are felt to be less acceptable in the L2.

4. Language Disorders

The members of the Language Disorders Group were mainly involved in the NWO Priority Project "Aphasia in Adults", which entered the third year of its second five-year period in 1989. This year saw the completion of a major patient testing project, resulting in a broad-based standardization pool. Specific research outlined in the proposal continued, and newer subprojects were begun in response to results from ongoing studies. In general, the thrust of the research has remained the same: Members of the group agree that aphasic patients' performance is due to the interaction of two major factors, the underlying deficit and adaptive strategies brought to bear by the patient. The core of the project research rests on studies aimed at elucidating these two aspects. Work on elliptical speech in 1989 led to new insights which challenge this aspect of adaptation theory. The pilot phase of investigations into the emotional status of aphasics continued. And a range of priming studies involving syntactic, lexical, and morphological components of grammar underscored interest in the temporal structure of language processing in aphasia and the view of the underlying nature of the deficit in agrammatism as computational rather than structural.

4.1 Test Standardization Completed

The standardization of the Dutch version of the AAT, the Aachen Aphasia Test (Huber, Poeck, Weniger & Willmes, Göttingen 1983) which started in 1982, has been completed.

For the standardization 4 groups of 30 aphasics (global, amnesic, Broca and Wernicke patients) and 2 groups of 30 control subjects (right hemisphere lesion patients and subjects without neurological impairment), which should meet a list of standardization criteria, had to be tested. Unfortunately, many amnesic patients did not meet these criteria, therefore it took extremely long to fill the group of amnesic patients. In all these years, testing was of course not restricted to amnesic patients; testing of all types of aphasic patients served the purpose of collection of enough tests to allow the extraction of test norms. This collection has also been completed by now.

In 1988, C. v.d. Veer (Technical Group), J. Meeuws and P. Graetz developed an Oracle database, from which the relevant data now have been transferred to Aachen for statistical evaluation. Publication of the test is expected in the course of 1990.

A total number of 820 (suitable) tests have been conducted in these past seven years; 85 of these were re-tests. Of the 735 first tests, 176 patients were classified as Broca's aphasics, 96 as Wernicke patients, 118 as global aphasics, 53 as anomics, 74 were non-classifiable, 79 were rest aphasics, 51 were non-aphasic left hemisphere lesion patients. For the control groups, 55 right hemisphere lesion patients and 33 normal control subjects were tested with the AAT. The first 30 patients in each of the 6 groups mentioned in the first paragraph constitute the standardization pool. The remaining 555 tests, including those which did not meet the standardization criteria completely, constitute the normalization pool.

4.2 Elliptic Speech: A Reconsideration

4.2.1 Telegraphic style in Broca's aphasia

C. Heeschen's work on the ongoing analysis of spontaneous speech of German Broca's patients yielded two results which present serious theoretical problems:

- (1) **All** grammatical subjects are missing if the verb is in non-finite form. Comparison with other variants of elliptic speech, in particular with (German) TV-inserts and newspaper-headlines revealed that such a radical omission of the grammatical subject is a peculiarity of telegraphic style. In headlines, subjects in non-finite constructions are only omitted if the omitted carrier of the finiteness is the Aux *haben* ('to have'). Thus, example (1) and (2) are o.k., example (3) not:

- (1) Außenminister nach Moskau abgeflogen
(Foreign minister departs for Moscow)
- (2) Ceaucescu tot
(Ceaucescu dead)
- (3) Kanzler Außenminister entlassen
(Chancellor foreign minister dismissed)

Constructions such as (1) or (2) cannot be found in telegraphic style.

- (2) Prepositions are radically omitted in telegraphic style irrespective of their status as either more lexical (e.g., *aus Dortmund*, 'from Dortmund') or more syntactic-obligatory (e.g., *hoffen auf*, 'hope for'). This is surprising because it is well known that Broca's patients are able to produce the more lexical prepositions if they are forced

to use them (e.g., in a Cloze procedure test). The radical omission of all prepositions sometimes yields utterances which are at the borderline of being wellformed:

- (4) Eine Woche Entlassung
(One week release)

A tentative linguistic account of telegraphic style – developed by M. Bierwisch, W. Klein and Heeschen – says that it is the result of removing the heads of phrases: Articles as heads of DP, prepositions as heads of PP, I as head of I', C as head of C', and (in very severely disturbed patients) even V of VP. This extremely straightforward account predicts correctly that all prepositions are omitted irrespective of their status, furthermore it allows for degrees of severity: If C (a very high node) is removed, then only main clauses, but complete ones(!), can be produced. This would be the mildest form of agrammatism, and patients of this type can easily be found. If even the V is removed, the result is the notoriously well known 'nominal' style of very severe cases. The 'classical' telegraphic style is somewhere in the middle: The most frequent and prototypical constructions are "Obj.NP plus non-finite Verb", e.g.:

- (5) Fernsehen geguckt
(Television watched)
(6) Bunten Teller gekriegt
(Colorful plate (of sweets) received)
(7) Bier trinken
(Beer drinking)

Thus, the 'head-removing' account works fairly well; however, it leaves us with one theoretical, one metatheoretical, and one empirical problem:

(1) The assumption of a removal of heads predicts correctly the omission of what is directly under the node (prepositions under P, articles under D, finiteness markers under I, verbs under V), and that that what the node is the head of is preserved (NP as rest of a DP or of a PP, Obj.NP as rest of a VP); however, this still does not solve the problem of the radical omission of grammatical subjects: although I is also (indirectly) head of the Subj.DP, the Subj.DP as the “rest” falls too. For the time being, all what can be said is that the omission of grammatical subjects requires a more sophisticated explanation – in all likelihood, pragmatic factors will come in.

(2) Let us assume that the ‘head-removing’ account will work, then we are still confronted with the problem what makes the heads so difficult to be **processed**. Thus, the decapitation account has to be complemented by a theory of head processing, in particular in language production. Some ideas in this respect are already “underway” and they are perfectly compatible with the delay hypothesis as developed by other members of the aphasia project (H. Kolk (U. Nijmegen)), but they are still not in a form that they could feasibly be presented in this report.

(3) As mentioned above, prepositions are **always** omitted. Although this fact is favourable for the decapitation account, it is detrimental to the hypothesis of Kolk and Heeschen that telegraphic style consists of totally **correct** elliptic expressions. Example (4) presents already an expression the correctness of which is highly doubtful. More and also more doubtful examples can easily be found.

In short, the whole ellipsis hypothesis as part of the adaptation theory by Kolk and Heeschen has to be reconsidered.

4.2.2 Studies on the emotional status of aphasic patients

Heeschen also continued with the assessment of depressivity of aphasic patients by means of external rating (Hamilton Scales) and self-rating (Beck's inventory) in Germany. Precise localizational data has now been obtained for a substantial number of patients. However, Heeschen refrains from a preliminary analysis of these data because all tests and experiments connected with emotional factors are more than the tests and experiments more common in psycholinguistics vulnerable to the Pygmalion-effect. It is also for this reason that Heeschen declines to present preliminary results obtained in some learned helplessness experiments. Only one new aspect of the learned helplessness experiments should be mentioned here: an automatized process should be immune against influences of emotional factors. One central issue of the aphasia project is whether the automaticity in language processing is lost in Broca's aphasia. The hypothesized loss has been investigated hitherto by checking two other properties of automatized processes: speed and cognitive impenetrability. If the learned helplessness experiments will finally provide evidence for the vulnerability of certain processes due to induced depressivity in the aphasic subjects, then the study of emotional factors and their potential influence will yield a powerful tool for determining whether a given process is automatic or (pathologically) de-automatized. Thus, the studies of emotional factors in aphasic patients are not too far away from the more traditional psycholinguistic studies carried out by the other members of the aphasia project.

4.3 On-Line Approaches to Syntactic and Lexical Processing in Aphasia

4.3.1 Temporal constraints on parsing: Syntactic priming in Broca's aphasia

The hypothesis that agrammatism is due to a computational rather than a purely structural deficit was further investigated by A.D. Friederici and K. Kilborn in a series of cross-modal priming experiments focussing on the temporal aspects of syntactic processing. In these experiments, subjects heard a Dutch sentence fragment consisting of a noun phrase and an auxiliary verb which provided strong syntactic constraints on a following word presented visually for lexical decision. In the critical condition, the target is a past participle verb form which either forms a grammatical continuation or an ungrammatical one. As a baseline visual targets were also presented in a no-context condition. Results for normal students and age matched controls show (a) the typical context effect with faster decision times for words in context (collapsed over grammatical and ungrammatical continuation) than for words in isolation and (b) a grammaticality effect with faster decision times for words in grammatical than in ungrammatical context. The findings from five agrammatic patients indicate (a) that agrammatics unlike normals show a context inhibition effect in so far as decision times are faster when words are presented in isolation than when presented in context (collapsed over grammatical and ungrammatical continuation, but (b) agrammatics much like normals show a clear grammaticality effect with faster decision times for grammatical than for ungrammatical continuations. The agrammatic behavior was taken to reflect slow retrieval of the syntactic information encoded in closed class elements (auxiliaries, in this case). In

other words, structural information is available in principle (grammaticality effect), but too late to meet the temporal constraints required for normal parsing (context inhibition effect). Whether this definition of the agrammatic deficit is congruent with a loss of automaticity claim has subsequently been tested by using two variations on the above paradigm. Different interstimulus intervals (ISI) were used to evaluate whether the agrammatic behavior is due to late-rise or fast-decay of structural information, and different instructions are used as a critical test for the cognitive impenetrability principle of syntactic processes inherent in the automaticity hypothesis.

In the first variation, we evaluated the temporal structure of the syntactic priming process in both aphasic and age matched groups more closely. If the slowness of Broca's aphasics' lexical decisions is, as hypothesized, due to a loss of fast and automatic syntactic processes, then we predicted that giving agrammatic Broca's aphasics more time to resolve on-line syntactic processes should improve their performance. This was accomplished by lengthening the interstimulus interval – i.e., the time span between the offset of the auditorily presented sentence fragment prime and the presentation of the visual target – from 0 msec to 200 msec. We found that Broca's aphasics, in contrast to age matched controls, showed faster decision times to targets after a span of 200 msec than after a span of 0 msec. Having more time to perform syntactic operations resulted in improved performance for agrammatic Broca's aphasics, supporting the interpretation of non-automatic processing of syntactic information.

One hallmark of normal language comprehension is the ability to access grammatical information in a fast and automatic way. The studies described above provide evidence

that while Broca's aphasics are sensitive to even rather subtle syntactic features during comprehension, there is a disruption in the timing with which such information becomes available and/or is applied. The second variation on the priming paradigm explored the loss-of-automaticity claim in more detail. If agrammatic patients lack automatic access to syntactic information, then their demonstrated ability to use such information may rely on controlled, strategic application of grammatical relations in comprehension. This experiment combined features of the first two – on-line crossmodal lexical decision were made at 0 msec ISI for the Broca group and at 0 and 200 msec for the age match controls. The critical difference is in the instruction component. In this experiment, subjects were explicitly instructed not to attend to the auditory prime. Automatic processes are, by definition, not subject to strategic influences. If the syntactic relationships reflected in both the aphasic and the control group performances in the first instruction version are due to automatic processes, these should not be affected the instruction to ignore the context. If, on the other hand, the grammaticality effect disappears under instructions to ignore the context, we can infer that the on-line use of the syntactic information presented here is governed by controlled processes, and not automatic ones.

The results show that the grammaticality effect observed in both age matched controls and in Broca subjects under the first instruction set disappear only for the aphasic subjects under the second version. This indicates that for age matched controls, automatic parsing routines are impervious to different instructions. This was true in both ISI conditions: the advantage for grammatical over ungrammatical continuations equally large at an ISI of 0 msec (41 msec) and 200 msec (45 msec). The access of syntactic information is not

under strategic control for neurologically intact controls. In contrast, agrammatic Broca's aphasics, despite the ability to utilize grammatical information during processing, as shown by the presence of a robust grammaticality effect in the first two experiments, do appear to have control over whether that information is used or not. The presence of controlled processing supports the claim that the comprehension deficit in agrammatic Broca's aphasia is due to a lack of automaticity in processing. This breakdown of automaticity is in turn responsible for the general finding that the time course of processing grammatical information does not follow normal patterns in aphasics.

4.3.2 The time course of lexical processing in open and closed classes

The series of experiments described above suggest that the source of the deficit in agrammatic Broca's aphasia is linked to the time course of processing different kinds of grammatical information. A separate experiment has been designed to elucidate additional aspects of on-line syntactic processing. We will draw here on a class of experimentation that has a long history in psychology, namely the interference paradigm. The interference paradigm has been used widely in testing for the automaticity of information processing in different perceptual domains, including color-word (classical Stroop paradigm), picture-word, color-color, picture-picture, and word-word interference, varying temporal as well as spatial separation of stimulus and distracter items. To our knowledge, however, there is no study that has established an interference effect for word-word stimuli when the target and distracter are in different modalities (auditory-visual). So far investigators have restricted such paradigms to semantic and conceptual aspects of

word processing, and there has been no need for a cross-modal word-word interference paradigm. However, in the syntactic domain, stimulus items are necessarily embedded in strings longer than one word, and it is essential to keep target strings in one modality. Distracter items from same or different word classes as the target item can easily be presented in varying temporal separations from the target (i.e., stimulus-onset asynchronies, or SOA). The rise and fall of interference effects over a range of SOAs can tell us much about the way the activation of different grammatical domains (lexical semantic/syntactic) unfolds over time. Once the temporal characteristics of normal non-pathological processing systems have been established in this paradigm, we will have an additional method to assess the effects of focal brain damage on processing.

A pilot experiment using auditory-visual word pairs in a lexical decision task has been carried out with normal subjects. Preliminary findings indicate that when tested for interference effects at very short SOAs (50 msec), pronouns prime themselves in both identical (*hij-hij*, 'he-he') and within-class (*hij-wij*, 'he-we') pairs, while prepositions and nouns are primed only in the identical but not in the semantically related conditions. At later SOAs, the within-class priming for pronouns disappears, while for nouns semantic priming emerges at 400 msec and for prepositions at 800 msec. These results show that (1) the cross modal interference technique is effective, and differentiates priming patterns across time for each word class tested, and (2) different word classes present different processing profiles. These materials will serve as the basis for a future experiment which will employ the same paradigm to examine how these effects are manifested when the auditory prime words are embedded in meaningful sentences, that is,

when the noun, pronoun, or preposition is carrying out its normal function in a sentence context.

4.3.3 Computational space and syntactic parsing

Friederici and L. Frazier (U. Massachusetts, Amherst) followed up an experiment described in the Annual Report 1988 in which they had tested the aphasics' ability to assign thematic roles in sentence comprehension. In this experiment they had used a sentence picture matching paradigm in which the aphasic subject was listening to a sentence while s/he was looking at two pictures in front of her/him. The performance of agrammatic aphasics in this task was surprisingly good. We had attributed this to the agrammatics' use of local grammatical markers provided in the sentence. One argument that might be raised against this interpretation, however, is that agrammatic subjects are able to perform that well due to the fact that in our sentence material the main verb which carries the verb argument information appeared after the first argument (e.g., (a) and (b)) and thus would allow thematic role assignment without using too much computational space.

- (a) Die Schüssel mit dem roten Streifen **steht** auf dem Teller.
(The bowl with the red stripe **stands** on the plate.)
- (b) Auf dem Teller mit dem roten Streifen **steht** die Schüssel.
(On the plate with the red stripe **stands** the bowl.)

We tested this hypothesis by taking the advantage of German as a verb final language. We conducted a second experiment in which the sentences were constructed in such a way that the main verb appeared at the end of the sentence (e.g., (c) and (d)). The experiment included the same subjects that

had participated in the first experiment. The test sessions of the two experiments were at least six months apart.

- (c) Zeigen Sie mir das Bild, wo die Schüssel mit dem roten Streifen auf dem Teller **steht**.
(Show me the picture, in which the bowl with the red stripe on the plate **stands**.)
- (b) Zeigen Sie mir das Bild, wo auf dem Teller mit dem roten Streifen die Schüssel **steht**.
(Show me the picture, in which on the plate with the red stripe the bowl **stands**.)

In this experiment where the main verb occurred in verb final position agrammatic Broca's aphasics again show a very good performance. A comparison between this experiment and the previous experiment revealed no significant effect of verb position. On the basis of these results we are able to reject the objection that subjects' performance is due to the early availability of the main verb.

From our first experiment we had concluded that agrammatic comprehension may become most evident when a particular computational space is required. To test this hypothesis we conducted a further experiment with the same subjects under a condition in which subjects had to listen to each of the test sentences in the absence of the pictures and were only then required to indicate their comprehension by picture choice. Under this condition Broca's aphasics but not Wernicke's aphasics showed a consistent decrease in performance.

These results were taken to support our initial hypothesis that agrammatic behavior in comprehension is most likely to become evident when a particular computational and/or memory space is required.

4.3.4 Processing inflectional morphology

Friederici and J.M.I. Wessels in collaboration with U. Bellugi and K. Emmorey (Salk Institute) finished the German part of the joint project on "Processing inflectional morphology: Constraints across languages". The experiments described in detail in the Annual Report 1988 were designed to test whether agrammatic aphasics are able to process inflectional morphology on-line. Using a word monitoring task we studied whether subjects are sensitive to the absence or presence of an inflectional element in a sentence. Five agrammatic Broca's aphasics, three Wernicke's aphasics and a group of young healthy and age matched controls were tested. The results revealed that Broca's aphasics like normals are sensitive to the incorrect presence of an inflectional element (verb inflection in a noun context). Unlike normals, however, Broca's aphasics are not sensitive to the incorrect absence of an inflectional element (missing verb inflection in a verb context). From these results we concluded that although agrammatic Broca's aphasics are able to recognize an inflectional element by form, they may not be able to recognize the particular grammatical information the element carries.

In a second experiment we tested this hypothesis by comparing subjects' word monitoring latencies for target words following a correct inflectional element (*er tanzte*, 'he danced') with those for target words following an incorrect inflection (*du tanzte* (3.Pers.Sing.), 'you danced'). The finding that Broca's aphasics unlike normals show no difference in monitoring latencies between the correct and incorrect condition suggests that these patients seem to process the form of an inflectional element (Experiment 1), but not the syntactic information it carries – at least when tested on-line.

4.3.5 Normal comprehension

Proposing the loss of automaticity hypothesis Friederici argued that slowing down the access to the syntactic information should result in agrammatic comprehension even in normals. In the search for a paradigm which would allow such a manipulation in normals Friederici, Kilborn and A. Deckers conducted a number of experiments using a syntactic priming paradigm in which they masked the critical prime element in the auditory context by different noise levels (white noise, pink noise). The combined results, however, indicated that as long as subjects are able to perceive the phonological input they have immediate access to the syntactic information the item carries.

In a second line of research Friederici, H. Schriefers and Deckers used a cross-modal interference paradigm. The subjects' task in the experiments was to judge strings of visually presented letters as words or non-words. An auditory distracter was given at different SOAs (50, 150, 400, and 800 msec). The visual targets were nouns, prepositions, and pronouns. The auditory distracters for the nouns and prepositions were either (a) identical with the target, or stood in (b) a close semantic or a (c) far semantic relation to the target. For pronouns the auditory distracter was either (a) identical, (b) of the same grammatical word category (personal pronoun) or of a (c) different word category within the same word class (e.g., conjunction, article). The results from young healthy subjects reveal a particular time course for the activation of semantic and syntactic category information during word recognition, with semantic information showing earlier effects than syntactic category information. The observed inhibition effects for the access to syntactic information serves as the basis for an experiment planned by Friederici, Kilborn and Deckers in

which the cross-modal word interference paradigm will be applied in sentences.

4.3.6 Unimodel syntactic priming in Broca's aphasia

H. Haarmann and H. Kolk (U. Nijmegen) started a series of syntactic priming experiments designed to test their timing hypothesis of Broca's agrammatism. This hypothesis predicts Broca's aphasics to show syntactic priming, however, only at a subrange of SOAs between prime and target. Competing hypothesis, such as the memory-capacity-reduction hypothesis and the loss-of-automaticity hypothesis, do not predict such a result.

In the syntactic priming studies, a visually presented (one- or two-word) syntactic fragment preceded a visually presented target word for which a lexical decision had to be made. Two pilot studies with a total of 240 students were conducted: one, to determine the range of SOAs over which a syntactic priming effect can be obtained in normals and a second one, to determine a suitable neutral prime condition. Syntactic priming was obtained for 6 different SOAs ranging from 200 to 1200 ms. It did not matter much to the size of the effect whether the SOA was manipulated by changing the prime onset – prime offset interval or by changing the prime offset – target onset interval. Both hash marks and the Dutch phrase *nu volgt*: ('now comes:') appeared to be suitable prime fragments for the neutral condition.

Currently, 15 Broca's, 3 Wernicke's, 25 student controls and 18 age-matched controls participate in a syntactic priming experiment with 3 different SOAs (administered in 3 separate sessions) and 4 different types of syntactic violations.

Haarmann and Kolk also continued their computer simulation study of Broca's asyntactic understanding. Changing the

temporal availability of all syntactic information in the model appeared to produce the same pattern of results as obtained in two studies with real Broca's aphasics.

4.3.7 Lexical ambiguities in context

P. Hagoort finished the research for his thesis by March. In a final set of experiments, the time course of integrating lexical items into their context was tested in agrammatic patients.

A first series of experiments presented Noun-Noun ambiguities within different contexts biasing only one of the ambiguous meanings. The sentence was followed by a target word that either related to the context-appropriate meaning or to the context-inappropriate meaning of the ambiguity. The ISI between the sentence and the target items was 100 msec in one version of the experiment and 750 msec in the other version. Both sentences and targets were presented auditorily. Subjects were required to make a lexical decision on the targets. For the normal control subjects selection of the context-appropriate reading of the ambiguity was obtained with both the ISI of 100 msec and of 750 msec. The agrammatic patients showed selection of the appropriate reading with an ISI of 750 msec, but not with an ISI of 100 msec. In the latter case both readings of the ambiguity were still activated. This shows that the time course of meaning selection is changed in agrammatic patients.

A second series of experiments presented Noun-Verb ambiguities within syntactic contexts. Again, the ISI between sentence and target was varied between 100 msec and 750 msec. Normal control subjects showed for both ISIs that they had used the syntactic context information to select the appropriate reading of the Noun-Verb ambiguity. Agrammatic patients showed the same pattern of performance with an ISI

of 750 msec only. However, with the ISI of 100 msec an abnormal pattern of results was obtained. With this short ISI between context and target, only the noun reading was activated, independent of whether the syntactic context biased the noun reading or the verb reading. This indicates that the agrammatic patients are impaired in the rapid, on-line use of syntactic information in the process of meaning selection, and thereby in the construction of a sentence representation.

5. Other Activities 1989

5.1 Experimental Facilities – Activities of the Technical Group

5.1.1 Development of experimental facilities and laboratories

The ERP Lab software was further expanded and ported to the VAX computers to allow more efficient and comfortable work. A completely new and highly application oriented graphic user interface was built for the specification of experimental parameters. First steps of porting the analysis software to a window oriented user interface on workstations have been made. This job will be finished in 1990.

In cooperation with scientists the technical group specified a graphic oriented specification language for experiments in the next decade. A prototype version of this language is now being implemented. The creation of the prototype including the experiment execution kernel will be finished and extensively tested in 1990.

For the project dealing with the acquisition of phonology a database has been specified and a user friendly interface has been implemented allowing input, manipulation and retrieval of the appropriate phonologic and orthographic coding. As all database applications at the institute, it is based on Oracle.

To allow combined orthographic and phonologic output on laser printers, the technical group implemented the IPA

symbol set on the Kyocera printers. It can be accessed from WordPerfect on both VAXes and PCs.

For a new series of experiments where the response of very young children (6-10 months) to acoustic stimuli is analyzed, the technical group set up a PC based lab. Audio signals including speech can be generated randomly with respect to sequence and channel. The reaction of the children is mainly recorded on videotape. However, online categorization along with timing information are also measured by PC as overlaid into the Video information.

For experiments run in Japan and China the technical group developed a powerful graphic editing system to manipulate Chinese characters and an experiment program which can present segments of characters, separate characters and sequences of them. This was done on a laptop with plasma display, which was equipped with a special home made response box for measuring reaction times via push button and/or voice key (see 5.1.3).

With respect to running experiments, the technical group supported many special purpose solutions, connected the Tandy hand held machines used for text input during experiments to the experiment AT and ported the new DMASTR version.

The technical group also participated in the computational modelling project. Studies of the physical and mathematical basis of neural nets, their application in the domain of speech recognition and existing simulators were carried out. The architecture of a more psycholinguistically motivated modular neural net for word recognition was worked out, based mainly on modules incorporating either time delay or recurrent neural nets, which can deal with the sequential, dynamic character

of the speech signal. Aspects of using a Kohonen type of associative map for representing a complex lexicon have been discussed.

5.1.2 Computer facilities and tools

The Max-Planck-Institute for Psycholinguistics has bought further IBM compatible ATs and laptops both for experimental and standard use. It especially introduced six new workstations. Three of these are VAX-architecture workstations running under VMS and three are RISC-architecture workstations running under UNIX. The latter are mainly intended as powerful machines, specifically for the computational modeling project involving CPU-intensive work with neural nets.

All these workstations are equipped with window software and sophisticated easy to use applications based on this window environment. Since RISC-workstations will be the driving force in the computer business, the technical group will intensify its work in the following domains: UNIX, DECwindows, DECwindow based applications. We started to port two applications to the window environment: ERP lab and Speech lab.

5.1.3 Electronic lab

A new small reaction response unit which can be used in connection with PCs or laptops has been designed, tested, and built (several copies).

Further the concept for a new timer server and speech server which are compliant with the new software planned for running experiments in the future has been specified and various submodules of them were built and tested. This work will be finished in 1990 too.

5.2 Projects Involving Other Institutes

CELEX: A centre for lexical information

Since January 1st, 1986, the Max-Planck-Institute and the Interfaculty Research Unit for Language and Speech of the University of Nijmegen have been housing the Dutch Expertise Centre CELEX (Centre for Lexical Information). This national Expertise Centre exists to support linguistic research and language-and-speech-oriented technological projects by providing lexical data, the hardware and software to access these data, and the expertise to apply these data and facilities effectively.

To this end, CELEX has constructed massive electronic databases that hold information on Dutch, English and German words – the three languages that are targeted by most Dutch research and software development projects involved in **Natural Language Processing (NLP)**.

Since January 1989, CELEX has also been an official common resource for all Dutch academic institutions. To ensure that this role can be fulfilled, the word information contained in the CELEX databases can be accessed through the Dutch academic research network SURFnet. Applications can either be on-line (e.g., querying the databases interactively) or off-line (e.g., extracting electronic dictionaries to set up new and better NLP systems). The specially-designed menu-driven user interface FLEX enables users to locate and extract the information they need with ease.

During 1989, special attention was given to the collection of various sorts of lexical data for German, to the improvement of phonological and morphological information for English, and to the collection of English/Dutch translation equivalency information.

In parallel with this work, much effort has gone into the further improvement of the FLEX user interface.

On January 1st, 1989, the CELEX team began the second three-year developmental stage, with the aim of further enhancing and improving the three language-specific databases. First of all, a new database of German was designed along the lines of the existing Dutch and English databases. The implementation of this database is already well underway, so that a first version of this database, including phonetic transcriptions for all entries, and unique data on the derivational and compositional morphology of German stems, can be released in the summer of 1990. In addition, CELEX started linking the Dutch and English lexical databases semantically by adding new information on translation equivalency. As a consequence, many entries in the Dutch database have been enriched with major semantic features and many subtle syntactic subcategorizations.

Further activities related to these interlingual semantic links will cover the complete second phase of the project. Once these formal semantic and syntactic categorizations are fully available, they will without doubt provide researchers and system developers in the field of natural language applications with a new and powerful computational tool, one which can subsequently be applied in various systems that are currently being developed within the field of language technology.

The user interface FLEX has now been extended with several additional tools developed in 1989. A significant new feature is the parser built into the Oracle database management system, the result of a joint effort between CELEX and the Dutch Oracle Company. This parser enables FLEX users to express many of their database queries in terms of context-sensitive grammars. It even allows users to formulate gram-

mars that change the representation of the lexical data: users can, for example, specify their own non-standard phonetic transcriptions, or re-write the codings of the various syntactic categorizations, or restructure morphological analytical trees, and so on.

These and many other additional software tools have led to a further significant increase in the number of people who use the CELEX lexical databases in their research and software-development projects.

5.3 Conferences, Symposia, and Workshops

5.3.1 Annual conference

Members of the Interface Project organized a three-day workshop which was held at the Max Planck Institute in December. The workshop “When words happen to be phrases” combined theoretical and experimental approaches to study structural intricacies of the morphology/syntax interface and their consequences for language processing.

Speakers included: M. Bierwisch, G. Booij (Amsterdam), G. Carlson (Rochester), L. Frazier (Amherst and Wassenaar), R. Job (Padova), A. Jongman, A. Lahiri, R. Lieber (Durham), M. Nespore (Amsterdam), S. Olsen (Bloomington), E. Reuland (Groningen), R. Schreuder (Nijmegen), J. Sereno, M. Tanenhaus (Rochester), and A. Zwicky (Columbus and Palo Alto).

Discussants were: J. Bayer, H. Günther, W. de Haas (Utrecht), W. Klein, J. Kornfilt (Syracuse), and P. Zwitserlood.

The proceedings of the workshop will be published as part of the Yearbook of Morphology, 1990.

5.3.2 The Nijmegen Lectures 1989

The 1989 Nijmegen Lectures were given by R. Jackendoff (Brandeis U.). The theme of the Lectures was "On Foundations of Cognitive Science". In two public lectures, Jackendoff addressed the place of language in the cognitive system, including computational aspects of vision and musical abilities. These lectures were followed by three seminars which dealt mainly with the mapping of syntactic argument structure onto conceptual structure, and with the mental representation of quantity and bounding as it is relevant for capturing verbal aspect and individuation. The three seminars were followed by a discussion between Jackendoff and M. Bierwisch (Academy of Science, Berlin (GDR) and Max-Planck-Institute for Psycholinguistics, Nijmegen) and a subsequent open discussion. The Nijmegen Lectures attracted a great number of researchers and students from The Netherlands, West Germany and other European countries.

These lectures were organized in cooperation with the Interfaculty Research Unit for Language and Speech (ITWS) of the University of Nijmegen by J. Bayer, H. van Jaarsveld, B. Weltens and P. Zwitserlood.

5.3.3 Workshop "Reaction time models and methods"

In February, D. Vorberg (Phillips U., Marburg) presented a week-long workshop entitled "Reaction time models and methods". The workshop addressed the following: elementary probability theory, different model types (e.g., parallel, serial, network), and various methodological issues (e.g., experimental procedures and data analysis).

5.4 Internal Lectures and Colloquia

A number of lectures were organized by the Institute's Colloquium Committee (V. Ehrich, K. Kilborn). Lectures were given by:

L. Frazier (U. Massachusetts, Amherst), G. Kempen (NICI, U. Nijmegen), J.H. Randall (Northeastern U., Boston), L. Rizzi (U. Genève), L. Selkirk (U. Massachusetts, Amherst), R. Wiese (Heinrich Heine U., Düsseldorf).

Furthermore, many informal lectures and colloquia were given by long-term and occasional visitors to the Institute.

5.5 Teaching

The staff of the Institute taught courses of varying duration in the following Summer Schools and Universities:

Centre for Language Behavior Research (FTT) (Bowerman, Vonk); Çukurova U., Adana, Turkey (Günther); DGfS, Hamburg (Bierwisch, Frauenfelder); East China Normal U., Shanghai (Levelt); Volkshochschule Münster, Steinfurt (Wittenburg); Inter-U. Centre, Dubrovnik (Bowerman); Peking U. (Levelt); Technische U. Braunschweig (Behrens); U. Düsseldorf (Weissenborn); U. Heidelberg (Klein); U. Köln (Günther); U. Konstanz (Klein); U. Leiden (Kilborn); U. Libre de Bruxelles (Frauenfelder); U. München (Günther); U. Nijmegen (Haarmann, Vonk, Weeks); U. Salzburg (Bierwisch).

5.6 Colloquia Presented

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

Bayer (U. Aachen; U. Groningen; U. Konstanz; U. Passau; U. Tilburg; U. Venice; U. Wuppertal); Bowerman (German Linguistics Society Summer School, Hamburg; U. Illinois, Champaign-Urbana; U. Wuppertal); Ehrich, (Goethe Institut, Amsterdam; U. Köln; U. Konstanz); Frauenfelder (CNR, Rome; Philipps U. Marburg); Friederici (Free U. Berlin; Institute for Neurosurgery, Kiev, USSR; U. Marburg; U. Oregon); Günther (Çukurova U., Adana (Turkey); T.U. Berlin; U. Dortmund; U. Freiburg; U. Köln); Levelt (Max-Planck-Institute Tübingen; MIT; U. Arizona, Tucson); Verrips (U. Amsterdam); Weeks (U. Amsterdam); Weissenborn (Carlton U.; Ottawa U.; Tel Aviv U.; U. Maryland, College Park, MD.; U. Wisconsin, Madison); Zwitterlood (IPO, Eindhoven).

5.7 Papers Presented at Congresses, Conferences, and Workshops

- Adone, D., and Verrips, M. "The acquisition of empty categories in Mauritian Creole". Conference on Language Development. Boston, October.
- Bassano, D., Hickmann, M., and Champaud, C. "Epistemic modality in children's discourse: Certainty and uncertainty". Society for Research in Child Development Biennial Meeting. Kansas City, April.
- Bayer, J., and Dasgupta, P. "WH-in-situ und Komplementstruktur in Bengali". 11. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Osnabrück, February.

- Bayer, J., and Kornfilt, J. "Restructuring effects in German". Workshop on Parametric Variation in Germanic and Romance. Edinburgh, September.
- Bayer, J., and Kornfilt, J. "Restrukturierungseffekte bei Extraposition von 'zu'-Infinitiven". Treffen der Gruppe 'Generative Grammatik im Süden'. Stuttgart, October.
- Bierwisch, M. "Three remarks on the status of lexical knowledge". Conference on Knowledge and Language. Groningen, May.
- Bierwisch, M. "Improper arguments and control verbs". Conference on Syntax und Semantik. Leipzig, October.
- Bierwisch, M. "Biologische Erklärung der natürlichen Sprache". Symposium on Soziale und biologische Determinanten der Sprache. Jena, October.
- Bierwisch, M. "Vergangenheit und Zukunft der kognitiven Linguistik". Tagung 40 Jahre Sprachwissenschaft der DDR. Akademie der Wissenschaften der DDR, Berlin, November.
- Bierwisch, M., and Haider, H. "Thematische Information von Infinitivkonstruktionen". Treffen der Gruppe 'Generative Grammatik im Süden'. Stuttgart, October.
- Bowerman, M. "The acquisition of spatial categories: Cross-linguistic studies of cognitive versus language-specific determinants". Theme day on First Language Acquisition. Werkgemeenschap Taal en Geheugen, Psychon. Nijmegen, January.
- Bowerman, M. "Puzzling over children's first word combinations: What have we learned in 25 years?" Society for Research in Child Development Biennial Meeting. Kansas City, April.

- Bowerman, M. Discussant, section on "Acquisition of language". Conference on Knowledge and Language. Groningen, May.
- Brown, C., Hagoort, P., and Swaab, T. "Does N400 reflect automatic lexical processing?". EPIC IX. Noordwijk, May.
- Champaud, C., Hickmann, M., and Bassano, D. "L'acquisition de la modalité épistémique en liaison avec le discours rapporté chez des enfants français de 4 à 8 ans". Conference on The Acquisition of Modality. Freie Universität Berlin, May.
- Cholewa, J., Friederici, A.D., Huber, W., and Wilbertz, A. "Processing of prepositions in sentence comprehension as reflected by gaze durations". Fifth European Conference on Eye Movements. Pavia, Italy, September.
- Deutsch, W. "William Stern – Person und Werk" (keynote address). Workshop on Differentielle Psychologie. Hamburg, February.
- Deutsch, W. "A natural history of possession on the basis of the Stern-diaries". Interdisciplinair Sociaal-wetenschappelijk Onderzoeksinstituut R.U.U.-Colloquium. Utrecht, February.
- Deutsch, W. "Vom Ende zum Anfang – Ein Prozeßmodell für die Entwicklung der referentiellen Kommunikation". Reimers-Symposium on Die Sprachproduktion und ihr Input. Bad Homburg, June.
- Deutsch, W. "Spracherwerb als konservativer und innovativer Prozeß". 9. Tagung Entwicklungspsychologie. München, September.
- Deutsch, W. and Behrens, H. "Die Tagebücher von Clara und William Stern". 2. Fachtagung für die Geschichte der Psychologie. Hagen, September.

- Deutsch, W., and Behrens, H. "Possession from a psycholinguistic viewpoint". First European Congress of Psychology. Amsterdam, July.
- Drews, E. "Priming of lexical and grammatical morphemes". Max-Planck-Institut für Psycholinguistik, Nijmegen, April.
- Drews, E., and Boelte, J. "Note : Not = Hefte : Heft? Visuelle oder morphologische Ähnlichkeit". 31. Tagung experimentell arbeitender Psychologen. Bamberg, March.
- Ehrich, V. "Aktionsartenbedeutung von Verben". Zweites Wuppertaler linguistisches Kolloquium zur 'Architektur des Lexikons'. Wuppertal, November.
- Feldweg, H. "The European Science Foundation second language acquisition data bank". ESF Seminar on Second Language Acquisition by Adult Immigrants. London, January.
- Frauenfelder, U. "Left and right context effects in speech processing". Speech 1989. Budapest, May.
- Frauenfelder, U. "Structure and process in the human mental lexicon". International Symposium on Synergetic of Cognition. Schloss Elmau, FRG, June.
- Frauenfelder, U. "The role of lexical databases in psycholinguistic research". Workshop on Lexicon and Computer. Utrecht, October.
- Frauenfelder, U. "Psychological constraints on connectionist models of word recognition". Colloquium Signaalanalyse en Spraak 1989. Utrecht, October.
- Friederici, A.D. "Wenn Sprache pathologisch wird: Zeitliche Bedingungen normaler Sprachverarbeitung". Reimers-Symposium on Die Sprachproduktion und ihr Input. Bad Homburg, June.

- Friederici, A.D. "Spatial assignment in extreme perceptual conditions: Mechanisms of adaptation". 8th Man in Space Symposium. Academy of Astronautics. Tashkent, UdSSR, October.
- Friederici, A.D. "Temporal constraints on language processes: What makes a module a module?" ZIF Conference on Domains of Mental Functioning: Attempts at a Synthesis. Bielefeld, December.
- Friederici, A.D., and Frazier, L., "Thematic role assignment in Broca's aphasia". 17th Annual International Neuropsychological Society. Vancouver, February.
- Friederici, A.D., and Wessels, J.M.I. "Taalperceptieprocessen bij kinderen in 't eerste levensjaar". Symposium der Nederlandse Vereniging voor Audiologie. Amsterdam, October.
- Friederici, A.D., Wessels, J.M.I., Emmorey, K., and Bellugi, U. "Sensitivity of lexical category and inflectional morphology in Broca's aphasia". 27th Academy of Aphasia. Santa Fe, New Mexico, October.
- Gevel, H.J. van den, and Vonk, W. "Het retorisch effect van linguïstische explicitering van tegenstellingen in argumentatieve teksten". 12e Minisymposium over Lezen. Nijmegen, April.
- Günther, H. "Was hat das Schriftsystem mit der Grammatik zu tun?" Jahrestagung der Deutschen Gesellschaft für Lesen und Schreiben. Bielefeld, April.
- Günther, H. "Die Worttrennung zum Zeilenende". 17. Tagung der Studiengruppe Geschriebene Sprache zur Orthographiereform im Deutschen. Bad Homburg, May.
- Haarmann, H.J., and Kolk, H.H.J. "Computer simulation of agrammatic sentence understanding: Hierarchical processing disrupted by a timing disorder". International Confer-

- ence on Neuropsychology. Harrogate, July.
- Hagoort, P. "Decay of syntactic information in language comprehension of agrammatic patients". 12th European Conference of the International Neuropsychological Society. Antwerpen, July.
- Hagoort, P., and Deckers, A. "On the nature of comprehension deficits in aphasia". Promotiedag Spraak- en Taalpathologie. Nijmegen, November.
- Heeschen, C. "Psychological stress in Broca's versus Wernicke's aphasics: Its repercussions on speech characteristics and on the emotional state of the patients". International Conference of the Academia Rodinensis Pro Remediatione. Dublin, Bangor, September.
- Hickmann, M. "Functional approaches to the development of reference: European perspectives". Society for Research in Child Development Biennial Meeting. Kansas City, April.
- Hickmann, M., Hendriks, H., and Liang, J. "A cross-linguistic study of cohesion in children's narratives: The introduction of referents". Society for Research in Child Development Biennial Meeting. Kansas City, April.
- Hickmann, M., Kail, M., and Roland, F. "The referential organization of children's narrative discourse as a function of mutual knowledge". Tenth Biennial Meeting of the International Society for the Study of Behavioural Development. Jyväskylä, Finland, July.
- Hickmann, M., Liang, J., and van Crevel, M. "The given/new distinction in children's narratives: A cross-linguistic analysis". Tenth Biennial Meeting of the International Society for the Study of Behavioural Development. Jyväskylä, Finland, July.

- Hoeken, J.A.L., and Vonk, W. "Context-invloed op lexicale verwerking: Kanaal-afhankelijk?" 12e Minisymposium over Lezen. Nijmegen, April.
- Hustinx, L.G.M.M., and Vonk, W. "Topic-shift markeerders en het verwerken van informatieve teksten". 2e Congres Nederlandse Vereniging voor Psychonomie. Noordwijkerhout, December.
- Jordens, P. "Linguistic knowledge in second language acquisition". The Ninth Second Language Research Forum. Los Angeles, February.
- Jordens, P. "Attrition in German as a foreign language". First European Congress of Psychology. Amsterdam, July.
- Kilborn, K. "Grammar out of sync: What agrammatism can tell us about the temporal course of syntactic processing". Sylvia Beach Language Comprehension Conference. Newport, Oregon, July.
- Kilborn, K. "Shifting strategies: Evidence for changes in native language processing in bilinguals". Workshop on Crosslinguistic Studies of Sentence Processing. Carnegie-Mellon University, Pittsburgh, July.
- Kilborn, K., and Friederici, A.D. "Cognitive penetrability of syntactic priming in Broca's aphasia". 27th Academy of Aphasia. Santa Fe, New Mexico, October.
- Klein, W. "Reduced language - Aphasia, foreigner talk and second language acquisition". Neurobiologisches Kolloquium der Universität Mainz, February.
- Klein, W. "Seven trivia of language acquisition". The Ninth Second Language Research Forum. Los Angeles, February.
- Klein, W. "Utterance structure in second language acquisition". The Ninth Second Language Research Forum. Los Angeles, February.

- Klein, W. "Deutsch als Wissenschaftssprache" (Podiumsdiskussion). 11. Jahrestagung der Deutschen Gesellschaft für Sprachwissenschaft. Osnabrück, March.
- Klein, W. "Funktionale Aspekte der Raumreferenz". Symposium Reimersstiftung. Bad Homburg, October.
- Klein, W. "How learners put their words together". Anéla-studiedag. Nijmegen, December.
- Kornfilt, J. "NP-movement and restructuring". Second Workshop on Comparative Syntax. Princeton, April.
- Kornfilt, J. "Functional categories: A diachronic perspective". Phrase Structure Conference (LSA Summer Institute). Tucson, July.
- Lahiri, A., and Marslen-Wilson, W.D. "Lexical processing and phonological representation". Second Conference on Laboratory Phonology. Edinburgh, June.
- Levelt, W.J.M. "Lexical access in speech production". Conference on Knowledge and Language. Groningen, May.
- Levelt, W.J.M. "Stages of lexical access in speech production". First European Congress of Psychology. Amsterdam, July.
- Levelt, W.J.M. "Speaking: How to get from intentions to articulations". Vth Bi-National Humboldt Colloquium. MIT, Cambridge, Mass., September.
- Levelt, W.J.M. "Speaking: How to get from intentions to articulations". AFinLA Conference. Turku, Finland, November.
- Li Ping. "What cues can Chinese speakers use in sentence processing?" Workshop on Crosslinguistic Studies of Sentence Processing. Carnegie Mellon University, Pittsburgh, July.
- Noordman, L.G.M., and Vonk W. "Knowledge based inferences in understanding conjunctions". Discourse and Dialogue Workshop. Lugano, October.

- Peeters, G., Frauenfelder, U., and Wittenburg, P. "Psychological constraints upon connectionist models of word recognition". *Neurospeech* 1989. Edinburgh, May.
- Perdue, C. "Complexification of the simple clause in the narrative discourse of adult language learners". *ESF Seminar on Second Language Acquisition by Adult Immigrants*. London, January.
- Perdue, C. "Les pronoms chez Paula". *VIIe Colloque International: 'Acquisition d'une Langue Etrangère'*. Aix-en-Provence, June.
- Perdue, C. "L'acquisition d'une langue étrangère en dehors de la salle de classe: Quelques enseignements du projet de la Fondation Européenne de la Science". *Ecole d'Eté de l'Alliance Française*. Paris, September.
- Perdue, C. "The European Science Foundation second language data bank: History, background and potential". *1st Meeting of the European Second Language Association*. Essex, November.
- Randall, J.H., and Carrier, J. "From conceptual structure to syntax: Projecting from resultatives". *Conference on Knowledge and Language*. Groningen, May.
- Reetz, H. "A fast expert program for pitch extraction". *Eurospeech* 1989. Paris, September.
- Reetz, H. "Comparison of spectrum windows for speech spectral estimation". *Speech* 1989. Budapest, May.
- Romaine, S. "Language development in a developing language: Relative clause formation strategies in Tok Pisin" (plenary address). *The Ninth Second Language Research Forum*. Los Angeles, February.
- Romaine, S. "The evolution of linguistic complexity in pidgin and creole languages". *Workshop on The Evolution of Human Language*. Santa Fe, New Mexico, August.

- Romaine, S. "The decline in predicate marking in Tok Pisin". Linguistic Society of America Annual Meeting. Washington DC, December.
- Sereno, J.A., and Jongman, A. "Phonetic priming: Explorations into the nature of the input representation in word recognition". Joint Meeting of the British Experimental Psychology Society and the Dutch Psychonomic Society. Cambridge, July.
- Simons, W.H.G., Vonk, W., and Noordman, L.G.M. "Kennis en inferenties bij het lezen van populair-wetenschappelijke teksten". 2e Congres Nederlandse Vereniging voor Psychonomie. Noordwijkerhout, December.
- Smoczynska, M. "The acquisition of Polish modal verbs". Conference on Modalität im Spracherwerb. West-Berlin, May.
- Vonk, W. "On the representation and processing of idiomatic expressions". Joint Meeting of the British Experimental Psychology Society and the Dutch Psychonomic Society. Cambridge, July.
- Vonk, W. "Referential devices and topic discontinuity in discourse". Discourse and Dialogue Workshop. Lugano, October.
- Vonk, W., Noordman, L.G.M., and Simons, W.H.G. "Kennis en integratieprocessen bij lezen" [poster]. Interuniversitair Instituut voor Fundamenteel en Toegepast Taalgedragsonderzoek (FTT). Nijmegen, May.
- Vonk, W., and Voort, M.E.C. "Het verwerken van idiomatische uitdrukkingen". 1st Tilburg Workshop on Idioms. Tilburg, May.
- Vorberg, D. "Parallel processing models, random utility models, and the choice axiom". 20th European Mathematical Group Meeting. Nijmegen, August.

- Vorberg, D. "Was passiert, wenn man die Variabilität zwischen Versuchspersonen mit der innerhalb von Versuchspersonen gleichsetzt?" 22. Treffen Gedächtnispsychologie und Informationsverarbeitung. Weschnitz, November.
- Weeks, L.A. "The lexicon and language acquisition: Cross-linguistic and word-class considerations". Meeting of the Dutch Organization for Applied Linguistics. Leiden, April.
- Weissenborn, J. "Some queries about parameter setting theories". Meeting on The Logical Problem of Language Acquisition. NIAS, Wassenaar, January.
- Weissenborn, J. "Null subjects in early grammars and what they can tell us about language acquisition". DFG Schwerpunktskolloquium 'Spracherwerb'. Hamburg, June.
- Wessels, J.M.I. "Taalverwerking bij jonge kinderen". Najaarsvergadering van de Nederlandse Vereniging voor Audiologie. Amsterdam, October.
- Wittenburg, P. "Neural nets in speech research". DECUS Europe, 1989. Den Haag, September.
- Zwitserslood, P., "Wann kommt semantische und syntaktische Kontextinformation während der Worterkennung zum tragen?" 22. Treffen Gedächtnispsychologie und Informationsverarbeitung. Weschnitz, November.
- Zwitserslood, P., and Schriefers, H. "Zur Rolle der Silbe bei der auditiven Sprachwahrnehmung". 31. Tagung experimentell arbeitender Psychologen. Bamberg, March.

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