The Language in Interaction consortium gratefully acknowledges the support of the Gravitation Programme of the Netherlands Ministry of Education, Culture and Science (OCW) and the Netherlands Organisation for Scientific Research (NWO).
Language in Interaction Consortium

Human language is the most powerful communication system that evolution has produced. It is the basis of culture and social life. It comes in many forms (> 6000 languages today). At the same time it is deeply rooted in the neurobiology of the human brain. The overarching quest of our programme is to account for, and understand, the balance between universality and variability at all relevant levels of the language system and the interplay with different cognitive systems, such as memory, action, and cognitive control. To achieve this, Language in Interaction brings together 41 researchers from eight different research institutions in the Netherlands to understand this unique capacity in its full glory.
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List of abbreviations

BGTC - Basal Ganglia Thalamocortical Circuitry
BoD - Board of Directors
CLS - Centre for Language Studies
CNS - Cognitive Neuroscience
DCC - Donders Centre for Cognition
DCCN - Donders Centre for Cognitive Neuroimaging
DGCN - Donders Graduate School for Neuroscience
ECoG - ElectroCorticoGraphy
EEG - ElectroEncephaloGraphy
ERN - Event Related Negativity
ERP - Event Related Potential
ET - Educational Team
EUR - Erasmus University Rotterdam
fMRI - functional Magnetic Resonance Imaging
MMN - MisMatch Negativity
FoA - Faculty of Arts
FoS - Faculty of Science
FOXP2 - box forkhead protein P2
GB - Governing Board
GPiL - Graduate Programme in Logic
IMPRS - International Max Planck Research School for Psycholinguistics
L2 - Second Language
LIi - Language in Interaction
LOT - Netherlands Graduate School of Linguistics
MEG - MagnetoEncephaloGraphy
MPI - Max Planck Institute for Psycholinguistics
MRI - Magnetic Resonance Imaging
NWO - Netherlands Organization for Scientific Research
PhD - Philosophiae Doctor
PI - Principal Investigator
RNN - Recurrent Neural Network
rs-fMRI - resting state functional Magnetic Resonance Imaging
RU - Radboud University
SIKS - Netherlands Research School for Information and Knowledge Systems
T - Tesla
tACS - transcranial Alternating Current Stimulation
TiU - Tilburg University
TT - Tenure Track
UL - Leiden University
UM - Maastricht University
UMCU - University Medical Centre Utrecht
UvA - University of Amsterdam
VU - VU University Amsterdam
WP - Work Package
PREFACE

Since its start in July 2013 the Language in Interaction consortium has made substantial progress. Its first phase was dedicated to establish the organizational infrastructure required for supporting the science and the knowledge dissemination. With the organization in place the important next step was to get the science going. In our case this meant that concrete project proposals were recruited from the 41 PIs that collaborate in our consortium. The challenge was to recruit innovative, risky research projects that are within the research domain of the LiI consortium, and to implement collaborations that would not have happened otherwise. In this way, after a very careful evaluation procedure and with the help of external experts 17 PhD projects were awarded, and in the meantime have started. Soon, a third round will award another 5 or 6 projects. At the same time knowledge dissemination is on its way. An external website, a special Theme page on Kennislink (“Over Taal Gesproken”), and the development of a whole series of Apps are the first concrete products of our efforts to translate our science to applications and knowledge for society.

After this first phase, time is now ripe for a second major step in the life of our consortium. In this next phase we will step up the consortium-wide collaborations by jointly identifying four or five big questions (The Big Five) that form the skeleton for the formation of collaborative research teams that collectively work on answering these big questions within our overall research endeavour.

Here we present a first report on what has been done so far in our Gravitation programme. The general feeling in our consortium is that this programme has allowed us to meet our scientific challenges at an unprecedented way, and made it possible to entertain in collaborative research that would not have happened otherwise.

This report presents facts and figures related to the first one and a half years of our Gravitation programme. I hope that nevertheless it will radiate some of the excitement that lies behind the facts, names and numbers.

Peter Hagoort

Programme director
INTRODUCTION

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.

DIVERSITY IN LANGUAGE (SKILLS)

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 6000 languages that are still around today vary widely, as do their grammatical structures, and the meanings that their lexical items code for. Furthermore, 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.

LANGUAGE READY BRAIN

Despite these differences between languages and individual language skills, most children master their mother tongue (spoken or signed) 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?

UNIVERSALITY AND VARIABILITY

A hallmark of the cognitive sciences (linguistics, psychology, neurosciences) has always been to understand the basic organization and infrastructure of our cognitive capacities as shared between all members of our species. In recent times, however, we have come to realize that variability is as much a hallmark of language as universality. Recent advances in human genetics have revealed that there is substantial variation in genomes of different individuals, and that this contributes significantly to variability in cognitive functions. Differences between languages or differences in general input conditions, as for instance in the congenitally blind, have been found to result in variation in the recruitment of brain areas for language. Moreover, the different interactional settings in which language is grounded vary in their goals and cultural forms, which will co-determine the variability in language use and skills.

OVERARCHING QUEST

The overarching aim of our programme can be summarized as accounting for the variability in languages and linguistic skills, and their boundary conditions, namely the constraining universals. Thus, to get an integrated explanation of how this extraordinary foundation for human culture and social life can have the properties that are so distinctive: a wide diversity of cultural patterning on a universal biological substrate.
Insights into universality and variability will not be gained if we study language at just one level of description and explanation. Language in Interaction is characterized by structured interaction between experts in all domains of language research (from genetics up to cultural contributions) and combines this with insights about different cognitive systems that are in continuous interaction with language.
CONSORTIUM MANAGEMENT

PARTNERS

To fulfil our aims and ambitions, the LiI consortium brings together researchers from the humanities and the cognitive sciences who are leading experts in multiple aspects of language and cognition. They come from eight different research institutions in the Netherlands, with complementary expertise in a highly interdisciplinary area of language research.

These are:
- Radboud University,
- Max Planck Institute for Psycholinguistics,
- University of Amsterdam,
- Leiden University,
- University Medical Centre Utrecht,
- University of Maastricht,
- Tilburg University,
- Erasmus University Rotterdam.

CONSORTIUM ORGANIZATION

To achieve our overarching aim, we chose a flat and transparent organizational structure enabling innovative research by lean, goal-directed management. All entities mentioned below are in place. For more details information on our project organization and the members of the different boards, please refer to appendix B.

ADVISORY BOARD

The Advisory Board represents the stakeholders. It monitors the research and educational programmes on the basis of annual reports and biannual meetings with the programme director.

SCIENTIFIC ADVISORY BOARD

The Scientific Advisory Board, consisting of (inter)national researchers who are the absolute top of our field, is installed to monitor the quality of our research and educational programme. It receives annual reports and meets with a representation of LiI researchers every second year, on the basis of which it advises the Scientific Board of our consortium on the design and implementation of the research programme and on the achievement of its scientific aims.
SCIENTIFIC BOARD
The Scientific Board, consisting of programme director and the leaders of the WPs, is responsible for day-to-day management. The Scientific Board meets every 2 months, taking all the major decisions regarding scientific, educational, financial and communication issues.

WORK PACKAGES
The research programme is organized into seven focused, but coherent work packages (WPs) with clear and open procedures to promote collaborative, innovative, interdisciplinary research at the cutting edge of the field. Five scientific WPs define the content of the research programme. These WPs are based on a decomposition of the human language faculty into its key components, the remaining two WPs provide the interface between research, methods and utilization.

EDUCATIONAL TEAM
Language in Interaction aims at teaching and training the next generation of leading scientists in its field of research. Our Educational Team (ET) meets twice a year and consists of the representatives of the graduate schools with central contributions to the PhD training programme, namely:
- Donders Graduate School for Cognitive Neuroscience (DGCN)
- International Max Planck Research School for Language Sciences (IMPRS),
- Netherlands Graduate School for Linguistics (LOT),
- Graduate Programme in Logic (GPIL),
- Netherlands Research School for Information and Knowledge Systems (SIKS),
The ET is responsible for coordinating and aligning their existing training programs, for monitoring the progress of our PhD students, for preparing educational activities and discussing any other educational issues. In addition, the ET intensifies the contacts between the different participating schools offering them the opportunity to exchange experiences and discuss good practices. From this new initiatives can emerge that transcend our consortium. Thus, the ET offers a platform from which both our partner schools and our PhD students can benefit.

MANAGEMENT TEAM
The management team is responsible for assuring efficient planning, control and organization of all scientific, educational and financial structures and meetings, as well as for organizing all dissemination and PR activities.

ENABLING INTERACTION
Next to the management structures, it is vital to organize the scientific life of the consortium. For this purpose different types of meetings are organized.
Six times per year we organize a full day devoted to bringing together all the members of Language in Interaction. On the mornings of these days time is reserved for meetings of the Scientific Board and a separate meeting for our PhDs. In the afternoon a session is organized for all members of the consortium to exchange information on and discuss ongoing research and future plans. All to foster scientific exchange and quality. The remainder of the afternoons are reserved for meetings within or between the different WPs. Dates of these consortium meetings are fixed for the upcoming year to guarantee maximal possibility of participation by the consortium members.
In addition, an annual PhD retreat is organized as an opportunity for our PhD students to present their research project in a talk or at a poster and to get additional training.
Next to the above mentioned fixed meetings, specific WP-meetings and research project meetings of collaborating PIs and their postdocs and/or PhDs are held on a regular basis, determined by the need and the progress of the project at hand.
RESEARCH PROGRAMME

RESEARCH ORGANIZATION

The research team consists of 41 Principal Investigators organized into seven focused, but coherent work packages (WPs). Clear and open procedures promote collaborative, innovative, interdisciplinary research at the cutting edge of the field, both within and between work packages. Five scientific WPs define the content of the research programme. These WPs are based on a decomposition of the human language faculty into its key components. In addition to this excellence in the domain of language and related relevant fields of cognition, the remaining two WPs provide the interface between research, complex research methods and utilization.

WP 1: Speech perception and production in interaction
WP 2: Semantic and conceptual basis of language
WP 3: Compositionality and contextuality
WP 4: Language in action
WP 5: Language evolution and diversity
WP 6: Toolkit
WP 7: Utilization

WORK PACKAGE CONTRIBUTIONS TO OVERARCHING QUEST

Work Package 1 - Speech Perception and Production in Interaction

The focus of this work package is on the primary mode of language for which our brain is evolutionarily adapted, namely the production and comprehension of spoken language. These adaptations have shaped our auditory and motor cortices in directions that allow us to perceive and produce the speech sounds which form, respectively, the entry point to or exit point from knowledge stored in long-term memory. The key innovation of WP1 is the bridging from expertise in the neurobiological foundations of perceptual and motor processes to psycholinguistic expertise in the perception and production of speech. It thus aims to advance understanding of how speech perception and production interact by linking neural, psychological and linguistic levels of analysis. This novel multi-disciplinary approach generates new insights precisely because speech has special characteristics. Specialised neurobiological infrastructure is adapted to these characteristics by evolutionary selection, and enables infants to perceive and produce speech without explicit instruction. Genetic diversity, however, may also have led to variability in this infrastructure, and to variability across languages (e.g. tone vs. non-tone languages) in the demand imposed on auditory and motor systems. In line with the overarching quest of the Language in Interaction consortium, it is therefore necessary to distinguish processes reflecting language-universal constraints from those reflecting linguistic diversity. The goals of WP1 are being addressed through three main questions: Are our auditory and motor cortices speech-ready? How does feedback support speech processing? And how do perception and production interact? WP1 has started up research projects to address each of those questions.
Work Package 2 - Semantic and Conceptual Basis of Language

The focus of this work package is on the mnemonic structures that are necessary to build and use semantic content and conceptual knowledge: how information is retrieved from memory to give linguistic expressions their content. In turn, the language system builds on existing memory structures which co-determine the organization of linguistic knowledge. The mnemonic structures are laid down during development. WP2 aims to shed light on the mechanisms underlying the development, structuring and deployment of abstract representations for both linguistic and mnemonic domains. The key innovation of WP2 is the unique collection of experts from different fields which provides the necessary interdisciplinary resources for investigating up-close the interplay of language and memory; the opportunity to study how linguistic structures can provide a basis for mnemonic tasks and, conversely, how pre-existing mnemonic structures can support the formation of linguistic knowledge. Moreover, WP2 will ultimately provide a mechanistic model of conceptual semantic memory which will be a crucial asset for the overarching quest of the Language in Interaction consortium. In particular, this will provide novel fundamental insights on the relationship between the developmental aspects of memory and language and the role of constraining universals in language variation, on the one hand, and on the role of mnemonic system for a language ready brain.

The goals of WP2 are being addressed through three main questions: How is conceptual knowledge extracted from our continuous flow of experiences? How is conceptual meaning represented? How do pre-existing concepts affect the formation of new ones and how do newly acquired concepts affect existing ones?

Work Package 3 - Compositionality and contextuality

The focus of this WP is on the largely open question of how the mechanism of binding is realized in distributed cortical networks along different time scales. Regarding the temporal configuration, current theories on neural processing point to transient synchrony of neuronal spiking as the neural correlate of information transmission between brain areas. Different spike-time-dependent mechanisms for flexible binding are investigated that will then be incorporated in a neurally plausible model of language processing. The role of different brain areas, such as Broca's area, that seem to be involved in binding will also be investigated. Key innovation is the unification of abstract computational accounts of compositionality and contextuality, that have been formalized in recent years at the mathematical level, with implementations of binding that have neural plausibility. Given that for producing and understanding language combinatorial operations are in place that dynamically construct composite syntactic and semantic structures from more primitive building blocks, WP3 will address the following main questions: How are such operations mechanistically instantiated in cortical networks (i.e., the binding problem)? What is the contribution of different brain areas to binding and unification? How is linguistic memory organized and how is it accessed? What are the primitive building blocks of language stored in lexical memory, and what aspects of an utterance are computed online by binding operations? How are complex linguistic structures, such as multi-word constructions, or (partly) abstract tree fragments stored in cortical networks, and how are they recruited? How do the different levels of linguistic description (e.g., phonology, syntax and semantics) interact within a neural architecture?

Work Package 4 - Language in Action

The focus of this work package is on language processing during social interaction. Language users operate in a constantly variable and dynamic context, provided by multimodal sources of information; they need to combine linguistic input with visual and other sensory aspects of the communicative interaction. To do this they also need a flexible cognitive control system. Although at a behavioural level there are detailed descriptions of multimodal language use in social interaction, the neural and cognitive infrastructure of this unique human ability is poorly understood. Research within the work package aims to explain these complex neural processes through the interplay...
between language and other cognitive systems in the brain. The **key innovation** of WP4 lies in its composition. The work package brings together renowned scientists who are experts in the areas of perception, action, prediction and multisensory integration outside of the domain of language, and those who are experts in the relations between action understanding, communicative actions (gestures, signs) and cognitive control in the domain of language. WP4 aims to also include clinical populations (Parkinson’s, autism), and provide better understanding of these conditions. The three **main questions** of WP4 concern the role of multimodal integration, the actions and goals understanding and cognitive control in linguistic communication. By studying these questions we aim to achieve a better understanding of the cognitive and neural infrastructures involved in language use in social context.

**Work Package 5 - Language evolution and diversity**

The **focus** of this work package is on exploring the biological underpinnings of linguistic universality as well as diversity, both at the population level (between species), at the linguistic level (between languages and dialects), and at the individual level (between speakers). **Key innovation** is the highly interdisciplinary composition of the work package. It brings together PIs from five relevant disciplines: linguistic anthropology, linguistics, psycholinguistics, genetics, and biology. The central strategy will be to explore both the universality and variability in the learning mechanisms and neurobiological infrastructure subserving language. WP5 will aid in shaping the overall focus on variability across all components studied in the consortium.

WP5 is now involved in projects evolving around **main questions** like: How does diversity - variation between languages and within languages -, emerge and how is it maintained: the Babel Problem? What are the functions of zebra finch FoxP genes for the perception, discrimination and processing of vocalizations? How do human listeners achieve multidimensional perception of speech and to what extent is it unique to human speech perception or is it a more general property of the acoustic system? What are the psychological and neural mechanisms responsible for the variation we find within and between individuals in the production and perception of speech rate?

**Work Package 6 - Toolkit**

The **focus** of this work package is on supporting the scientific WPs by developing and facilitating the use of cutting edge technologies such as structural and functional imaging, neural modelling, genomics, cognomics and genetic imaging in order to investigate the biological underpinnings of language, and by providing the clinical infrastructure of studying language problems in clinical conditions. **Key innovation** revolves around using state-of-the-art imaging and genomic technologies to investigate the dynamic and interactive aspects of language processing in the brain. To test novel concepts in language research, the consortium employs the latest technologies in imaging quality and signal processing in conjunction with sophisticated analytical and modelling techniques. Understanding of the organizational concepts of neural processing of language and their interaction may ultimately pave the way for enhanced language acquisition and better compensatory training of people with speech and language deficits. WP6 has a primarily supportive role in supporting the other WPs by providing the analytical and clinical-translational expertise necessary to achieve the overarching objectives of the language in interaction programme at the highest level of methodological sophistication. In this respect, some of the **main questions** that WP6 seeks to address are: In which way do specific brain circuits interact to generate speech and language comprehension and production? What is the inter-individual variation in the pattern of brain circuits subserving language comprehension and production? Are those neural signatures abnormal in case of disorders of speech and/or language? How do known genetic factors (i.e. candidate genes) and to be identified genetic factors affect this pattern of interacting brain circuits? Can we build whole brain computational models of speech and language and their disorders?
Work Package 7 - Utilization

The focus of this work package is on charting and developing ways for LiI research outcomes to be applicable and relevant in the outside world. It shapes the LiI infrastructure for knowledge utilization by ensuring that the means and personnel are available to support researchers in their utilization efforts. These range from ideas, theories, inventions and innovations towards actual use and benefit to society. Key innovation is the active encouragement of LiI researchers to transform ideas into commercial and/or societal products. WP7 will coach and assist them in identifying and designing applications (of any kind), in finding partners, and finding their way in the world of patent and grant application.

WP7 participates in research projects in the domain of language research that can be applied in clinical or technological settings. These projects evolve around main questions like: How do different forms of feedback (e.g. neurofeedback) support speech processing and production in L2 learning? How can we make use of innovative techniques for analyzing brain language data? The answers to such questions may help in developing applications like Brain-Computer Interface systems or clinical applications.
RESEARCH PROJECTS
For all our research activities we aim for projects that are new, innovative, interdisciplinary, and of the highest scientific quality. Behind all research positions initiated there is the rationale that our consortium should be more than the sum of its parts, leading to research activities that go far beyond "business as usual".

EMBARKING ON OUR QUEST
To reach our ultimate goal of getting insight into universality and variability of language(skills) by structured interaction between experts in all domains of language research, all PhD positions that are financed through the grant are distributed through an internal open competition. This keeps flexibility and quality of our consortium as high as possible. PIs directly involved in LiI are invited by the LiI scientific board to submit standardized, short research proposals for each call with two PIs as main applicants.

Criteria on which submitted proposals were assessed were set by the LiI scientific board to be the following:
1. Innovative potential and quality of the proposed research
2. Interdisciplinarity and collaboration within and between work packages
3. Contribution to the Language in Interaction consortium
4. Scientific expertise

Two internal PhD calls were published in which, out of 30 submitted proposals, 17 were awarded (9 in the first and 8 in the second PhD call). For details on the followed procedures, we refer to Appendix C.

AWARDED COLLABORATIONS

Figure 1: Connectome of PhD projects awarded in the first two internal PhD proposals. Every arrow connects, and therefore represents, the work packages to which the two main applicants are officially assigned. Numbers represent project numbers as referred to in the text.
As can be seen in figure 1, the 17 awarded proposals are collaborations both within and between work packages. However, the level of work packages is simply a vehicle for transparent and structured organization. Detailed examination of the awarded research projects shows that our internal procedures indeed seem to have the effect of sparking off novel, innovative collaborations between experts from different disciplines.

Around 80% of the projects involve a novel collaboration between Principal Investigators who have never worked together before in the context of language research. The projects span and integrate many fields in language research, like (empirical-, computational- and psycho-)linguistics, (philosophical) logic, experimental psychology, psycholinguistics, cognitive neuroscience, computational modelling, artificial intelligence, psychophysics, biology, methods for fMRI data analysis, cognitive control, molecular genomics and clinical neuroscience. All projects started can be regarded as innovative by the mere fact of their interdisciplinarity and by the individual methods and models used. Several projects start with completely novel and unanswered research questions. Others propose novel approaches for solving highly relevant and highly debated questions in the field of language research.

In addition, several projects are partly integrated so that a dense network of new collaborations has been formed. Furthermore, multiple projects take direct advantage of both the available expertise in the wide range of available research technologies and utilization of research, as can be seen by the collaborations between the scientific work packages 1 to 5 with the support work packages 6 and 7.

On the following pages detailed descriptions of the content of the awarded PhD-projects are provided. In addition, per project insights are provided in why the project is novel, innovative and interdisciplinary and therefore fulfils the criteria to be able to live up to our overarching quest.
PhD Positions

PhD position 1
Feedback loops in learning to perceive and produce non-native speech contrasts
PIs: James McQueen(WP1) and Peter Desain(WP7)
PhD-candidate: Jana Krutwig
Start date: 16 June 2014

How do perception and production interact during L2 speech category learning? Emerging categories will be tracked with EEG (MMN, ERP, ERN) measures, using online single-trial multivariate pattern classification techniques. We will compare the effects of different feedback loops on learning: 1) behavioural feedback on perceptual decisions and/or produced speech; 2) self-monitoring in production and imitation tasks; 3) neurofeedback on perceived and produced speech. These comparisons will advance understanding of the nature of phonological category representations in perception and production, and their inter-dependence. Findings should also guide construction of Brain-Computer Interface systems for L2 learning that outperform behavior-based training methods.

This project combines psycholinguistics and brain-computer interfacing translating findings of linguistic research into applications in the AI domain. It is at the cutting edge of single-trial EEG classification and seeks to develop novel language-learning technology using neurofeedback.

PhD position 2
Driving forces behind perceptual adaptation in speech
PIs: Anne Cutler(WP1) and Elia Formisano(WP1)
PhD-candidate: Shruti Ullas
Start date: 16 June 2014

Spoken-language comprehension requires dynamic adjustments in how the acoustic signal is mapped onto abstract phonetic categories. This enables listeners to deal rapidly and effectively with many sources of variability in speech. Several specific mechanisms have been documented which demonstrate that the re-tuning of phonetic categories can be driven by a range of different kinds of information. This project asks whether these mechanisms converge or if they are in fact separate phenomena. Four different types of adaptation will be investigated in terms of their behavioural characteristics and their effect(s) on neural processing in auditory cortex.

Although this project is primarily in the domain of cognitive neuroscience it has substantial involvement of other disciplines: experimental psychology, psycholinguistics, and linguistics. Project 2 investigates learning mechanisms in speech for the first time with ultra-high-field fMRI and state-of-the art analysis techniques.

PhD position 3
Language regions in Interaction: An investigation of directional connectivity in the human language system using laminar fMRI
PIs: David Norris(WP6) and Peter Hagoort(WP3)
PhD-candidate: Daniel Sharoh
Start date: 01 August 2014

This ambitious project will examine the interaction between temporal cortex and Broca’s area during language comprehension using event-related fMRI at 7T. For each area data will be acquired at sufficient spatial resolution to measure the fMRI signal as a function of cortical depth. This will allow us to interrogate feed-forward and feedback connections between regions. Four experiments of increasing linguistic complexity will be performed under the hypothesis that as unification demands increase, so will the strengths of feedforward and feedback interactions.

This project involves close collaboration between cognitive neuroscientists, language experts and physicists.
It will be the first time that layer specific fMRI has been demonstrated outside of the primary cortices, and the first time that measures of directional connectivity will have been obtained with this technique.

PhD position 4
Basal ganglia thalamocortical mechanisms of cognitive control in speaking
PIs: Ardi Roelofs(WP4) and Roshan Cools(WP4)
PhD-candidate: Marpessa Rietbergen
Start date: 01 September 2014

Mounting evidence suggests that cognitive control is essential for speaking. Three important cognitive control functions are updating, inhibiting, and shifting, which seem to depend on basal ganglia thalamocortical circuitry (BGTC). However, little is known about how the BGTC circuitry contributes to speaking. The aim of the proposed project is to examine whether BGTC contributions to cognitive control in speaking are (1) domain-general, (2) reflected in functional and structural connectivity, (3) affected by dopaminergic genetic variation, and (4) affected by Parkinson's disease. Results are expected to advance theory and to have important clinical implications.

This project approaches the unresolved question of domain-specificity of language in a novel and unique way. Expertise in the function of BGTC in cognitive control will be used to examine whether its contribution in speaking is domain-general, or domain-specific.

PhD position 5
The Babel Problem: The genesis and maintenance of diversity in human language
PIs: Steve Levinson(WP5) and Pieter Muysken(WP5)
PhD-candidate: Luis Miguel Berscia
Start date: 01 September 2014

Diversity is one of the most extraordinary properties of human communication. An intriguing question is how this diversity - variation between languages and within languages - emerges and is maintained: the Babel Problem. The present project focuses on detailed fieldwork on the micro-level of indigenous communities. Indigenous communities most resemble the situation of prehistoric language diversification. How much internal variation do these show? Given wide-spread multilingualism and contacts with others, how are boundaries maintained? This concerns both sharp (with unrelated languages) and soft boundaries (with related varieties). Do we find variation across all components of language? How is variation perceived?

This project is among the first to approach language documentation and description from the perspective of variation studies. It not only involves collaboration inside, but also outside our consortium (Roberto Zariquey - PUCP Lima and MPI-EVA Leipzig) on comparative methods in Amazonian linguistics. The project combines descriptive methods and issues in language documentation and language typology with methods from sociolinguistics and variation studies.

PhD position 6
Sharpening sensory predictions by linguistic primes
PIs: Harold Bekkering(WP4) and Rolf Zwaan(WP4)
PhD-candidate: Lara Todorova
Start date: 01 September 2014

Studies within the visual domain have shown that top-down prediction facilitates perception by sharpening the response to expected percepts in early visual cortex. Here, we aim to investigate whether this also holds for cross-modal priming between language and vision. We will use words to prime visual stimuli and measure magnitude and sharpness of responses in primary and high-order visual areas. We will study how the prediction for specific visual features, e.g. colour, depends on colour words vocabulary.
We will further manipulate the predictions by varying the frequency of congruent prime-target pairs, and by using primes with different levels of specificity.

This project proposes novel approaches (from the modern perspective on perception as afforded by predictive inference) to explore the classical question on the interaction between perception and language. The main hypothesis in this project is based on very recent advances in the research on sensory perception (Kok et al., 2012). This study therefore will bring novel ideas into the discussion on language-perception interaction.

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**PhD position 7**

**Neurogenomics of vocal learning: decoding the functions of FoxPs in vocal perception and production learning**

PIs: Carel ten Cate (WP5) and Simon Fisher (WP5)

PhD-candidate: Fabian Heim

Start date: 01 September 2014

The discovery that the FOXP2 gene is implicated in speech and language provided the first molecular windows into this trait. One way to decipher the roles of genes like FOXp2 is through comparative research using songbirds - birds that acquire their songs by auditory-guided vocal learning. Using FoxP knockdown technology, we will assess functions of zebra finch FoxP genes for a novel subject - the perception, discrimination and processing of vocalizations, such as natural songs, along with strings of song elements organized according to artificial grammar algorithms. This promises unique insights into evolutionary precursors of linguistic function in non-speaking species.

This project uniquely brings together behavioural work and molecular genomics experiments. It not only involves collaboration inside, but also outside our consortium (Constance Scharff; Freie Universität Berlin) and combines expertise in neurogenomic techniques and behavioural test essays. Thus far, no study has examined the role of FoxP genes for vocal perceptual learning in any animal model. This may also provide a new window on their role in human speech and language processing, where the effects of these genes on vocal perception are hard to disentangle from other effects and not experimentally accessible.

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**PhD position 8**

**Giving speech a hand: how functional brain networks support gestural enhancement of language**

PIs: Asli Özyürek (WP4) and Ole Jensen (WP6)

PhD-candidate: Linda Drijvers

Start date: 01 September 2015

Face-to-face communication involves audiovisual binding of speech and gesture, both carrying semantic information to varying degrees. Using MEG, we propose for the first time to investigate how oscillatory neural interactions in an extended brain network reflect the integration of gesture and speech information and its time course when gestures can have enhancement effects; (a) during comprehension of degraded speech and (b) for subsequent memory of newly learned words. Results will integrate previous findings on the role of oscillations in speech comprehension, memory, and action observation and provide insights into how brain networks adjust to processing audiovisual input involving differential semantic information.

This project seeks to investigate for the first time how oscillatory neural interactions reflect the integration of gesture and speech. The project promises to provide novel insight into the physiological substrate of the interaction between gesture and speech perception.
PhD position 9
Neurocomputational mechanisms of communicative pointing
PIs: Ivan Toni (WP1) and Pieter Medendorp (WP4)
PhD-candidate: Tobias Winner
Start date: 15 October 2014

Pointing movements can serve instrumental goals ("pointing to press a button") or communicative goals ("pointing to indicate to someone else which button to press"). This project is concerned with understanding how the cognitive structures required to organize this communicative behaviour interface with the control variables and neurophysiological mechanisms that ultimately shape our communicative actions. By testing four hypotheses on whether and how the control of communicative actions differs from the control of instrumental actions, we will identify the control parameters, computational structure, and neural implementation of how humans convey meaning with an action.

This project seeks to explore the neural basis of communicative actions from the perspective of action preparation and control. As such it is closely linked to project 12, which focuses on the neural processes allowing an addressee to understand the message communicated through an action or gesture. Although this project is primarily in the domain of cognitive neuroscience it has substantial involvement of "experimental psychology". The innovative aspect lies in the combination of human communication with formal cognitive modelling, optimal control theory, and neuroimaging.

PhD position 10
Modelling and mapping generalization and knowledge acquisition in the hippocampal-prefrontal-thalamic circuit
PIs: Christian Döller (WP2) and Guillén Fernández (WP2)
PhD-candidate: Stephanie Theves
Start date: 01 February 2015

While the hippocampus is implicated in forming specific memories, recent proposals argue that nuclei in anterior thalamus process memory attributes en route from the medial prefrontal cortex to the hippocampus and determine their generalization. By integrating computational modelling, high-field functional MRI and multivariate data analyses we will track the emergence of knowledge representations within this neural circuit. This project will expand our understanding of how the brain assigns conceptual meaning to novel information, with implications for research on semantics and semantic memory.

The project is an interdisciplinary approach to the study of conceptual memory which involves different methodologies and different fields of inquiry; namely experimental psychology, cognitive neuroscience and computational modelling. The unprecedented and innovative aspect is the possibility to look closely at the representations that emerge in specific brain areas (brain networks) associated with the processing of mnemonic and linguistic structures.

PhD position 11
Perception of multidimensional sounds in humans and birds: Are speech categories special?
PIs: Jean Vroomen (WP1) and Carel ten Cate (WP5)
PhD-candidate: Merel Burgering
Start date: 01 February 2015

Humans are remarkably skilled at extracting various types of information from the speech signal, such as phonemic categories and speaker identity. Unclear is whether these dimensions are represented in different higher-order modules; whether and how these modules affect basic aspects of categorization; and whether these properties are unique to human speech perception or represent a more general property also present in non-human animals, which was utilised for the evolution of human speech. In this project we address these questions by comparing humans with songbirds using
similar tasks and stimuli, combining psychophysics with fMRI.

This project is very interdisciplinary combining psychophysics, biology and neuroscience. Auditory perceptual tests with humans will be performed in Tilburg, perceptual studies on zebra finches in Leiden and fMRI on humans in Maastricht. The project is unique in combining comparative and neuroimaging approaches to study speech perception. This study is the first to test animals in a multidimensional task and to compare the performance of humans and animals on the same stimuli.

**PhD position 12**

**Neural processing of action, gesture and language in healthy and autistic individuals**

PIs: Asli Özyürek (WP4) and Harold Bekkering (WP4)

PhD-candidate: James Trujillo

Start date: 01 February 2015

It is often suggested that language and action on the one hand, and language and gestures on the other hand, share similar neurocognitive processes. We want to investigate in more detail if this is true. We will use fMRI repetition suppression paradigm to identify the shared neuronal substrate for processing communicative and semantic information across these modalities. We will further explore the features of the cross-modal processing in autism. Finally, interpersonal differences in the processing of the communicative component in normal population will be assessed. The project will inform on the neural mechanism and relation between the different communicative modalities.

This project is closely linked to project 9, both exploring the communicative aspects of actions. This project focuses on the neural processes allowing an addressee to understand the message communicated through an action or gesture, while project 9 seeks to explore neural basis of communicative actions from the perspective of action preparation and control.

**PhD position 13**

**Neurobiologically realistic computational models of language processing**

PIs: Karl-Magnus Petersson (WP3) and Peter Hagoort (WP3)

PhD-candidate: Marvin Uhlmann

Start date: 01 February 2015

This project entails a team effort to understand the neurobiology underlying language processing by building computer model prototypes for sentence processing based on recurrent networks of spiking neurons. The goal is to develop an RNN model with processing memory based on vector representations of words which are incrementally interpreted in terms of thematic roles ("who did what to whom"). A core objective will be to investigate the computational role of different neuronal models (e.g. kernel and conductance based models), connectivity types, neurobiologically motivated adaptation mechanisms (e.g. asymmetric spike-timing-dependent plasticity), and different methods for calibrating the model’s read-out units.

This project brings together high-level syntax and neurally plausible modelling of language, thereby crossing the disciplines linguistics, computational linguistics, psycholinguistics and neuroscience. The problem of developing recurrent networks (RNN) of spiking neurons for high-level syntax and semantics is one of the most challenging endeavours in language modelling.

**PhD position 14**

**Connectivity-based fingerprinting of memory and language network dynamics**

PIs: Christian Beckmann (WP6) and Guillén Fernández (WP2)

PhD-candidate: Izabela Przezdzik

Start date: 16 February 2015

The acquisition of language is an immense
mnemonic achievement as it requires linking thousands of verbal codes with semantic meaning. This project will provide fine-grained functional segmentations across the language and memory domains where overlapping dynamics support the acquisition of language by mnemonic processes. We will utilize rs-fMRI and task-fMRI data together with novel multivariate data analysis approaches to disentangle different mnemonic processes such as episodic encoding, hippocampal consolidation and neocortical long-term storage as well as characterize the interaction between different memory processes involved in language acquisition.

This project integrates new fMRI data analyses methods with cognitive neuroscience of memory and language interaction. Assessing individual maps of neural representations (finger prints) is a novel method that has been developed by Christian Beckmann, which offers entirely new insights that allows to assess common features that represent linguistic information in more or less all of us and it assesses individual features that explain differences.

PhD position 15
Data driven investigation of intrinsic dynamic brain states underlying language processing
Pis: Nick Ramsey(WP6) and Peter Desain(WP7)
PhD-candidate: Julia Berezutskaya
Start date: 01 March 2015

State of the art in sensory, and recently associative, cortex research reveals a detailed topographical representation, with indications that functions are represented in groups of neuronal ensembles. The goal of this project is to extract structures in language processing from brain activity dynamics, informed by symbolic and high-dimensional representations of recurring and dominant brain events. We will use extensive sets of unlabeled ECoG data from epilepsy patients and use machine learning to identify canonical brain responses occurring during conversations and listening to television. These structures may map upon existing conceptual language frameworks or generate novel avenues for future research.

This project bridges clinical neuroscience with artificial intelligence, translating mathematical principles to the clinical setting, with potential direct applications in the clinic for language brain mapping. It contributes joint development of data mining techniques and new research strategies to obtain greater insight into cortical organization of language.

PhD position 16
The Game of Language: Complex Communication and Mental States
Pis: Johan van Benthem(WP2) and Ivan Toni (WP1)
PhD-candidate: Iris van de Pol
Start date: 01 April 2015

Humans can communicate about factual states of the world (‘there is no apple in the basket’), but can also convey and interpret information about mental states (‘she does not know there is an apple in the basket’). Everyday communication largely depends on this ability to represent, to strategize, and to act upon information about mental states of other people. Using interactive game-theoretical scenarios, this project combines two levels of investigation: logical models to capture the complexity of reasoning about mental states underlying communication, and neurocognitive research to define the neural mechanisms supporting those complexity demands.

This project brings tools from the formal study of logic to cognitive neuroscience of language. The fact that it investigates how much higher-order knowledge of what the other participants of the conversation believe and desire is required for successful communication is highly innovative.
PhD position 17
Processing vague expressions: The interplay between semantics, pragmatics and cognition
PIs: Robert van Rooij (WP2) and Herbert Schriefers (WP3)
PhD-candidate: t.b.a.

A vague term like ‘big’ can be easily used and processed when there is a clear gap between bigger and smaller objects. We will test the hypothesis that a gap in distribution is the default criterion used in the processing of vague words in classificatory tasks, but that other criteria might also come into play. Secondly, we will test whether a similar default exists for the processing of quantity expressions like ‘most’ (use the approximate number system if there is a gap, and precise counting otherwise). The ultimate goal is a unified theory of the processing of vague expressions.

The project involves a novel combination of disciplines, namely empirical linguistics and philosophical logic with experimental psychology. The investigation of vague expressions will give new insights on how these are interpreted by humans.
Postdoc Positions
At the start of the consortium each work package was assigned a postdoc position. These WP-postdocs are assigned a clear role in enabling coordinated research activities that exploit potential synergies by interdisciplinary research between all the Principal Investigators participating in Language in Interaction.

Next to this important coordinating role, the postdocs are involved in establishing their own lines of research, which are described in more detail below.

Work Package 1 - Frank Eisner

Project 1
Title: "Interaction between speech perception and production under adverse conditions"
Collaboration with: Ivan Toni (WP1) and James McQueen (WP1):

To what extent is speech perception facilitated by interactions with the motor systems that subserve speech production? This project aims to test a potential contribution of motor systems to perception specifically under adverse listening conditions. Motor and auditory cortices will be disrupted selectively by transcranial magnetic stimulation while participants are engaged in perceptual tasks with degraded speech materials. The results will allow us to make causal inferences about the role of motor systems in language comprehension.

Collaboration: This project involves a new collaboration between researchers in speech perception and action planning/motor execution.
Interdisciplinarity: It combines methodological approaches from speech science with neuroscience, specifically transcranial magnetic stimulation.
Innovativeness: Brain stimulation method allows establishing causal relationships in the interaction of auditory and motor cortices.
Contribution to overarching quest LiI: It contributes to the larger aims of LiI by trying to explain how "variability" is dealt with at the level of perceptual processing.

Project 2
Title: “Learning and memory gains from linguistic processing”
Collaboration with: James McQueen (WP1) and Jean Vroomen (WP1)

How does the language system support learning and retention of new associations? This study tests the contribution of phonological processing to the learning of novel sound–picture associations. Participants will be asked to learn associations between spoken non-words and pictures of non-objects. By using sine-wave synthesis to distort the speech materials, we can manipulate whether participants are aware that they are in fact listening to speech or to non-speech sounds. This enables us to test whether memory encoding and retention are enhanced when the language system is engaged.

Collaboration: The project involves a new collaboration between researchers in learning and plasticity with psychophysics and multisensory integration.
Interdisciplinarity: It combines experimental approaches from the fields of speech science, learning, and memory.
Innovativeness: The approach allows us to study learning and memory processes in a tightly controlled fashion by keeping the bottom-up signal constant.
Contribution to overarching quest LiI: The project contributes to the larger aims of LiI by studying how the language network is interlinked with other cognitive systems; specifically, with long-term memory.
Work Package 2 - David Neville

Project 1
Title: "Geometry of Conceptual spaces"
Collaboration with: Guillén Fernández (WP2), Christian Döller(WP2), Peter Hagoort(WP3), Julia Uddén (MPI and RU), Ruud Berkers (DCCN, RU), Nils Müller (DCCN, RU).

Research on concept learning very often focuses on explaining how we form concepts (i.e. the meaning of chair) on the basis of statistical regularities we perceive in the environment (i.e. chair always means an object with four legs, something you sit on, etc.). A crucial question for this research is whether the structures used to represent domain knowledge are domain specific. More precisely, the question is whether the similarity structure found in language can support the learning of new (non-linguistic) categories: Can linguistic similarity lead to new abstract representations (i.e. category) by affecting the perceived similarity of associated (non-linguistic) percepts? In this experiment we’ll explore this hypothesis by having naïve subjects learn words from an artificial language and associate them with artificial creatures. This project will provide important information on how linguistic similarity drives the acquisition of novel abstract information increasing our understanding of the interactions between language and memory systems.

Collaboration: This project brings together a unique collection of researchers across WPs and research institutions, thus providing an unprecedented synergy between memory and language research.

Interdisciplinarity: In this project different fields of inquiry are brought together to investigate from a truly interdisciplinary angle an aspect of conceptual/semantic memory that is fundamental for both theories of memory and language.

Innovativeness: The results will provide important insights on the mechanism underlying conceptual semantic memory by using an innovative experimental approach that integrates knowledge from both domains of inquiry in a single analytical framework.

Contribution to the overarching quest of LiI: The results of the project will ultimately provide important information for understanding the characteristics of the constraining universals of language and their relation with linguistic variability.

Project 2
Title: "Modelling the emergence of Concepts"
Collaboration with: Christian Döller (WP2), Guillén Fernández (WP2), Jaap Murre (WP2), Christian Beckmann (WP6), Stephanie Theves (WP2)

The mechanism by which the brain accumulates information into knowledge remains poorly understood. While the hippocampus is implicated in forming specific memories, recent proposals argue that nuclei in anterior thalamus process memory attributes en route from the medial prefrontal cortex to the hippocampus and determine their generalization. By drawing on the recent advancements from two different modelling approaches, deep belief networks and connectionism, we will develop a model to carry out by-directional inferences between theories of relevance and neuroimaging / behavioural data. The model will provide, on the one hand, a mechanistic analysis of how different hypotheses on brain functioning support (or don’t support) the empirical data (i.e. from project 1 but not limited to). On the other hand, by reversing the inference, the model will be used to generate novel theory-driven predictions. This project will expand our understanding of how the brain assigns conceptual meaning to novel information, with implications for research on semantics and semantic memory.

Collaboration: This project involves a selection of researchers that span different WPs and institutions. Crucially, each researcher focuses on a different facet of conceptual/semantic memory.
using a different experimental approach.

**Interdisciplinarity:** This modelling project brings together two different approaches to knowledge modelling in order to look up-close at the interaction between memory and language systems in the brain.

**Innovativeness:** The model will ultimately provide a mechanistic theory of how abstract information emerges and is represented in the brain. The methodological innovation of this project will be the possibility to draw bi-directional inferences between theories of brain functioning and behavioural/brain data.

**Contribution to the overarching quest of LiI:** The results will be of crucial importance for understanding how the functional aspects of conceptual/semantic memory are implemented in cortical networks. This project will provide fundamental insights on how the mnemonic and linguistic systems interact in the brain which in turn will further our understanding of the language-ready brain.

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**Work Package 3 - Gideon Borensztajn**

**Project 1**

**Title:** "The neural basis of the combinatoriality and contextuality of language"

**Collaboration with:** Willem Zuidema (TT), Rens Bod (WP3), David Neville (WP2), Francesco Battaglia (DCN, RU)

This project consists of two parts, which both aim at modelling the neural instantiation of a critical component of the human language system. The first part of the project, in close collaboration with Willem Zuidema, investigates the neural basis of the combinatoriality of language. Our main focus is on spike-time-dependent mechanisms of flexible, dynamic binding, and the development of a novel type of neural network models of language processing that incorporates effective spiking dynamics. Among others, we will explore the possibility of a neural switchboard that flexibly routes properly coded neural signals between remote brain areas. The project, as well as the closely related PhD project 13, aims at integrating formal, computational accounts of syntactic processing with neurally plausible implementations of binding, capitalizing on the various expertises of the members of work packages 2 and 3, which cross the disciplines of a.o. computational linguistics, psycholinguistics and neuroscience.

The second part of the project deals with the contextuality and context-dependency of language, which question we approach from the perspective of the human memory system. The basic idea is that generating a novel sentence involves both binding abstract (context-free) elements from a semantic memory (part 1), as well as reuse of larger, sentence fragments (multi-word constructions) that are stored in episodic memory, where they are embedded in the context of previously analyzed sentences (part 2). Building on our expertise from computational linguistics, particularly Data Oriented Parsing, and the neuroscience of memory, we develop a computational model of the interaction between episodic and semantic memory in language, which we apply to the tasks of syntactic parsing and next word prediction.

**Collaboration:** For this project new collaborations have been and will be established between researchers from WP2, WP3 and outside the consortium, offering a unique opportunity to integrate a bottom-up, neuroscientific perspective with a top-down, linguistic perspective to the problems of binding and memory processing in language.

**Interdisciplinarity:** The project brings together insights from computational linguistics, psycholinguistics, neuroscience, and cognitive science in a unifying theory on the neural foundations of language processing.

**Innovativeness:** Within the emerging field of neuro-computational linguistics, this is the first time
computational theories of dynamic binding, and particularly neural routing, will be applied to language processing. We are further pioneering the notion that episodic-semantic memory integration is responsible for the contextuality of language.

**Contribution to overarching quest LiI:** This project contributes to LiI by revealing universal and fundamental neural mechanisms, such as flexible binding and memory retrieval, that underlie not only the human capacity to understand and produce language, but also reasoning, planning and visual cognition.

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**Work Package 4 - Irina Simanova**

**Project 1**

**Title:**
The representation of mammals in the human brain

**Collaboration with:** Julia Berezutskaya (WP6/7), Harold Bekkering (WP4), Marcel van Gerven (DCC, RU), Peter Hagoort (WP3)

In the first project we set out to disentangle the role of visual object features and semantic factors such as typicality and familiarity in the organization of representations in the brain. We explored fMRI responses to pictures of animals from a large set (over 300 unique animals), along with a set of semantic ratings obtained for each animal. We found a strong interaction between the semantic factors and low-level visual properties of the images.

**Project 2**

**Title:** Decoding of concepts within and across semantic categories

**Collaboration with:** Evgeniya Bednaya (CNS master student), Harold Bekkering (WP4), Marcel van Gerven (DCC, RU), Peter Hagoort (WP3)

In the second project, we test the hypothesis that there is a posterior-to-anterior gradient of specificity of semantic representation in the temporal lobe, where categorical information is processed in the posterior part of the middle temporal gyrus, while more detailed representations are computed in the anterior temporal lobe. In this fMRI study participants are presented with words that are either basic or subordinate names from the categories of animals and buildings (e.g. dog/house or retriever/bulldog). We use searchlight-based multivariate pattern analysis in order to locate the brain substrate that discriminates between categories, and between individual words within a category.

**Collaboration:** Both projects are performed in collaboration between researchers from different research groups and different work packages of the Language and Interaction project.

**Interdisciplinarity:** The human semantic system is studied here from the perspective of the interaction between sensory perception and language. We use fMRI in combination with behavioural data (surveys) and computational analysis methods, such as MVPA, hierarchical clustering, and representation similarity analysis.

**Innovativeness:** Both projects bring together research on the neurobiology of sensory perception, semantic memory and language.

**Contribution to overarching quest LiI:** The present results contribute to the discussion on the role of low-level visual features, semantic factors and categorical distinctions in the structure of semantic representations in the brain. In line with the goals of LiI, the projects aim not only to update on specific unresolved issues in the field of neurobiology of language and conceptual system, but also to broaden our perspective on the interaction between perception and conceptual knowledge.
Work Package 5 - Hans Rutger Bosker

Project 1
Title: What are the psychological mechanisms responsible for the variation we find within individuals in the production of speech rate?
Collaboration with: Antje Meyer (WP5), Mirjam Ernestus (WP1), and Louis ten Bosch (CLS, RU)

Speech can be delivered at different rates, with great diversity between languages, between speakers, within a particular talker, and even within a single utterance. Project 1 aims through the development of computational models of speech planning, and a series of speech rate elicitation experiments, to expose the psychological mechanisms behind this variation in speech rate production. The current investigation is innovative in its aim to provide a better understanding of lexical access in everyday communication, where speech rate varies, testing a very broad range of speakers (i.e., also including the non-student population). It has a broader scope than most psycholinguistic models of speech production, which tend to cover exclusively the planning processes. And finally, it builds upon and will contribute to psychological and phonetic theories of speaking and uses research techniques developed in psycholinguistics, phonetics, and computational modelling.

Collaboration: This project involves collaborations between researchers that have not yet worked together. It is a cross-discipline and cross-work package collaboration. Interdisciplinarity: This project aims to contribute to the psychological, phonetic, and computational study of language, and speech production in particular. Innovativeness: This project is innovative in its aim to provide a better understanding of lexical access in everyday communication, where speech rate varies, testing a very broad range of speakers (i.e., also including the non-student population). Contribution to overarching quest LiI: This project contributes to LiI by providing more insight into the diversity we find in speech production and by revealing the psychological mechanisms by which this diversity is maintained.

Project 2
Title: How can neural mechanisms explain variation between individuals in speech rate normalization?
Collaboration with: Antje Meyer (WP5), Anne Kösem (DCCN, RU), Ole Jensen (WP6), and Peter Hagoort (WP3)

Given the large-scale speech rate variation in production, listeners perceiving the speech signal need to normalize for this variation. This project investigates a possible neural mechanism behind this normalization process involving neural theta oscillations phase-locking to the syllabic rate of speech. Innovations flowing forth from this project include (1) neural evidence of how listeners normalize for speech rate variation; (2) both correlational and causal links between neural oscillatory entrainment and speech perception can be tested using MEG (brain imaging) and tACS (brain stimulation); and (3) parallel methodology that can provide insight into both speech perception, speech production, and covert speech production.

Collaboration: This project involves collaborations between researchers that have not yet worked together. It is a cross-discipline and cross-work package collaboration. Interdisciplinarity: This project aims to contribute to the psychological, neurophysiological, and phonetic study of language, and speech perception in particular. Innovativeness: This project is innovative in its aim to set up a framework, supported by experimental evidence, that bridges the field of neurobiology and the study of speech perception. Contribution to overarching quest LiI: This project contributes to LiI by providing more insight into how listeners manage the acoustic variation in the speech signal and by potentially revealing
neurobiological mechanisms which allow for successful speech comprehension in the face of immense variation.

**Project 3**  
**Title:** Can rate normalization be found in non-human species?  
**Collaboration with:** Carel ten Cate (WP5)

Bosker collaborates with Carel ten Cate (WP5) in an experiment testing rate normalization in songbirds (zebra finches). There have been several studies investigating the perception of local prosodic cues in human speech by songbirds, such as zebra finches, of which many have come from Ten Cate’s lab. This project is unique in its attempt to test how prosodic characteristics in the preceding distal context affect the categorization of speech stimuli. If it can be shown that zebra finches show the same perceptual effects of distal speech rate as found in human perception, this would provide evidence for convergent evolution of rate normalization in species of very different lineages. The project combines methods and insights from phonetics, psycholinguistics, and behavioural biology.

**Interdisciplinarity:** This project aims to contribute to the psychological, phonetic, and biological study of language, and speech perception in particular.  
**Innovativeness:** This project is innovative in its aim to investigate whether non-human species show similar processing skills when it comes to prosody perception. Thus, it will provide insight into the nature of prosodic processing in humans and birds.  
**Contribution to overarching quest LiI:** This project contributes to LiI by providing more insight into how different species manage the same sort of acoustic diversity and by potentially revealing convergent evolution of prosodic processing in two distant species.

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**Work Package 6 - Andre Marquand**

**Project 1**  
**Title:** Normative modelling for neuroimaging data  
**Collaboration with:** Christian Beckmann (WP6) and Jan Buitelaar (WP6)

The case control paradigm has been dominant in many areas of neuroscience, including the study of language. This is useful for detecting group level effects, but is not optimised for detecting patterns of variation in individual subjects and does not accurately capture the clinical decision making process where diseases in individual patients are recognized as deviations from a normal pattern of functioning. Therefore, we will develop a normative modelling framework for neuroimaging which we will apply to: (i) detect structure-function association patterns in a language task and (ii) detect deviations from normality in disorders such as autism where communication problems are central.

**Collaboration:** The project provides a novel collaboration between methodological, clinical and applied language research within the Language in Interaction consortium.  
**Interdisciplinarity:** The project is inherently interdisciplinary and combines expertise in experimental design, data acquisition and analytic methodology with clinical expertise and high quality datasets. It will provide insights into language mechanisms in addition to methodological tools that are useful in a range of disciplines relevant to the study of language and beyond.  
**Innovativeness:** The project is highly innovative in that it challenges a central concept in clinical neuroscience. It suggests a fundamental shift away from the case-control paradigm. As such, we anticipate that it will have broad relevance in the study of language.  
**Contribution to overarching quest LiI:** Understanding of the organizational concepts of neural processing of language and their interaction may ultimately pave the way for enhanced language acquisition and better compensatory training of people with speech and language deficits.
Tenure Track & Junior PI Positions
We created four positions (three tenure tracks and one junior PI) that offer a special opportunity for the very best young, creative and talented researchers from outside the research consortium to establish an independent research group. As such, these positions promote development of individuals and long-term embedding of innovative language research into our partner institutions. Descriptions of these positions are provided below. Recruitment of candidates is currently ongoing. Selected candidates will start in 2015.

Position 1 - Tenure Track
Donders Centre for Cognition and Donders Centre for Neuroscience, Radboud University
"Neuropsychology of Language and Language Disorders"
This position focuses on performing neuropsychological research in a clinical setting and the enhancement of collaborative research in the field of language-related disorders. This position bridges the gap at the clinical/non-clinical intersection, promoting the interaction between clinical and pre-clinical researchers.

Position 2 - Tenure Track
Centre for Language Studies, Radboud University
“Quantitative approaches to language processing and use”
The specific focus of this position is on quantitative approaches to language, bridging gaps between various strands of language research, both experimental and descriptive. The new research group will be the host of new quantitative and data management techniques in the human and life sciences.

Position 3 - Tenure Track
Institute for Logic, Language, and computation, University of Amsterdam
“Formal modelling of language in a semantic and/or computational direction”
One of the major challenges in current research on the human language system is to unify formal modelling of crucial interactive linguistic activities, such as communication, learning and argumentation, with the wide-ranging experimental approaches to language found in psychology and neuroscience. This position realizes long-term embedding of integrated formal and cognitive modelling of language, and promotes the interaction between formal, logical, linguistic, and computational modelling of language and cognition.

Position 4 - Junior PI
Donders Centre for Cognitive Neuroimaging, Radboud University and Max Planck Institute for Psycholinguistics
"Neuroanatomy of Language"
The primary focus of this tenure track is on imaging language structures in the brain. The position fills the gap between the level of genetics and functional brain measures of language. This is the structural aspect of the brain organization that is crucial for supporting human language.

In total, our consortium has successively initiated 17 PhD, 7 postdoc and 4 tenure track positions in the reporting period. For the future, we will step up the consortium-wide collaborations by jointly identifying four or five big questions (The Big Five) that form the skeleton for the formation of collaborative research teams that collectively work on answering these big questions within our overall research endeavour. For all to be established positions, collaboration, innovativeness, and interdisciplinary approaches will remain vital for answering the many outstanding questions within our field of language research.
ACTIVITIES

EDUCATION
To enable optimal and individualized curricula for our PhDs, the already existing training programs at our partner schools were integrated under the responsibility of our Educational Team. Irrespective of their home-institution LiI PhD candidates are allowed to compose their own educational programme and to participate in courses of all partner schools without additional costs. In addition, they are provided with possibilities for lab rotations at all participating research groups, and with annual Toolkit courses. The latter provide lectures, discussions, and direct hands-on interactions with lecturers on the most advanced methods implemented in our research consortium. In the upcoming year a PhD retreat will be organized. In addition we are currently working on organizing a workshop on "valorization" specifically targeting both internal and external PhD students. Another important event is the organization of a summer school on the full spectrum of language research performed within our consortium. The visibility of Language in Interaction will be largely increased when our first large group of young researchers start publishing their results which will make them and the consortium more visible in the scientific world.

SOCIETAL IMPACT
APP DEVELOPMENT
WP7 started to collaborate with a selected group of LiI researchers who had submitted an app idea to the specific call organized for this purpose. Through this app call, interdisciplinary development tracks have been commenced that combine several expertise strands in LiI with user interface design and app development.

The first app, "Woordwolk" (word cloud) was released in 2014. This app was specifically designed to help patients with aphasia to find words, they are still able to read, by browsing through clouds of associated words. This app attracted a lot of attention via press and media: 9 online articles, 3 TV shows and 5 radio shows. The app has been downloaded > 1500 times until the end of 2014. Four more apps will be developed in the upcoming year. Secondary outcome will be user feedback to research: apps can serve as crowd-sourcing channels, feeding back experimental data in unusually large quantities.

In the upcoming year 4 more apps will be released.

ONLINE PRESENCE
Kennislink
In collaboration with Kennislink.nl, the largest popular science website in the Dutch language area, we developed a theme page "Over Taal Gesproken" (Talking about Language). From our financial contribution, a specialized editor is appointed for the period of 1 year, starting May 2014. On average 3 articles are published each month. These involve background and review articles, interviews, and reports on events. Diverse topics involving "language", both from inside and outside the consortium, are discussed. As such, awareness on language (research) is enhanced in society.

Website
www.languageininteraction.eu and/or www.languageininteraction.nl
In October 2013 development of our own consortium website was initiated. The design is based on our own consortium identity. From March 2014 the website is fully operational. It offers the latest
news, an agenda on upcoming events and an overview on our research program, organization and educational program, and a list of our job-opportunities. To keep the website up-to-date, content is constantly renewed and added. During the reporting period we saw a clear increase in (foreign) visitors to our website.

**ORGANIZATION OF SCIENTIFIC EVENTS**

**Workshop**
A workshop on Language Evolution and Diversity (30-31 October, 2014) was organised to bring together the different questions and methodologies of researchers of language diversity. Four international, four national, and two PhD speakers gave a presentation. The aim was to find common ground that connects the study of language diversity at three different levels (cognitive, cultural, and biological) through interdisciplinary interaction (e.g., shared research questions, mutual interests, methodology that can be adopted from different research fields). From the meetings a number of new international and national collaborations have emerged, which will directly benefit the current PhD projects as well as help structure new research plans.

**External events**
Our consortium was present as main contributor at both the Nijmegen Lectures (27-29 January 2014, Nijmegen) and the annual scientific meeting of the Society for the Neurobiology of Language (27-29 Aug 2014, Amsterdam, The Netherlands). Both conferences allow broad and intensive coverage of research topics by providing extensive interaction among invited speakers and the participants, fostering interdisciplinary exchange of ideas. Attendees were provided with information about our consortium, its aims and job-opportunities. By contributing to these two conferences awareness on our consortium was greatly enhanced in the world-wide neurobiology of language community and the PhD/Postdoc community in the Netherlands, respectively.

**CONSORTIUM IDENTITY**
(Inter)national outreach will be crucial for success of our consortium. To increase visibility and distinctiveness of our consortium the development of our own consortium identity was initiated in 2013. This identity is applied to all our communications, including designs for logo, poster formats, PowerPoint format, writing paper, flyer, badges, app-development and the format used for this report.

It is our ambition to further strengthen and extend the outreach of the Language in Interaction Consortium.
HIGHLIGHT

APP DEVELOPMENT

Our Utilization WP provides the infrastructure for knowledge utilization, so that research outcomes can be translated into applications for society in domains such as education, health, and new media. In 2014, we have started developing a range of apps based on research from the Language in Interaction consortium.

‘WoordWolk’

It is on the tip of your tongue. You want to say something, but the right word doesn’t pop up from your memory. This is the daily experience of patients with aphasia. The new app "WoordWolk" (word cloud) helps such patients if they are still able to read. They browse through clouds of associated words until they reach the word they had in mind. The app has a clear and simple interface, but underneath clever techniques are being used to enable the user a fast and effective search. WoordWolk was launched on 09 October 2014. Platform: iOS.

‘SynQuiz’

Synaesthesia is an interesting trait estimated to occur about 4% of the general human population. For people with synaesthesia two or more senses appear to be interconnected; for example a synaesthete perceives certain concepts, such as letters or numbers, as inherently coloured. This app contains four playful quizzes to find out whether a user may have this type of synaesthesia, i.e. for letters and numbers, days of the week, or months of the year. SynQuiz was launched on March 2015. Platforms iOS and Android.

‘LingQuest’

This game helps the player to discover the world’s languages by listening to sound fragments and connecting these to each other. After making the right language combination more info is shown about the language concerned, such as the number of speakers worldwide and the region(s) where it is spoken. To be launched in 2015. Platforms: iOS and Android.

‘TicTacTeam’

A game where players can mutually develop a new ‘language’ through a collaboration while they are not allowed to talk. Each player only sees his or her own screen. Each player possesses a different object, such as a square or a triangle, and has to communicate to the other player where to move his or her object and in what position, by making movements with his or her own object. After several starting levels, the players gradually learn to communicate using different strategies that emerge during the process. To be launched in 2015. Platform: iOS.

‘VowelSpaceTravel’

This app will help users to learn sounds from a foreign language. The exercises adapt automatically to the level of the user, so that they are perceived as an ‘executable challenge’. The user moves through a kind of galaxy where he can interact with galaxy objects in a fun way in order to practice the vowels. The app may be accessible later via other, non-visual, interfaces, e.g. when the smartphone is in someone’s pocket. To be launched in 2015. Platforms: iOS and Android.
KENNISLINK ARTICLES

In collaboration with Kennislink.nl, the largest popular science website in the Dutch language area, we developed a theme page "Over Taal Gesproken" (Talking about Language). From our financial contribution, a specialized editor was appointed for the period of 1 year, starting May 2014. On average 3 articles were published each month. These involve background and review articles, interviews, and reports on events. Diverse topics involving "language", both from inside and outside the consortium, are discussed. As such, awareness on language (research) is enhanced in society.

‘Ik kan diep genieten van merkwaardige drogredenen’
Interview with Johan van Benthem, professor in pure and applied logic

Van de goddelijke vonk tot wiskundige theorieën: hoe kunnen we ons ingebouwde gevoel voor logica verklaren? Logicus Johan van Benthem kan uren vertellen over de ontstaansgeschiedenis van zijn vak, en hoe hij het taalvermogen van ons brein met logische theorieën wil ontdelen. Volgende week gaat de Amsterdamse hoogleraar met emeritaat: een mooi moment om terug én vooruit te kijken.

‘Op dáát bootje de Amazone over?’
Interview with PhD student Luis Miguel Berscia


‘Live ondertitelen met je bril’
Interview with Niels Schiller, professor of psycho- and neurolinguistics

Een bril die de woorden van je gesprekspartner live ondertitelt op de binnenkant van je glazen, alsof je een film kijkt. Taalonderzoeker Niels Schiller heeft hem mede-ontwikkeld. “De bril is bedoeld voor doven en slechthorenden, maar met een beetje fantasie stoppen we er een vertaalfunctie in. Dan kan je hem meenemen op vakantie, als vertaalbril.”
FINANCES

The Language in Interaction consortium was awarded a m€27.6 subsidy for two project phases of 5 years each, within the NWO Gravitation programme. First phase (Jul2013-Jul2018) budget is m€16.7. This financial paragraph covers the start up period of the project from July 2013 until December 2014, in which the managerial and financial organization has been put in place and the first rounds of budget allocations were executed.

FINANCIAL ORGANIZATION

To formalize the consortium, all PIs involved signed the LiI Consortium Letter, co-signed by their director/dean to secure the commitment of the PIs and their organizations as well as to organize tax and legal matters within the consortium. This letter describes the commitment, obligations and responsibilities of the PI and their organizations.

Day-to-day financial management is performed by the financial coordinator, under supervision of the programme director and with assistance of the financial controller. As far as finances are concerned, they are the link between all involved institutes and the Scientific Board as well as NWO.

BUDGET ALLOCATION

Following the project setup (see chapter Consortium Management and Appendix A), the PIs are leading in the budget allocation to the stakeholder institutions. Budget is allocated to the partners at several pre-described time points during the project, mainly as a result of the outcome of the internal calls. Thus, budget allocation is not executed through upfront determined advance payments, as often common within other consortia. This requires an intensive and flexible financial organization.

Closely following the initial project proposal, as well as in response to developments within the consortium, the management team prepares and executes project policies. All strategic and financial decisions are made by the Scientific Board, in which stakeholder institutions are represented through their work package leaders.

Budget is allocated as follows:
At the time of proposal submission within the internal calls, the main applicants also have to fill out a budget request form, specifying the expected budgets on materials, travel and lab hours. This form has to be signed by both the main applicants and the financial controller of the institution where the project will be embedded. When a position is granted the hosting institution receives a grant award letter. This process of filling out budget requests and receiving confirmation through grant-letters is applicable for every budget item allocated to our partner institutes.

To streamline the financial/administrative process, the financial controllers of the partner institutions have received a financial-administrative manual as well as personal instructions from the financial team. This manual explains the financial structure of the project and provides information on the management of budgets, guidelines on financial reporting, payments and other administrative issues. In addition, biannual meetings with all financial controllers involved are scheduled. Purpose of these meetings is to ensure proper interpretation of the financial guidelines, to explain and discuss financial and reporting issues and to ensure that the financial controllers are well prepared for their financial statements, which forms the basis of this financial report.

FINANCIAL REPORT July 2013 – December 2014
Project finances are developing as expected and no major budget shifts are foreseen at this moment. The most significant changes are the following:

- Due to a slightly delayed start, a minor part of the first phase personnel and related material budgets will be spent in the second phase of the project, see table B for more detailed information.
- Applicant replacement costs are somewhat lower than initially planned, due to earlier retirement of co-applicants.
- Non-scientific staff costs are lower than expected; due to somewhat less management team FTE’s.
- Expected purchase date of the granted ICT and data storage/archiving budget is July 2015 at the latest. A three-year term of depreciation is used for validation. As a result, the main part of the budget is allocated in the second part of the first phase budget.
- Lab hour budgets are to be expected 10% less, based on current granted projects.

Combined, these developments made it possible to create an extra four year junior PI position to facilitate the long term cooperation between MPI and DCCN. This vacancy was initially foreseen in the original grant application but had to be cancelled in the recalculation of the budget in January 2013, due to a budget cut that was asked for by NWO.
## A. FINANCES

### TABLE A: GRANTED BUDGET PHASE 1

<table>
<thead>
<tr>
<th>Budget Year</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018-1</th>
<th>Total</th>
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<tbody>
<tr>
<td>Applicant Replacement costs</td>
<td>96,900</td>
<td>196,533</td>
<td>199,284</td>
<td>202,094</td>
<td>204,943</td>
<td>77,937</td>
<td>977,692</td>
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<tr>
<td>Post-doc positions</td>
<td>160,978</td>
<td>324,400</td>
<td>329,325</td>
<td>334,328</td>
<td>339,403</td>
<td>172,276</td>
<td>1,660,709</td>
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<tr>
<td>Post doc in utilisation toolkit</td>
<td>64,391</td>
<td>129,790</td>
<td>131,730</td>
<td>133,731</td>
<td>67,370</td>
<td>-</td>
<td>526,982</td>
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<tr>
<td>PhD student positions</td>
<td>-</td>
<td>462,983</td>
<td>995,849</td>
<td>1,584,845</td>
<td>2,097,841</td>
<td>390,596</td>
<td>6,055,114</td>
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<tr>
<td>3 tenure track fellowships</td>
<td>128,273</td>
<td>394,957</td>
<td>420,797</td>
<td>438,058</td>
<td>150,985</td>
<td>1,533,070</td>
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<td><strong>Scientific staff total</strong></td>
<td>322,269</td>
<td>1,241,948</td>
<td>2,051,145</td>
<td>2,658,794</td>
<td>3,147,615</td>
<td>1,331,795</td>
<td>10,753,566</td>
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<tr>
<td>Non-scientific staff (NWP)</td>
<td>75,856</td>
<td>154,229</td>
<td>156,404</td>
<td>158,609</td>
<td>160,845</td>
<td>81,557</td>
<td>787,500</td>
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<td>Consortium meetings, invited guests etc.</td>
<td>15,000</td>
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<td>18,000</td>
<td>6,000</td>
<td>18,000</td>
<td>3,000</td>
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<td>Graduate School, incl. summer school &amp; conference</td>
<td>18,750</td>
<td>37,500</td>
<td>37,500</td>
<td>37,500</td>
<td>37,500</td>
<td>18,750</td>
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<td>PR, website, etc.</td>
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<td>25,000</td>
<td>12,500</td>
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<td>Consortium conferences</td>
<td>30,000</td>
<td>30,000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>60,000</td>
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<tr>
<td>ICT and data storage/ archiving</td>
<td>25,000</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</td>
<td>250,000</td>
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</tr>
<tr>
<td>Lab hours: fMRI/EEG/MEG/Other</td>
<td>250,000</td>
<td>500,000</td>
<td>500,000</td>
<td>500,000</td>
<td>500,000</td>
<td>500,000</td>
<td>2,500,000</td>
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<tr>
<td>Materials: utilization &amp; toolkit</td>
<td>60,000</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
<td>60,000</td>
<td>600,000</td>
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<tr>
<td>Conference visits scientific staff</td>
<td>10,500</td>
<td>40,875</td>
<td>63,000</td>
<td>79,500</td>
<td>91,500</td>
<td>39,563</td>
<td>324,938</td>
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<td>Materials (bench fee, research consumables, etc.)</td>
<td>17,500</td>
<td>101,250</td>
<td>175,000</td>
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<td>114,375</td>
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<td><strong>Total</strong></td>
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<td>1,064,854</td>
<td>1,144,904</td>
<td>1,206,609</td>
<td>1,302,845</td>
<td>604,744</td>
<td>16,562,628</td>
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</tr>
</tbody>
</table>

(Due to a slightly delayed start, a minor part of the first phase personnel and related material budgets will be spent in the time frame of Phase 2 of the project and is therefore depicted in green.)

### TABLE B: REALIZATION & ALLOCATION JULI 2013 - DECEMBER 2014

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Applicant Replacement costs</td>
<td>89,694</td>
<td>165,513</td>
<td>164,412</td>
<td>168,249</td>
<td>156,732</td>
<td>72,731</td>
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<td>Post-doc positions</td>
<td>49,834</td>
<td>312,384</td>
<td>328,522</td>
<td>346,399</td>
<td>367,949</td>
<td>192,087</td>
<td>1,597,175</td>
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<td>130,422</td>
<td>156,009</td>
<td>162,680</td>
<td>148,451</td>
<td>45,637</td>
<td>45,637</td>
<td>23,305</td>
<td>729,959</td>
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<td>PhD student positions</td>
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<td>140,608</td>
<td>740,711</td>
<td>1,418,849</td>
<td>1,902,557</td>
<td>1,175,607</td>
<td>520,308</td>
<td>5,898,641</td>
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<tr>
<td>3 tenure track fellowships (incl. PhD)</td>
<td>-</td>
<td>-</td>
<td>82,904</td>
<td>382,154</td>
<td>428,785</td>
<td>223,200</td>
<td>228,688</td>
<td>241,605</td>
<td>1,587,387</td>
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<tr>
<td>1 junior Position (incl. PhD)</td>
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<td>-</td>
<td>29,449</td>
<td>130,635</td>
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<td>73,967</td>
<td>75,325</td>
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<tr>
<td><strong>Scientific staff total</strong></td>
<td>157,345</td>
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<td>Graduate School, incl. summer school &amp; conference</td>
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<td>6,500</td>
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<td>4,000</td>
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<td>19,500</td>
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<td>Consortium conferences</td>
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<td>7,000</td>
<td>37,000</td>
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<td>ICT and data storage/ archiving</td>
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<td>83,333</td>
<td>41,667</td>
<td>250,000</td>
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<tr>
<td>Lab hours: fMRI/EEG/MEG/Other</td>
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<td>500,000</td>
<td>700,000</td>
<td>700,000</td>
<td>353,000</td>
<td>2,278,500</td>
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<tr>
<td>Materials: utilization &amp; toolkit</td>
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<td>145,000</td>
<td>145,000</td>
<td>145,000</td>
<td>600,000</td>
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<td></td>
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<tr>
<td>Conference visits scientific staff</td>
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<td>7,236</td>
<td>53,051</td>
<td>81,675</td>
<td>92,311</td>
<td>52,379</td>
<td>26,900</td>
<td>313,655</td>
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<td>86,353</td>
<td>138,460</td>
<td>200,245</td>
<td>227,033</td>
<td>133,456</td>
<td>75,072</td>
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<td><strong>Total</strong></td>
<td>57,841</td>
<td>358,486</td>
<td>1,103,621</td>
<td>1,518,641</td>
<td>1,490,613</td>
<td>862,523</td>
<td>101,973</td>
<td>387,163</td>
<td>16,598,984</td>
</tr>
</tbody>
</table>

Annual Report 2014, Language in Interaction Consortium
B. CONSORTIUM ORGANIZATION

Scientific Advisory Board
Prof. dr. Karen Emmorey (San Diego State University)
  Expertise: Sign Language, Multimodality
Prof. dr. Peter Gärdenfors (Lund University)
  Expertise: Cognitive Science, Semantics
Prof. dr. Elena Grigorenko (Yale School of Medicine)
  Expertise: Genetics
Prof. dr. Edward de Haan (University of Amsterdam and chair)
  Expertise: Neuropsychology
Prof. dr. Ray Jackendoff (Tufts University)
  Expertise: Linguistics
Prof. dr. Tom Mitchell (Carnegie Mellon University)
  Expertise: Machine Learning
Prof. dr. David Poeppel (New York University)
  Expertise: Cognitive Neuroscience
Prof. dr. María Sebastián Gallés (Universitat Pompeu Fabra)
  Expertise: Language Acquisition and Perception

Advisory Board
Prof. dr. Franciska de Jong (member G8 NWO and chair)
Prof. dr. ir. Karen Maex (dean of FcS, UvA and VU)
Prof. dr. Margot van Mulken (dean of FcS, RU)
Prof. dr. Esther-Mirjam Sent (Prof. of Economics, RU)
Representing society at large:
  Prof. dr. Paul Smits (vice-chairman of BoD, RadboudUMC)

Educational Team
Dr. Christian Döller (speaker DGCN)
Dr. Els den Os (coordinator IMPRS and chair)
Prof. dr. Henriette de Swart (director LGT)
Dr. Sonja Smets (coordinator GPl)
Prof. dr. Paul de Bra (scientific director SIKS)

Management Team
Prof. dr. Peter Hagoort (programme director)
Sander Berends (coordinator science & education)
Maaike Rengers (controller finances)
Kitty van der Vooren (secretary)

Scientific Board
Prof. dr. Harold Bekkering
  Prof. dr. René Bod
  Prof. dr. Antal van den Bosch
  Prof. dr. Han Brunner
  Prof. dr. Jan Buitelaar
  Prof. dr. Anne Cutler
  Prof. dr. ir. Peter Desain
  Prof. dr. Guillaume Fauconnier
  Prof. dr. Simon Fisher
  Prof. dr. Peter Hagoort (chair)
  Prof. dr. James McKeen
  Prof. dr. Pieter Mulysken
  Prof. dr. Asli Özyürek
  Prof. dr. ing Robert van Rooij

Workpackages

Workpackage 1
  Speech Perception and Production
  Prof. dr. Anne Cutler (MPI)
  Dr. Frank Elsner (RU)
  Prof. dr. Miriam Ermentrout (RU)
  Prof. dr. James McKeen (RU)
  Prof. dr. John van Oostal (RU)
  Prof. dr. Niels Schiller (UL)
  Prof. dr. Ivan Toni (RU)
  Prof. dr. Jeson Vroomen (TU)

Workpackage 2
  Semiotic and Conceptual Basis
  Prof. dr. Johan van Benthem (UvA)
  Dr. Christian Döller (RU)
  Prof. dr. Guillaume Fauconnier (RadboudUMC)
  Prof. dr. Asifa Majid (RU)
  Prof. dr. Jaap Murre (UvA)
  Dr. David Neville (RadboudUMC)
  Prof. dr. ing Robert van Rooij (UvA)

Workpackage 3
  Compositionality and Contextuality
  Prof. dr. René Bod (UvA)
  Dr. Gideon Borenstein (UvA)
  Dr. Hartmut Fitz (UvA)
  Prof. dr. Peter Hagoort (RU)
  Prof. dr. Michiel van Lambalgen (UvA)
  Dr. Karl-Magnus Petersson (MPI)
  Prof. dr. Herbert Schriefers (RU)

Workpackage 4
  Language in Action
  Prof. dr. Harold Bekkering (RU)
  Prof. dr. Roshan Cools (RU)
  Prof. dr. Pieter Medendorp (RU)
  Prof. dr. Asli Özyürek (RU)
  Prof. dr. Ardis Roelofs (RU)
  Dr. Irina Simonova (RU)
  Prof. dr. Rolf Zwaan (EUR)

Workpackage 6
  Toolkit
  Prof. dr. Christian Beckmann (RU)
  Prof. dr. Han Brunner (RadboudUMC)
  Prof. dr. Jan Buitelaar (RU)
  Prof. dr. Barbara Franke (RadboudUMC)
  Prof. dr. Olof Jensen (RU)
  Prof. dr. Roy Kessels (RU)
  Dr. Andre Marquand (RadboudUMC)
  Prof. dr. David Norris (RU)

Workpackage 5
  Language Evolution and Diversity
  Dr. Hans Rutger Bosker (RU)
  Prof. dr. Carel ten Cate (UL)
  Prof. dr. Simon Fisher (MPI)
  Prof. dr. Stephen Levinson (MPI)
  Prof. dr. Artje Meyer (MPI)
  Prof. dr. Pieter Mulysken (RU)

Workpackage 7
  Utilization
  Dr. Pashiera Barkhuysen (RU)
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C. PROCEDURE INTERNAL CALLS

To keep flexibility and quality of our consortium as high as possible, all PhD positions that are financed through the grant are distributed through an internal open competition. Two internal PhD calls have been published between July 2013 and December 2014.

GENERAL PROCESS

For both calls, PIs directly involved in LiI were invited by the LiI scientific board to submit standardized, short research proposals. The LiI management team composed and provided all PI members with an application form and an information sheet. The latter provided additional information, guidelines and conditions.

Main criteria for submitting a proposal were:
(1) Proposals could only be submitted by PIs directly involved in LiI
(2) Each proposal needed two PIs as main applicants, and
(3) Each PI could act as main applicant on one proposal only.

The LiI scientific board decided on the following assessment procedure for all submitted proposals:
(1) Each proposal was provided with commentary by 2 external (inter)national referees in a peer review procedure.
(2) An assessment committee was put together consisting of external experts.
(3) The assessment committee ranked the proposals that are eligible for funding.
(4) LiI Scientific Board made the final decision regarding allocation or rejection to guard an even distribution of PhDs or for other consortium relevant reasons.

Criteria on which referees and assessment committee assessed submitted proposals were set by the LiI scientific board to be the following:
(1) Innovative potential and quality of the proposed research
(2) Interdisciplinarity and collaboration within and between work packages
(3) Contribution to Language in Interaction consortium
(4) Scientific expertise

During both calls, for each individual proposal a pre-announcement had to be send in for the LiI management team to be able to organize the evaluation process (see below). Pre-announcements had to include the names of the applicants, title, topic and 10 lines summary of the final proposal, and a list of preferred referees.

REVIEW PROCESS

Each proposal was provided with commentary by 2 external (inter)national referees in a peer review procedure. Selection of referees by the programme director was based on a list of preferred referees sent in by the applicants of the individual proposals and identification of additional referees with the relevant expertise by the programme director.

Referees received the original PhD proposal, a summary of the LiI project, and a review form. The latter two were composed and provided by the LiI management team.

ASSESSMENT PROCESS

Members of the independent assessment committee were selected based on their research experience, their experience in assessing applications, and their non-involvement in the applications being assessed by the committee.

Prior to the their meeting chair and members of the assessment committee received an instruction letter from the programme director, including a summary of the Language in Interaction project and
the submitted PhD-proposals. In his instruction letter the programme director formulated the following three tasks for the assessment committee:
(1) assess if the quality of the proposal justifies funding.
(2) rank order the proposals according to the criteria of funding.
(3) indicate how many proposals should be funded.
The assessment committee rank-ordered the proposals taking into account the weighed and calibrated review reports.
For both internal PhD calls, the independent assessment committees reached an unanimous decision regarding its recommendation to the LiI scientific board, as formulated in their final reports. In both instances, the Scientific Board, which made the final decision regarding allocation or rejection of the submitted proposals, followed the advice of the assessment committee without changes.

Based on these procedures, out of 30 submitted proposals 17 were awarded, 9 in the first and 8 in the second PhD call. Below, the details on the procedure for each individual call are described.

DETAILS OF TWO INTERNAL PHD CALLS

First PhD Call
The first internal PhD call was published on 16 September 2013. The aim was to award 9 proposals in this first round. However, as budget allocation allowed flexibility, the exact number of granted positions (be it less or more) was fully dependent on the quality of the submitted proposals.

On the pre-announcement deadline of 30 September 2013 14 pre-announcements were received by the LiI MT. For three proposals the applicants made use of the opportunity to mention two preferred referees. On the submission deadline of 30 October 2013 the LiI MT received 14 full PhD proposals that were all administratively approved.

Review reports were collected in the period of 31 October 2013 until 23 November 2013.

The independent assessment committee met on 27 November 2013 at the Donders Centre for Cognitive Neuroimaging, assisted by the LiI scientific coordinator and LiI secretary.

The assessment committee consisted of the following members:
Prof. dr. Willem Levelt (technical chair)
Prof. dr. dr. Peter Indefrey (Heinrich Heine University Düsseldorf, Faculty of Arts and Humanities, Institut für Sprache und Information)
Dr. Stefan Frank (Radboud University, Faculty of Arts, Centre for Language Studies)
Prof. dr. Marcel Brass (Gent University, Dep. of Experimental Psychology)
Dr. Yiya Chen (Leiden University, Faculty of Humanities, Centre for Linguistics)
Dr. Arfan Ikram (Erasmus Medical Center Rotterdam, Dep. of Epidemiology)

After careful evaluation of all the submitted proposals, the committee reached an unanimous decision regarding its recommendation to the LiI scientific board (as formulated in its final report) to award 9 out of 14 submitted PhD projects in this first internal PhD call.

Second PhD Call
The second internal PhD call was published on 27 January 2014. The aim was to award 9 proposals in this second round. However, as budget allocation allowed flexibility, the exact number of granted positions (be it less or more) was fully dependent on the quality of the submitted proposals.

Based on the experiences from the first call, the scientific board decided to set some additional criteria for the second call, namely (1) A bonus was awarded to proposals that sprung from new collaborations defined as "no co-authorship between PIs during the 8 years preceding the submission
of the current proposal” and (2) PIs already awarded a PhD project in the first call were asked to restrain themselves from entering this second call.

On the pre-announcement deadline of 23 February 2014 16 pre-announcements were received by the LiI management team. On all proposals the applicants made use of the opportunity to mention five preferred referees. On the submission deadline of 30 March 2014 the LiI MT received 16 full PhD proposals that were all administratively approved.

Review reports were collected in the period of 24 February 2014 until 09 May 2014.

The independent assessment committee met on 03 June 2014 at the Donders Centre for Cognitive Neuroimaging, assisted by the LiI scientific coordinator and LiI secretary.

The assessment committee consisted of the following members:
Chair: Prof. dr. Annette de Groot (University van Amsterdam, Faculty of Social and Behavioural Sciences, Programme group Brain and Cognition)
Prof. dr. Pienie Zwitserlood (University of Münster, Dep. of Psychology, Institute of Psychology)
Prof. dr. John Nerbonne (University of Groningen, Faculty of Arts, Center for Language and Cognition)
Prof. dr. Rineke Verbrugge (University of Groningen, Faculty of Mathematics and Natural Sciences, Dep. of Artificial Intelligence & Cognitive Engineering)
Prof. dr. Gabriella Vigliocco (University College London, Faculty of Brain Sciences, Dep. of Experimental Psychology)
Prof. dr. Petra Hendriks (University of Groningen, Faculty of Arts, Center for Language and Cognition Groningen)
Prof. dr. ir. Natasha Maurits (University of Groningen, Faculty of Medical Sciences, Dep. of Neurology)
Prof. dr. Eric Postma (Tilburg University, Tilburg School of Humanities, Dep. of Communication and Information Sciences)

Six out of seven committee members participated in this meeting. One member was not able to join the meeting in person, but did sent his evaluations to the chair prior to the meeting.

After careful evaluation of all the submitted proposals, the committee reached an unanimous decision regarding its recommendation to the LiI scientific board (as formulated in its final report) to award 8 out of 16 submitted PhD projects in this second internal PhD call.
D. SELECTION OF KEY PUBLICATIONS


E. SELECTION OF GRANTS AND AWARDS

Work Package 1

Anne Cutler

Elia Formisano
- UM Systems biology call (MacsBIO) - A systems biology approach to model experience and disease-induced modifications in NEUral and GENetic NETworks (Formisano, De Weerd, Smeets, Westra) (1.45 M€ from UM/Province Limburg)
- Human Brain Project Competitive Call - Large-scale and sub-millimeter functional comparisons between human and non-human primates (Vanduffel, Roelfsema, Goebel, Formisano, total: 480k€, 120 k€ Formisano)

John van Opstal
- Coordinator Innovative Doctoral Programme (IDP) Marie Curie FP7 “HealthPAC”: 3.5M€ (14 PhD students), started 01 Jan 2014.
- Participant Integrative Network (ITN) Marie Curie FP7 “iCARE”: 375k€ (1 postdoc, 1 PhD), started 01 Jan 2014
- MaGW Talent (1 PhD) 175k€, started 15 Sep 2014.
- Investment subsidy EEG - fNIRS (Gelderland): 300k€, as of Jan 1, 2015

Niels Schiller
- Work package leader "Being Multilingual" AThEME project.

Ivan Toni
- Radboud Science Award 2014

Jean Vroomen
- Investment grant (Tilburg University); 2 year FTE Onderzoeker4, ~80 k€.

Work Package 2

Johan van Benthem
- Received the royal honour of Knight in the Order of the Netherlands Lion.
- Honorary Member, Dutch Association of Logic

Christian Döller
- Marie-Curie fellowship for Postdoc Tobias Staudigl (supervised together with Ole Jensen; 2015-2017)

Guillén Fernández
- Elected member of the Academia Europeae.

Asifa Majid
- Ammodo KNAW award for her innovative research on the relation between language, cognition, and the senses (300 k€).
- Elected member of the Academia Europeae.

Robert van Rooij
- Co-applicant of the project `Logicas no-transitivas. Una Nueva Approximacion a las paradoxes` (2014) that was funded by the Spanish ministry of Economics.
Work Package 3

Rens Bod
- Digging Into Data project (NWO & NSF, on modeling derivational reasoning).
- Member of BoD CLARIAH: Common Lab Research Infrastructure for the Arts and Humanities (NWO Roadmap).

Peter Hagoort
- Elected chair of the Society of Spinoza Prize winners (Genootschap van Spinozaprijswinnaars)
- Elected member of the Royal Holland Society of Sciences and Humanities (Koninklijke Hollandsche Maatschappij der Wetenschappen)

Work Package 4

Roshan Cools
- Research TopTalent Grant from MagW for a PhD student, entitled: "Overcoming affective biases of decision-making: Combining neurophysiology, neurostimulation and computational psychology" (406-14-028).

Pieter Medendorp
- Donders TopTalent, PhD grant awarded to Nynke Niehof. ~200k€
- Focom Food and Cognition grant. With Dr. D. Schutter 100k€
- Radboud Excellence Initiative, 150k€. Postdoctoral fellowship for Dr. Sara Fabbri.
- Radboud Research Facilities, 275k€. Funded by Province Gelderland.

Work Package 5

Hans Rutger Bosker
- Radboud Internationalisation Fund (2225€) to organize workshop 'Combining different approaches to linguistic diversity'.
- AVT/Anela Dissertation Prize: 1000€;
- Jacqueline Ross TOEFL Dissertation Prize: 2500$.

Carel ten Cate
- Australian research Council - "Understanding different speakers vs. accents: apples and apples or apples and pears?" (postdoc (70 k€), 2014)

Simon Fisher
- Appointed to the Scientific Advisory Board of the Netherlands Institute for Neuroscience.

Antje Meyer
- Elected member of the Academia Europeae.

Work Package 6

Christian Beckmann
- AGIKO funding 'ECT induced connectivity mechanisms in treatment resistant depression", 2013
- NWO VIDI grant 'Connectivity-based Fingerprinting of resting-state dynamics', 2013
- ERC 'The developmental Human Connectome Project', 2013
- NWO funded PhD grant via Li1 consortium "Connectivity-based fingerprinting of memory and language network dynamics", 2014
- Thomson Reuters 'Highly Cited Researcher' (2 in neuroscience within NL), 2014
**Jan Buitelaar**
- Guest Professorship, Goethe University in Frankfurt, 2014

**Barbara Franke**
- EU Horizon2020 Program, European Training Network: Mastering skills in the training Network for attention deficit hyperactivity and autism spectrum Disorders - MiND (H2020-MSCA-ITN-2014 SEP-210159050; 643051); 3.9M€ coordinator and PI, 250k€ allocated to Franke, 4 years.
- NIH Big Data to Knowledge (BD2K) Program, Centres of Excellence (RFA-HG-13-009): ENIGMA Center for Worldwide Medicine, Imaging and Genomics (U54 HG008023-01, PI Paul Thompson), total grant volume 11M$, 400k$ allocated to subcontract-PI Franke, 4 years.

**Ole Jensen**
- Marie Curie grant to Sara Aurtenetxe (Spain) to work with Jensen on the project “Neural correlates of working memory control in aged bilinguals”

**David Norris**
- External Scientific Member MPI for Psycholinguistics in Nijmegen
- Fellow Institute of Physics
- Fellow International Society for Magnetic Resonance in Medicine
- Fellow European Society for Magnetic Resonance in Medicine and Biology
- Coordinator European Industrial Doctorate (EID) Marie Curie FP7 “ABRIM” (2 PhD students)
- ITN Marie Curie FP7 “HiMR” (1 PhD)
- Helmholtz Society, Germany (3 PhD)
- Deutsche Forschungsgemeinschaft (DFG), Germany (1 postdoc)
- Siemens Medical Solutions, Germany (1 PhD).
- Investment subsidy Prisma fit, Gelderland, The Netherlands

**Work Package 7**

**Bas Bloem**
- Development of a ParkinsonNet in Niederrhein. Grant of Euregio (Europees Fonds Regionale Ontwikkelingen), with co-funding by the German Parkinson Patient Foundation and the Dutch province of Gelderland (total amount 400 k€). Role: project leader (together with Marten Munneke).
- A novel fMRI approach to investigating the pathophysiology of postural instability in Parkinson’s Disease, grant of the Parkinson Society Canada’s National Research Program (funding for full PhF program for Eveline Pasman). Role: co-investigator (project leader: Dr. Mark Carpenter).
- Effect of health games on cognitive function in Parkinson’s disease. Grant of MyCognition (300 k€). Role: project leader.
- Center of excellence subsidie for the Parkinson Center Nijmegen. Grant of the National Parkinson Foundation (60 k€). Role: project leader.
Antal van den Bosch
- DISCOSUMO, an NWO GW Creative Industry project. With Tilburg University and Sanoma Media BV, 2015-2018. 423,920€
- FutureTDM, a Horizon 2020 GARRI-2014-1 project. With National Library (The Hague, NL) and other partners, 2015-2016. 1,388,003€
- TraMOOC, a Horizon 2020 ICT-17 project. With Humboldt University and other partners, 2015--2018. 3,270,710€

Peter Desain
- Stichting Technologie en Wetenschap (STW) Takeoff allotment BCI 40k€
- Private donation for LiI App-development 50k€