

Neurobiology of Language: Key Issues and Ways Forward



April 8 and 9, 2021

Welcome and Introductory Remarks

By Peter Hagoort

Welcome to this two-day event on the Neurobiology of Language: Key Issues and Ways Forward.

Language is not only one of the most complex cognitive functions that we command, it is also the aspect of the mind that makes us uniquely human. Most of our culture clearly depends on the human ability to communicate ideas and construct artefacts with the help of natural language. To a large extent language is constitutive for human interaction and cooperation. At the same time, the diversity in form and content of existing languages is shaped by the interactional settings in which they are grounded. One of the remarkable features of linguistic phenotypes is that they come in very different forms, at all levels of organization. The sound repertoires of the more than 7000 languages that are still around today vary widely, as do their grammatical structures, and the meanings that their lexical items code for. For instance, some languages have a sound repertoire of only a dozen phonemes, whereas others have more than a hundred; some languages have a very elaborate system of morphological markers, whereas others are very limited in their morphological inventory; some languages make semantic distinctions in one domain, others in another domain. Further, sign languages are expressed by movements of hands and face, whereas spoken

languages are expressed by movements of the vocal tract. In addition to the variability in the world's languages, there is individual variation in language skills within the population of any given language community. Some people command only a limited vocabulary and simple sentence structures, whereas others are polyglots speaking multiple languages fluently, or can do simultaneous translation between languages.

Despite these differences between languages and individual language skills, most children master their mother tongue within about the first four years of life and with little or no explicit instruction. They command their native language at a remarkable level of complexity and computational sophistication well before they are capable of lacing their shoes or performing even simple mathematical operations such as addition and subtraction. Moreover, they are internally driven to communicate, exhibiting 'proto-conversation' in gesture and vocalization, and passive comprehension well before they can produce any words. This implies that the human brain exhibits a language-readiness not found in the brains of other species. What makes for the language-readiness of human brains, which genetic instructions contribute to building such a brain, and how does that language capacity build on the other systems of perception, action, memory and cognitive control?

Insights into the organization of the uniquely human system for language (including the universality and variability of the human language faculty) will not be gained if we study language at just one level of description and explanation. We will only make progress if we build on the insights from multiple levels of organization. For instance, there are both genetic and cultural contributions to

language variability. In addition, we need to combine insights about different cognitive systems that are in continuous interaction with language and that co-determine the structure and content of the utterances that speakers produce and listeners understand. In recent decades language has been increasingly studied at multiple levels, including neurobiological, psychological and linguistic levels of description and explanation.

The aim of our Max Planck Institute is to bring together the knowledge about the organization of human language skills acquired in many different fields (genetic/genomic, neurobiological, psychological, linguistic, computational, and even animal research).

On the next page we see a picture of the opening of the institute 40 years ago, in 1980. When Pim Levelt and Wolfgang Klein started the MPI for Psycholinguistics back then, ways to investigate this complex cognitive capacity were relatively limited. Traditionally they were restricted to observational and behavioural methods in healthy people and young children, and to studying neuropsychological patients with a language disorder. In recent decades this picture has changed dramatically. Partly due to technological developments and partly as a result of developments in other fields of research, methods to study language and communication have seen a vast increase in number and level of sophistication. Due to the technological progress in computing power, we are now able to build computational models of language processing that are much more advanced than ever before. Thanks to developments in neuroimaging and genetic sequencing, we are able to study the neural basis and the genetic underpinnings of the language-ready brain in an unprecedented manner.



Opening of the institute in 1980. On the pictures Reimar Lüst (President of the Max Planck Gesellschaft), Willem Levelt (founding director), Wolfgang Klein (co-director).

When I did my PhD on research on aphasia in 1990, one could hardly foresee that some 10 years later PET, fMRI and MEG would be available as research tool for investigating the neural basis of language in large numbers of healthy participants. Certainly no one could have anticipated that this institute would open a *Language and Genetics* Department. Here we see a picture of the opening of the new wing of the institute with its wet labs, in 2015.



Opening of the new wing of the institute by Princess Laurentien, planting the tree of language on June 10, 2015.

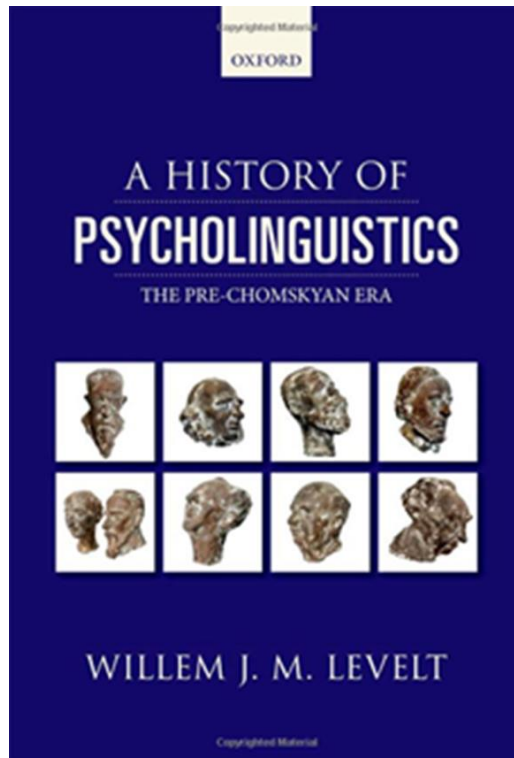
These developments, however, come at a price. To be able to appreciate research findings or actively and fruitfully participate in research on human language, one has to be acutely aware of the developments in the multiple specialized fields that are currently involved in understanding the foundations of human language skills. These developments have also increased the theoretical challenges. An integrated theory combining the insight from all levels of investigation is still missing. We have bits and pieces, but no overarching theory. Given the short history of the field in its current form that should come as no surprise. But of course it remains the ultimate goal of our efforts.

Last year, 2020, the Max Planck Institute for Psycholinguistics celebrated its 40th anniversary, as the only research institute worldwide fully dedicated to investigating human language as a central cognitive system. Due to the pandemic, the celebration was not as festive as we had hoped. However a series of scientific events have been organized. We had four very successful workshops on the *Future of Linguistics*.

And the next event is the one of today and tomorrow, with a focus on the neurobiology of language. I am very pleased that 14 leading researchers in this field immediately reacted positively to the invitation to contribute to our meeting. Originally the meeting was scheduled for last summer, but had to be postponed to this year with the hope that we could host it on-site in our own institute. We were too optimistic. Hence we had to decide to run the meeting on-line. The downside is that we will miss the informal interactions and the feeling of being together. The good news is that in this way many more attendees can join than the 150 that could be hosted on site. About 1000 attendees from all over the

globe registered for this meeting, indicating that the neurobiology of language field is blooming.

Celebrating the 40th anniversary of our institute could have been done by looking backwards, into what has been achieved in the past. Instead, we decided to look into the future.



Whoever is interested in the past should read the fantastic book about the History of Psycholinguistics by our founding director, Willem Levelt. But for this meeting we have asked the speakers not only to discuss their own work but also to reflect on the challenges for the future. What are the key issues and ways forward that they see for the neurobiology of language?

I wish and hope that this meeting will be an inspirational one for all of you.