

2007

*Linnéstöd och Berzelius Center

Area of science

Vetenskapsrådet

Announced grants

Linnaeus Grant 2007

Total amount for which applied (kSEK)

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500

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DESCRIPTIVE DATA

Project title, English (max 200 char)

Thinking in Time: Cognition, Communication and learning

Abstract (max 1500 char)

The research within the proposed environment concerns the interplay between cognition, communication and learning. Modern brain imaging techniques have provided extensive knowledge about where different processes take place, but we know less about the temporal side of the processes. For example, we only have limited knowledge about the fast processes behind language understanding during a dialogue. The research will focus on temporal aspects since they can inform us about causal relations. The temporal processes will be studied at different levels of brain and behavior modeling and the long term goal is to bridge the different levels. The following subareas will be studied within the environment: How humans, in particular children, learn concepts and to understand the words of a language – and also how the concepts of an individual change over time. How the structure of language and the surrounding culture affect learning and attention – and how this is manifested in speech and writing. How the ability to read the thought and emotions of others, for example during a conversation, affects communication and learning. How different kinds of disabilities and language disturbances influence the timing of communication and how this can be tied to memory capacities. How temporal processes operate in neurons during different forms of learning. How the capacity of the brain to simulate actions and utterances, before they are performed, influences the ability to plan and communicate.

Abstract language

English

Research areas

*HS och Utbildningsvetenskap

Review panel

VR-HSU, VR-Övergr

Classification codes (SCB) in order of priority

113901, 131204,

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Date of birth	Sex
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Academic title	Date of doctoral exam
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CO-OPERATING HEI

ENCLOSED APPENDICES

A, B, C, U, V, S

BUDGET

Funding period (planned start and end date)

2008-07-01 -- 2018-12-31

Funds applied for (kSEK)

Linnéstöd och Berzelius Center

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500
Total (kSEK):	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500

Total amount for which applied (kSEK)

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500

POPULAR SCIENCE DESCRIPTION

Popularscience heading and description (max 4500 char)

Forskningen inom den föreslagna miljön handlar om samspelet mellan kognition (tänkande), kommunikation och lärande. Moderna tekniker för att avbilda hjärnan har gett mycket kunskap om var olika processer äger rum, men vi vet förhållandevis



VETENSKAPSRÅDET
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lite om tidsförloppen för processerna. Vi har exempelvis mycket begränsad kunskap om de snabba processer som verkar när man förstår talat språk under en dialog. Forskningen kommer att fokusera på tidsaspekterna eftersom de kan ge värdefull kunskap om olika orsakssamband. Tidsförloppen kan studeras på olika nivåer av hjärnprocesser och beteenden och det långsiktiga målet är knyta samman de olika nivåerna. Följande delområden kommer att studeras inom forskningsmiljön: Hur människor, särskilt barn, lär sig begrepp och att förstå orden i ett språk – även hur en individs begrepp ändrar sin betydelse över tiden. Hur den språkliga strukturen och den kulturella omgivningen påverkar inläring och uppmärksamhet – och hur detta visar sig när man skall uttrycka sig muntligt eller skriftligt. Hur förmågan att sätta sig in i andras tankar och känslor, exempelvis under ett samtal, påverkar kommunikation och lärande. Hur olika former av handikapp och språkstörningar påverkar kommunikationens tidsförlopp, exempelvis i dialoger – och hur detta kan knytas till minnesförmåga. Hur tidsförloppet i hjärnans neuroner ser ut under olika former av inläring. Hur hjärnans förmåga att föreställa sig handlingar och yttranden innan de utföres påverkar förmågan att planera och kommunicera. Forskningsmiljön kommer att utnyttja teorier och metoder från neurofysiologi, logopedi, lingvistik, psykologi och kognitionsvetenskap. Forskare inom gruppen Brain-Mind-Behaviour vid Lunds Universitet kommer att samverka inom miljön och det nya Humanistlaboratoriet kommer att vara en central resurs för forskningen.



VETENSKAPSRÅDET
THE SWEDISH RESEARCH COUNCIL

Kod

Name of applicant

Date of birth

Title of research programme

Appendix A

Research programme

Appendix A: Research program

Thinking in Time: Cognition, Communication and Learning

1. Vision

The research of the proposed research environment concerns the relations between cognition, communication strategies and learning processes. The main topics will be temporal aspects of how cognitive capacities such as intersubjectivity ("theory of mind"), attention and memory interact with communicative strategies – linguistic as well as non-linguistic – and learning processes. In the proposed research we integrate natural sciences, behavioural sciences and the humanities.

Rapid methodological advances in functional neuroimaging have provided better spatial resolution and safer procedures. This has led to a vast gain in knowledge of the functional architecture of cognitive processes. There are thousands of publications demonstrating various correlations between cognitive phenomena and brain activation, but we still know very little about the causal relations. We know, for instance, that some brain areas tend to be activated differentially when we think about nouns and verbs. But what are the underlying causal processes and what is the sequence of events? Brain areas activate in meaningful sequences, and thus the more we know about the "where" of the brain, the more important the brain's "when" becomes. This has stressed the need for studies highlighting temporal and serial order aspects of cognitive function and communication. The overarching focus of the proposed research environment is to study time-critical processes in cognition, language, communication, and learning.

As an example of a time-critical process, the understanding of language is normally very fast, with lexical effects evident after 100-200 ms. This obviously requires quick access to stored representations. These are not only representations of speech sounds/orthographic codes, but also semantic information, allowing us to establish a context of meaning. The process is not restricted to understanding linguistic material, but is equally important for understanding and adapting to the rapidly changing signals of social interaction. Communication unfolds in time, and we know from everyday experience that undue response delay is easily detected. In early cognitive development, time-locked social signals serve as indicators of attentional focus, for instance in the well-known phenomenon of joint attention. Time-locked social interaction facilitates not only relational development, but also phonemic discrimination and early production of syllabic utterances. The sequence from physical representation to meaning can be quantified and analysed through temporally precise techniques already in our hands. These are mainly electrophysiological methods, from single cell recordings to event-related potentials (ERPs) and eye- and body-tracking techniques. Previous research shows that temporal information is differentially represented in the brain, with different brain areas contributing to different time scales, and a varied technical approach is thus warranted.

There are two main reasons for focussing on the temporal dynamics of cognition, communication and learning. Firstly, temporal relations are important for understanding causality. We cannot understand the relationship between a behavioural event and a brain event unless we know which comes first, and we will never be able to formulate meaningful theories that can unify different levels of analysis without understanding causal processes. Secondly, temporal relations are unusual in that they can be defined on all levels of analysis. Understanding timing may therefore offer an instrument for bridging gaps between different

disciplines and different levels of description.

The ultimate goal, our vision, is to be able to describe temporal control of movement and time perception at the cellular level, explain how these processes contribute to sequencing in language and cognition, spell out the causal relationship between activation of the brains language and memory systems, and thereby understand how these contribute to the generation of a meaningful message and how the corresponding processes occur in a dialogue. These processes are instrumental in cognitive processes which rely on simulation of verbal behaviour and interaction with the external world and we aim to explore both at an experimental and a theoretical level, using information about timing and causal processes, the role of simulation in cognition.

The proposed research environment brings together and greatly extends already existing individual research projects at Lund University on aspects of cognition in basic and clinical contexts. Lund has produced leading research on language development in children and adolescents and on language impairment and intervention in hearing, hearing impaired, and deaf children with cochlear implants. In recent research developments, we are pioneering the study of the dynamics of linguistic behaviour in real time in both visual and tactile modalities, for example in reading and writing; visual versus tactile reading. We have the expertise to design formal models that can explain the complex interaction between attention and other cognitive processes, and how this interplay develops over time. Such models will be useful both for basic understanding of these cognitive processes and in the design of intervention methods for enhanced learning situations. We have the opportunity and expertise to integrate experimental and clinical data on attention, language, learning and communication with formal models. We will be able to combine methodologies and techniques from several disciplines in new and fruitful ways.

Lund University offers a unique opportunity to implement the proposed research environment. It has an internationally solid record of research on cognition, communication and learning distributed across Cognitive Science, Linguistics, Logopedics, Phoniatrics and Audiology, Neuropsychology, and Neurophysiology. In 2004 a research consortium called “Brain, Mind and Behavior” (BMB) was initiated at Lund University and was formalized by the Vice Chancellor in October. The BMB initiative aims to integrate and stimulate innovative research across the fields of neuroscience, cognitive science, linguistics, and behavioural science. The group is constituted of members representing leading research groups at the university, among which the five main applicants of this proposal have been the most active.

2. Research background and previous research

In describing the background for the proposed research environment and previous research by its members, we start with topics that focus on cognition and learning. These are then tied to topics connected with communication and general modelling.

2.1 Modelling conceptual development and semantic change

Concept formation is a fundamental aspect of human learning, since it involves the very structure and contents of what we are learning – the concepts. If you have misunderstood the basic concepts of a particular knowledge area, it does not matter how many facts you learn, since your knowledge will be flawed (Vosniadou 1994). There are many theories of concept formation within various disciplines. For example, Barsalou’s (1999) theory of concepts as perceptual symbols connects to the simulation models that will be presented below. Thus the area is truly interdisciplinary, but the various theories differ widely in their assumptions concerning the structure of concepts and in their modelling of how they are learned.

Conceptual development is closely related to word learning. Children learn to understand about 10 new words per day. Even though there is no unique mapping between words and concepts, it is clear that human concept learning is extremely fast, in that each concept is determined from only a few examples. However, most models of concept learning, in particular within connectionist modelling, require extensive training with a large number of instances. Gärdenfors (2000) proposes a model where word meanings are organized in conceptual spaces. Using this kind of modelling, the fast learning of word meanings can be explained. The model has led to a number of international collaborations, including researchers at University of Amsterdam, University of Venice, University of Palermo and Technical University of Sydney.

In the research environment we will try to ground these models in empirical work using a new methodology that has begun to emerge for large scale studies of concepts, meaning, and semantic based data, namely Latent Semantic Analysis (LSA) (Landauer, Laham, and Derr 2004, Landauer and Dumais 1997). LSA produces a distributed high dimensional conceptual space where each word and its corresponding concept are represented. These techniques extract meaning from large corpora of text based on whether words occur in the same context. By applying LSA to large corpora it is possible to create semantic spaces that can be compared with performances on cognitive and linguistic tests. Earlier research has emphasized that LSA may serve as a tool for understanding how children can comprehend and understand new concepts and words. However, very few studies have directly applied LSA on cognitive development of children and these studies have mainly looked at LSA as a way of predicting recall of text material (Lemaire and Denhière 2004).

In addition to the LSA technique, researchers in the proposed environment extensively use two other techniques that are suitable for the modelling of children's conceptual development. One is Scriptlog, developed by Strömquist, a research tool with millisecond resolution based on key-stroke logging which has been used in several studies of writing development in school children with typical language development and in studies of subjects with dyslexia, language impairment and hearing impairment (Strömquist et al., in press, Asker-Arnason et al. manuscript). It has also been used in crosslinguistics studies of the text creation process and its cognitive underpinnings. The budding ScriptLog paradigm has opened a number of paths of research cooperation between Strömquist's group in Lund and research groups in Berkeley, Dundee, Jyväskylä, Lyons, Poitiers, Paris, Reykjavik, San Diego, Stavanger, Tel Aviv and the Max Planck Institute for Psycholinguistics. In several of their studies, Strömquist and his group analyses writing development and its interaction with spoken language development. The Scriptlog also offers a special opportunity to study the temporal dimensions of writing (speed, pauses etc) as a window on cognitive processes ranging from working memory load to strategic decision-making during text construction. Sahlén and her research group has specially focused the relationship between working memory, the written product and the writing process. Furthermore, written language communication tends to be more demanding with regard to intersubjectivity than spoken language communication, where the speaker, as a rule, gets continuous feedback from his interlocutor, something which makes the contrastive developmental study of speech and writing an interesting window on cognition and learning (Strömquist et al. in press; Berman et al. 2002). The second technique is SVIPS (Sound and Vision Information Processing System) developed by Sahlén and others (Vass et al. in press). Using this platform, the development of working memory can be studied from two different theoretical perspectives as well as language representation from a more linguistic perspective: phonological awareness, lexical access and semantic decision making. The advantage of the technique is that it registers not only response accuracy but also speed of

information processing. Furthermore, Sahlén and Lindgren are currently developing ERP-paradigms to study the linguistic and cognitive development in children with language communication disabilities.

2.2 Cognitive consequences of linguistic and contextual diversity

Most research on children's early language learning has focused on the cognitive prerequisites of the language learning task, including early conceptual development. Much in the tradition of Piaget, this conceptual development has been assumed to be universal. At the same time, language development reinforces conceptual development. As words, denoting concepts, are getting used, frequency of usage reinforces associative links and promotes concepts to more privileged positions in memory. And language usage provides contexts for words/concepts so that their ties to co-occurring concepts or situational properties are strengthened.

Later research, however, has challenged the assumption of universality. Children growing up in different linguistic corners of the world learn to map partly different concepts onto their early words and grammar. For example, children growing up with Germanic languages learn to talk about manner of motion to a far greater extent than children growing up with Romance languages, and children growing up with Mayan languages learn to talk particularly much about distinctions of body posture, and so on (see e. g. Strömqvist and Verhoeven 2004). One cognitive consequence of language learning and linguistic diversity is channelling of attention (Berman and Slobin 1994). Thus, if you grow up with a Mayan language and learn a rich subvocabulary dedicated to distinctions of body posture, you have to pay due attention to details of body posture in order to choose the right word, when you intend to talk about a given person's stance or locomotion. In short, "thinking-for-speaking" (Slobin 1996) will be different for Mayan and Swedish speakers.

The study of the cognitive consequences of linguistic diversity are being taken to the level of empirical measurement and experimental testing by Strömqvist and his group in the Humanities laboratory at Lund University, using eye-tracking equipment (Strömqvist, Holmqvist and Andersson, in press) to study the effects of the linguistic production process from first thoughts to connected discourse on visual attention. Further, Strömqvist and his group has extended the notion of "thinking-for-speaking" to "thinking-for-writing" to study the cognitive consequences of the linguistic production process in writing – as compared to speaking, partly in cooperation with a research programme coordinated by Dan Slobin, University of California, Berkeley (Strömqvist et al. 2004). Strömqvist and his group has begun to further extend these comparative studies to visual writing as compared to tactile writing (Breidegard et al. 2006, in press).

Written language communication tends to be more demanding with regard to intersubjectivity than spoken language communication, where the speaker gets continuous feedback from his interlocutor, something which makes the contrastive developmental study of speech and writing an interesting window on cognition and learning (Strömqvist et al., in press; Berman et al. 2002). In ongoing projects researchers from Sahlén's and Strömqvist's groups are specially exploring oral and written narration in comparative studies of typically developing children. Preliminary data indicate interesting relationships between the writing process and the written product, i.e. between temporal (fluency, pauses etc) and formal aspects (grammar, lexical variation) of written picture elicited stories and also a relationship between working memory capacity and lexical variation in the written products (Asker-Arnason, Wengelin and Sahlén, submitted).

2.3 Intersubjectivity in communication

There is a rapidly growing body of research on the development of children's ability to learn and to communicate that focuses on their intersubjectivity, i.e. their ability to understand the minds of others. In the philosophical and psychological literature, this capacity has been called "theory of mind". However, it is apparent that the intersubjectivity involved does not only include the beliefs of others, but also their emotions, attention, intentions, etc. Gärdenfors (2003, 2007) has developed a model of mental representations and intersubjectivity that contains several levels. There is an interesting connection between a child's development of intersubjectivity and the levels of intersubjectivity from an evolutionary perspective (Tomasello 1999, Gärdenfors 2003). Researchers from the proposed environment are already involved in an EU project (Stages in the Evolution and Development of Sign Use – SEDSU) that investigates this connection.

For example, attention is fundamental in all cognitive processes. Gärdenfors' group has a strong background in studying how attention interacts with other cognitive abilities such as motivation, emotion, learning and concept formation (Balkenius 2000, Balkenius, Åström and Eriksson 2004). Attention is involved in every learning situation since it is the channel through which learning takes place. It is likely that the main influence of emotions and motivation in learning comes from their interaction with attention. For most forms of dialogue, it is necessary that joint attention is achieved. Consequently, disturbances in joint attention will have effects on the efficacy of the dialogue.

2.4 Temporally based hypotheses of language use and speech/language impairment

Children with language impairment (LI) are children with otherwise typical development and normal hearing, exhibiting a significant deficit in the production and/or comprehension of language. The prevailing theory of underlying factors of LI claims that children with LI have limitations of general information-processing capacity. The assumption is that within some domain, the specific nature of the material is less important than how the material is mentally processed. Speed of processing can be employed as a measure of processing capacity if assumed that speed determines the amount of work that can be accomplished in a given unit of time. Children with LI display slower response times across a range of linguistic and non-linguistic tasks. The slower speed is manifested as slower reaction times on pegboard moving and visual rotation, picture naming, judgements of grammaticality and lexical learning as a function of presentation rate. Processing constraints could also explain problems at a macro-level in communication in children with LI. The limitations as to the complex processing needed for a fluent dialogue in conversations could partly be explained by temporal dynamical constraints.

Working memory theory is closely connected to the account of processing constraints in language impairment. The relationship between working memory and language processing (phonology, grammar, lexicon) in Swedish children with LI has been extensively studied in cross-sectional and longitudinal studies, as well as in comparative studies on children with LI and children with hearing impairment by Sahlén and her group in collaboration with Reuterskiöld Wagner's group at New York University.

Children with hearing impairment often exhibit similar problems of language and communication as children with LI. Most children with profound hearing impairment receive one or two cochlear implants (CI) today. The general empirical picture is that cognitive/linguistic processing is strongly and positively influenced by a CI as compared to hearing impaired children without CI. The studies by Sahlén and her group have shown that linguistic and cognitive factors, in particular the development of phonological processing, are more predictive in children with CI than such demographic factors as age at implant or time

as deaf before implantation (Willstedt et al. 2004). A recent study on conversations between children with CI and hearing peers clearly indicate that working memory capacity is related to strategies used in referential communication tasks. For example, the frequency and types of requests for clarification of information during such tasks seem to be related to the child's verbal working memory. Children with CI with better working memory capacity use other types of requests for clarification than those with poorer working memory capacity. Requests for confirmation of old information are significantly more often used in children with restricted working memory capacity (Ibertsson et al., submitted). Thus, the study of how conversational strategies such as the frequency and the types of requests for clarification vary as a function of individual and contextual factors merits further study.

These children offer special methodological challenges regarding brain imaging. Lindgren and Sahlén are therefore currently developing the ERP methodology in order to be able to study brain activation patterns in children with hearing impairment, prospectively as well as cross-sectionally within this project. Lindgren has an extensive collaboration with linguists and developmentalists in Oslo (Torkildsen et al. 2006, 2007 a-c). Studies have focused on electrophysiological correlates of lexical-semantic processing in toddlers with or without increased risk of language pathology, as well as an experimental ERP model of fast mapping.

It has been recognized for a long time that the cerebellum is involved in temporal processing of both sensory and motor functions (e.g. Highstein and Thach 2002, Ivry and Spencer 2004). Speech production is a prime example of an activity where the correct timing of movements is necessary for spoken language communication. One example is the timing between oral and laryngeal events in voiceless consonant production (e.g. Löfqvist and Yoshioka 1981, 1984) Another example is the coordination of lip, jaw, and tongue movements in sequences of vowel-labial consonant-vowel (e.g. Löfqvist and Gracco 1999, Löfqvist 2006). Given these requirements of well controlled timing of articulatory movements, it is not surprising that cerebellar lesions often are associated with impaired voiceless consonant production (e.g. Ackermann and Hertrich 1997). Cerebellar lesions result in a clinical condition usually referred to as apraxic dysarthria (e.g. Darley et al. 1975, Yorkston et al. 1998). It is associated with dysrhythmia and irregularities of fundamental frequency and effort as well as inadequate syllable stress duration of intervals and pace. In addition to the segmental examples of timing control in speech, another one is the coordination of variations in the fundamental frequency of the voice with boundaries between syllables, and between vowels and consonants, usually referred to as prosody or intonation. Children with apraxia of speech usually have prosodic problems (e.g. Odell and Shriberg 2001) and are typically unable to produce the variations between stressed and unstressed syllables (Shriber et al. 2003). There is also evidence suggesting that dyslexia is associated with cerebellar dysfunction (Ivry et al. 2001, Nicholson et al. 2001).

Prosodic problems are frequent in children with LI (Samuelsson 2004), perhaps more prevalent in Swedish than in languages where prosody carry less information relevant to the interpretation of the spoken message. The problems occur at the word, phrase and discourse levels. The children with LI in Samuelsson's study had difficulties in the acquisition of tonal accent or word stress and they omitted unstressed elements and non-stressed pronominal sentence subjects affecting prosody at the phrase level. At the discourse level problems with pitch agreement or signalling emotions were noted. Prosodic problems were more salient in children with receptive language impairment than in children with expressive language impairment. Results from an ongoing study by Samuelsson's group in Linköping in collaboration with Sahlén's group (Samuelsson et al. submitted) support the assumption of a perceptual component in prosodic problems in children with LI at least regarding omission of

unstressed syllables at the phrase level.

2.5 Neural mechanisms underlying timed movement and perception of time

Although adequate timing is important in almost all behaviour, the underlying brain mechanisms are still largely unknown. In the research environment we will pursue two neuroscientific themes as support for the previous tasks – one experimental and one based on computational modelling.

Humans are able to time behaviour and perceive temporal relations on very different time scales from circadian rhythms down the millisecond range. In the range from milliseconds to seconds, which is relevant for skilled movement and language, accumulating evidence increasingly implicates the cerebellum (Ivry 1997, Mauk and Buonomano 2004). The cerebellum in timing appears to go deeper than merely controlling motor performance and it may actually be necessary for perception of temporal relations. Patients with cerebellar damage have an impaired ability to judge temporal intervals or perceive discrepancies in rhythmicity of sounds (Ivry 1997). It is not surprising, therefore, that cerebellar damage not only impairs skilled movement the ability to perceive and understand speech and music.

A widely employed experimental model of well-timed responses controlled by the cerebellum builds on Pavlov's classical description of the conditioned reflex. An air puff to the eye elicits a blink. The air puff is repeatedly preceded at a fixed interval, usually a couple of hundred milliseconds, by an initially neutral stimulus, such as a tone. After a period of training, the tone will acquire the ability to elicit the blink on its own. This conditioned blink is precisely timed, and occurs just before the air puff. Thus, if the time interval between tone and air puff is increased, the response will (after some training) be delayed so that it again matches the expected onset of the air puff. The mechanism behind this adaptive timing is probably the same as that underlying other forms of timing such as in speech or musical performance.

Hesslow and his group have developed an experimental setup for, recording from single nerve cells in the cerebellum during conditioning. After a recent breakthrough they can record from single cells for over 15 hours, which has enabled them as the only group to follow learning, extinction and relearning of a behaviourally defined associative memory at the level of the individual cell (Jirenhed et al. 2007). In this way, they have identified the cerebellar Purkinje cells that control the blink and they have characterised the response that drive the behavioural response. This conditioned cellular response has the temporal properties needed to explain the timing of the behavioural response. For instance, when the interval between tone and air puff is increased, causing a corresponding delay in of the blink, there is a matching delay of the cellular response. The group has previously shown that a learned timing of a blink can be overridden by strong conditioned stimuli (Svensson et al. 1997). In a recent set of experiments, they have shown a similar phenomenon in the Purkinje cells (Svensson et al. 2007). This report also suggests a simple mechanism whereby the cerebral cortex could override the learned timing of a response.

2.6 Temporal aspects of cognition modelled as internal simulation

A view of cognitive function that has been gradually emerging in cognitive science and neuroscience proposes that humans can simulate interaction with their environment before performing it (Hesslow 2002, Gärdenfors 2003, Grush 2004). This "simulation" theory is based on three assumptions about brain function. First, an action can be simulated by activating motor structures in the frontal lobe roughly as they would be activated during an overt action, except that the motor output is suppressed. Second, perception of an external stimulus can be simulated by internally elicited activation of sensory cortex as it would have

been activated during normal perception of that stimulus. Third, there is an anticipation mechanism such that early stages of both overt and covert actions can elicit perceptual simulation of their normal consequences before the action has been performed. There is a very large body of evidence, from brain imaging and other areas, that supports the first two assumptions (Nishitani and Hari 2000, Kosslyn et al. 2001, Hesslow 2002). The anticipation assumption is plausible but direct evidence is lacking.

In this way behavioural strategies may be “envisioned” and evaluated as a guide to future action. Simulation can also explain the appearance of an inner or “mental” world. It also unifies and explains a host of specific cognitive phenomena such as working memory, imagination and problem solving. Barsalou (1999) proposes that concepts can also be analysed as perceptual simulator systems. Simulation provides a plausible account of how evolution has added cognitive functions to brains originally designed for moving around in the environment. It also explains why structures traditionally regarded as motor systems such as the cerebellum are involved in cognition. Recent work on empathy by Decety and his collaborators (e.g. Decety and Chaminade, 2003) has been interpreted in terms of the simulation theory and connects it to intersubjectivity.

The mechanism underlying anticipation is a poorly understood. Anticipation comes in two forms. One is our ability to *act* in advance of a certain event, as in eyeblink conditioning. This is dependent on the cerebellum. A different form of anticipation is the ability to *experience* an impending event before it occurs. When approaching the edge of a cliff we may “see” ourselves falling in time to interrupt our movement. This probably occurs in the sensory cortex, where we can also compare predicted events with the actual sensory input. However, recent results suggest that the cerebellum is involved in predicting the sensory consequences of action (Blakemore et al. 2001). These forms of prediction are interdependent. For instance, when a movement has a consequence that does not match the predicted consequence (probably detected in the sensory cortex) an error signal is sent to the cerebellum to teach it to adjust future movements. We have suggested that executive areas of the frontal lobe could learn to activate sensory cortex (Hesslow 2002). This is consistent with recent results suggesting that semantic memory stores in sensory cortex are activated by frontal lobe signals acting as pointers (Ruchkin et al. 2003).

In collaboration with Tom Ziemke in Skövde, Mary-Anne Williams in Sydney and Antonio Chella in Palermo, Hesslow and Gärdenfors have applied theories of simulation in the form of robot simulations. Among other things, we have demonstrated that a very simple robot can learn to predict the consequences of its movements and use those predictions instead of sensory input to guide it through a maze (Ziemke et al. 2005, Hesslow and Jirenhed 2007a,b).

3. Time plan and milestones

On the basis of the theme of temporal processes, we will now describe more concretely the proposed activities of the research environment within the context of cognition, communication and learning. As will be seen, the timing processes in cognition, communication and learning that will be investigated range from the neuronal to the social level. The proposed projects will not be pursued in isolation, but their contents are heavily intertwined and involve researchers from several of the disciplines behind the application. Ph.D. students and other researchers affiliated with the research environment will also be involved. The five principal researchers behind this application will lead all of the projects proposed here. The proposed research environment is highly interdisciplinary, which we see as one of the core motivations for this application.

3.1 Modelling conceptual development and semantic change

Short term: In a first subproject, to be accomplished during the first two-year period, Sikström and his group, in collaboration with Gärdenfors, Strömquist and Sahlén, will use Latent Semantic Analysis (LSA) to study conceptual development in children. The research group is in the excellent position to have researchers who have produced several corpora from children's language production. Strömquist has extensive diachronic material from the spoken language of five children, following their development from 1.5 to 4 years (Richthoff 2001). Sahlén has rich material from the spoken language of children with specific language impairment and children with hearing impairment from preschool to adolescence and also data about their working memory capacities. These corpora have not been analyzed using LSA, which will yield insights of a totally novel type concerning the children's semantic development. As a complement also text corpora of material that children are exposed to, using sources such as children's books and films, and text-books from schools will be analysed. Using these sources, we can investigate the relation between the conceptual environment that children are exposed to and the speech produced by children.

Long term: The ultimate goal is to match the results of these investigations with the models of the development of intersubjectivity. For example, recent theories of language learning emphasize that children exploit the fact that speakers have intentions to communicate when they speak (Bloom 2000). Our plan is to develop models of how various aspects of children's conceptual development depend on their intersubjective abilities.

Short term: One particularly rich source about how concepts are learnt and represented is which *combinations* of concepts are produced. As a second subproject, also to take place during the first two years, we will analyse how meanings are be combined, by various linguistic mechanisms and by various speakers, to generate more precise meanings. The methods applied for this project will be two: (a) A mathematical analysis of how approximations of a continuous meaning spaces, by composition can generate more precise approximation. This will, to a large extent follow the framework of Gärdenfors and Warglien (2006). (b) An empirical linguistic semantic investigation of concept combinations, using LSA. LSA will be used to extract meaning from large corpora of text based on whether words occur in the same context. We will determine the strength of association between multiple concepts while also measuring the moderating effects of context. By applying LSA to large corpora it is possible to create semantic spaces that can be compared with performances on cognitive and linguistic tests. In particular, we aim for an analysis of how concept development can occur at a rate that is higher than what can be expected from the environment, where concepts seldom are properly defined, or presented sufficiently frequently for an understanding of meaning to emerge (Landauer and Dumais 1997). As mentioned above, researchers from the proposed environment have produced several corpora of language production that can be used for this analysis.

Medium term: Further, we will apply LSA to longitudinal case studies in a machine readable format, profiting from a large local corpus (Strömquist's and Richthoff's corpus) as well as from the large collection of corpora from many different languages in the so-called CHILDES archive. In an extensive inter-nordic project, Strömquist used corpora in a machine readable format of longitudinal case studies of early child language development to track the early development of language for talking about time and space in children growing up with the five Nordic languages Danish, Finnish, Icelandic, and Swedish (Strömquist et al. 1992, Ragnarsdóttir and Strömquist 1996, Plunkett, Ragnarsdóttir and Simonsen 1996). Some effects of language specific features were tangible in the earliest phases of development. For example, the very frequent particles – such as "up" and "down" – in the Scandinavian

languages have no grammaticalized counterpart in Finnish and Finnish children, as evidenced in the case studies available, started to talk about vertical motion more than a year later than their Danish, Icelandic and Swedish peers. The LSA method will be used to re-examine the Scandinavian corpora available and to extend the cross-linguistic comparison of early mappings of concepts to lexical and grammatical items both to other languages than the Nordic ones and to other conceptual domains than time and space.

3.2 Cognitive consequences of linguistic and contextual diversity

A new wave of modestly neo-whorfian crosslinguistic studies (e.g. Berman and Slobin 1994, Strömquist and Verhoeven 2004) has shown that speakers of different languages differ systematically with respect to which aspects of a given event they render in their linguistic retelling of the event. Here, we will forward this line of research concerning the consequences of linguistic diversity in three ways: (a) we will extend it to contextual diversity including medium (speech, visual writing, tactile writing) and (b) we will make it more precise through a series of experimental approaches and c) we will use LSA to map similarities and differences with respect to which semantic spaces children growing up with different languages construct (see above).

Supplementing the other lines of research proposed in the present programme with these approaches will put us in a much stronger position than today to examine the *interaction* between language and thought both in short dynamic activities, such as a narration, and in longer dynamic periods of change, such as early child language development. Our research plan includes five main lines of investigation.

Short term: First, during the initial two years, the influence of frequency factors on lexical retrieval processes will be investigated. Drawing on previous cross-linguistic research by Strömquist et al. (2002) and Sigurd et al. (in press), we will (a) compare response latencies in word recognition tasks where frequency of occurrence is systematically varied, and (b) compare close cross-linguistic semantic equivalents which differ with respect to frequency. Second, we will study the influence of lexical and grammatical structure on what information gets selected and detailed in the linguistic construction of a situation or event. Drawing on extensive previous cross-linguistic work with picture-elicited narratives (Strömquist and Verhoeven, 2006), we will use the so-called frog story task to elicit descriptions of situations and events in narrative.

Medium term: Third, we will study the influence of medium-related factors (speech, visual writing, tactile writing) on retrieval processes, search strategies during reading, and on what information gets selected and detailed in the linguistic construction of a situation or event. Drawing on previous work by Breidegard et al. (2006, in press), reading and picture exploration strategies in sighted and blind subjects will be compared. Fourth, we will study the cognitive consequences of these factors in terms of attentional processes and neurophysiological activation patterns. Drawing on a technique for studying the effects of language on visual attention by means of eye-tracking developed by Strömquist, Holmqvist and Andersson (in press), the linguistic production process during the production of a picture-story elicited narrative will be studied. Further, EEG/ERP measures will be added in cooperation with Lindgren and his group. In order to get a more precise idea about lexical and conceptual consequences of the language and medium conditions under study, we will apply the LSA method to the spoken and written narrations resulting from the picture-story task mentioned above.

Fifth, performance under a dialogical/interactional condition (as opposed to the other,

monological tasks) will be studied, using a combination of phonetic, eye-tracking and body-tracking methods. The joint action of constructing meaningful discourse in dialogue will be analysed with particular reference to coordination (Schelling 1960; Clark 1996) in terms of how the interactants are timing speech events (especially prosody), gestural events and changes of body posture in relation to each other. Long term: A goal for these studies is to contribute a partly new model of the linguistic production process from first thoughts to a spoken or written span of connected utterances which is valid for both speech and writing and which is more closely tailored to the online structure of the production process than present-day models (e.g. Levelt 1989, Hayes and Flower 1980).

According to this model, then, building a linguistic utterance or a text fragment, means constructing a working model of your thoughts on the conditions of the language and medium used for the construction of that model. Strömquist (2006) presents a first draft towards such a model, where building a linguistic utterance or a text fragment is less like a logistic process where semantic goods gets packaged, transported and repackaged, but more like building a working model of your thoughts. This working model is necessarily selective and perspectival.

3.3 Intersubjectivity in communication

The overall goal is to study the role of dialogue and its dependence on intersubjectivity in the development of learning. Starting from Pickering and Garrod's (2004) analysis, we will investigate how children and young align their communication, on lexical, semantic and syntactic levels, in collaborative learning tasks. A key component is therefore the role of collaboration in learning (Tomasello, Kruger and Ratner, 1993, Brinck and Gärdenfors, 2003). Our main hypothesis is that there is a close connection between levels of collaboration, communication and intersubjectivity both from a developmental and an evolutionary perspective. It is one aim of the program to work out this triangulation.

Short term: Central research questions are whether the brain structures that support the development of dynamical world models also are used for the understanding of other; what are the similarities between dynamical psychical situations and social interaction; and whether models of attention can be extended also to social attention or is something fundamentally different required. Lindgren's group has studied ERP correlates of fast mapping in toddlers, especially dynamic brain changes during the establishment of word-picture connections. We have shown that these vary according to the linguistic competence of the child. In collaboration with Christian Balkenius, we now propose a new study of this phenomenon during the first two years. In a longitudinal study between ages 12 and 27 months, we intend to measure fast mapping competence with tri-monthly intervals, using our newly developed paradigm. As our previous study only had one time point (20 months), we now intend to characterize the maturation of the fast mapping ability during the second year of life and its relation to vocabulary size on an individual level.

Medium term: The learning processes required for dynamical interaction with the world have many similarities to those needed for different forms of social attention. By developing complex models of attention control it will become possible to investigate to what extent those mechanisms are sufficient also for social situations, for example for the development of joint attention. For example, Tomasello et al. (2005) emphasize the crucial importance of joint attention in the development of linguistic communication. It is clear that disturbances in joint attention will have effects of the efficacy of the dialogue. However, the connections between general attention mechanisms and joint attention are hardly studied. As a preparation for this task, Lindgren's group, in collaboration with Lars Smith, has studied the EEG correlates of

gaze detection in toddlers and found differential effects of communicative intent. On a middle term range, we will study the correlations between various forms of attentional deficits in different groups of children and the structure of the dialogues they involve in.

Gärdenfors' group and Sahlén's group intend to together further explore the relationship between conceptual/lexical development and intersubjectivity by studying how children learn to understand metaphorical expressions. In a study of children with typical language development in grades 2 and 3, understanding of metaphorical expressions (presented in a film condition) turned out to be significantly related to general working memory. Comprehension of idioms and metaphorical expressions is strongly predictive of reading comprehension in children with typical development and in children with language impairment. Of special interest is how different contexts can influence understanding of metaphorical expressions and how different contextual conditions/cues can facilitate or disturb understanding in different disability groups.

Short term: We will develop an ecologically valid paradigm that makes it possible to study the comprehension of metaphorical expressions in oral and written discourse. Then we will collect data from typically developing children in different ages. We will study gender differences, and whether there are differences in the understanding of (1) metaphors presented in oral narratives (stories told in an auditory only and in an audiovisual condition) and (2) metaphors presented in free conversation between the child and adult and (3) metaphors presented in a text condition. We will assess working memory using SIPS, semantic/lexical skills, intersubjectivity and reading comprehension according to already existing paradigms. Further the CCC (Children's communicative checklist) will be used in order to assess pragmatic skills.

Medium and long term: We will collect data from different disability groups, which will also be used for longitudinal study. Our prediction is that in children with autism there will be a closer connection between intersubjectivity and comprehension of metaphors than in children with LI, and that the reading condition will be more difficult. Nonverbal cues will facilitate the understanding more for children with hearing impairment and children with LI than for children with autism. We also want to test whether manipulation (incongruency) of nonverbal cues will have different consequences for children with different disabilities.

3.4 Temporally based hypotheses of language use and speech/language impairment

The temporal coordination and adaptation of speech, prosody, gestures and gaze by partners in a conversation will be studied by Sahlén, Strömqvist and Lindgren in collaboration. We will continue to explore the influence of working memory on conversational strategies in children with perceptual or cognitive/linguistic disabilities in conversation with peers. Within the present framework we already have available a methodology that will make it possible to compare different types of conversations (referential communication, narration, free conversations) between different groups of children with language and communicative disabilities and their peers. An individual as well as a dialogic perspective will be taken. From an individual perspective, we will study accuracy and speed in cognitive/linguistic processing by using the test platform SIPS. Lexical variation, utterance length, grammatical complexity and hesitation phenomena will be assessed according to existing paradigms. A dialogical perspective will be taken by using a modified version of Conversation Analysis (Sachs et al. 1977) or initiative response analysis (IR-analysis; Linell and Gustavsson 1987) depending on the type of dialogue. As for the participants' language production, the primary focus is not whether lexical and grammatical structures are produced correctly but the relation between specific structures and conversational circumstances and to what degree phenomena as

repetitions, pauses and reformulations in conversations are dependent on the context and the partner. For the non-verbal aspects of the dialogues the methodology developed by Strömquist's group will be used. One important research question is thus how dialogues will be affected by slower speech processing in one partner. Another question is what role the conversational context or the genre plays for verbal and non-verbal adaptation between partners in dialogues and how the partners individual contributions to the dialogue becomes dependent on the cognitive load of the task. Tasks will be varied with respect to the amount and congruity of information given to participants in advance. Thus, we will study situations when participants have incomplete but correct and compatible starting information, and situations where the information is not only incomplete, but also erroneous and contradictory.

Short term: Already collected data from free conversations between severely/profoundly hearing impaired children and their peers will be analyzed using IR-analysis. Results will be related to results from the referential communication tasks already studied. Pilot studies on children with typical development in conversation with peers will be performed in order to integrate the methodology from Strömquist's lab (eye tracking, movements etc) and the paradigm used by Sahlén's group.

Medium term: Conversational data from children with mild/moderate hearing impairment, children with language impairment and children with autism in conversation with hearing peers will be collected and analyzed. The children will be assessed on a range of cognitive, linguistic tests. In this context, we will undertake a new type of analyses of the temporal properties of children's speech as well as of their input (child-directed adult speech as compared to adult-directed adult speech). We will analyse the fundamental speed and speech rhythm in the children and parents as manifest in their dialogical interactions in the longitudinal case studies in Strömquist's and Richthoff's corpus. A number of properties of typical child-directed speech, such as a simplified syntax and shorter utterances as compared to adult-directed adult speech, may well be properties emerging from an underlying temporal adjustment: slower speech as compared to adult-directed adult speech. We will study how the mutual adaptations in terms of speed and rhythm of speech look like over a dialogical interaction in early and late child language development.

Long term: Given that data from the first part of the project has provided us with an understanding of non-verbal aspects of the attempts of shared understanding, it would be of great interest to study the ERP correlates of joint attention-like behaviour. It is reasonable to assume that participants in dialogues try to establish shared references (relevant objects, places, etc). Infants show an ERP enhancement when looking at an object previously fixated by an adult in conversation with the child. This phenomenon is largely unstudied in older children and adults, especially concerning possible co-variation with task parameters such as load information quality.

Short and medium term: The influence of working memory on conversational strategies in children with perceptual or cognitive/linguistic disabilities has not been studied before. On the basis of our available methods, it is possible to compare dialogues between different groups of children with language and communicative disabilities and their peers. The aim of this subproject is to further explore alignment in dialogues and the role of temporal aspects of language processing in conversations. Sahlén's group will, in collaboration with Gärdenfors' group, investigate whether the results that have been found for children with CI also hold for children with other language communicative disabilities, e.g. children with language impairment, children with autism and children with ADHD. In particular we will study what role the conversational context plays – the genre. Using conversational analysis and initiative response analysis, we will evaluate the hypothesis that conversational strategies will differ in

free conversations as compared to more open-ended conversation. Also the influence of outer disturbances on dialogue, e.g. noisy surroundings, will be investigated. A third problem concerns how the partners' contributions to the dialogues depend on the cognitive load of the task. A fourth question is how dialogues are affected by slower speech and language processing, for example hesitation phenomena, pauses and working memory (as assessed by the SIPS) in one conversational partner. The time plan is that in the nearest two years semi-structured conversations between profoundly deaf children and their peers will be studied; in the middle range perspective data from other disability groups will be collected and analysed; and in the long range, in collaboration with Strömqvist's group, verbal interaction in conversations will be related to non-verbal activities, such as gestures and gaze coordination.

3.5 Neural mechanisms underlying timed movement and perception of time

3.5.1 Classical conditioning at the cellular level

Short term: (1) Hesslow and his group will locate the synapses that undergo change. The learned cellular responses described above can result from changes in Purkinje cells but also in interneurons. Recordings from interneurons would probably determine which cells are responsible for the learning. (2) Identifying the timing mechanism. This could involve delay lines or a clock mechanism in the Purkinje cell itself. This will be tested by direct stimulation of fibres terminating on Purkinje cells.

Medium term: (1) Identify synaptic mechanisms. Once the timing mechanism has been localised, it will be crucial to identify the type of mechanism responsible. By application of specific receptor agonists and blocker, we will identify the type of receptors mediating time signals. (2) Study effects of drugs such as ethanol and cannabinoids. This is important because these drugs influence cerebellar learning and timing at the behavioural level (for instance as in human eyeblink conditioning) and they also impair language processing (cf. below).

Long term: An exciting possibility in the present project concerns anticipation mechanisms and comparison between predicted and actual consequences of movement. When a movement has a consequence that does not match the predicted outcome (probably detected in the sensory cortex) an error signal is sent to the cerebellum to teach it to adjust future movements. To unravel the causal processes, we need to work with whole organisms. Within the next few years, due to techniques being developed at the Nanotechnology Research Centre in Lund, with which we are associated, it will become possible to record from brain regions now inaccessible for ethical reasons and study the origin of the error signal.

3.5.2 Classical conditioning at the behavioural level

Hesslow has developed a setup for studying eye-blink conditioning in humans. The technique uses a tone and an air puff as the conditioned and unconditioned stimuli (but can be easily be modified). Blinking is measured by detecting changes in the magnetic field caused by a small magnet attached to the eyelid. The system is portable and non-invasive, and is ideally suited to study the learning of temporal relations in various patient groups and children.

Short term: (1) We would start with "base-lining" this technique, for instance determining normal acquisition and extinction times, individual and age and sex variability in learning and in appropriate timing. (2) We will study disturbances of timing in people abusing cannabis and ethanol. Cannabinoids have recently been shown to interfere with conditioning (Skosnik et al., 2007). Cannabis abusers also frequently have abnormal time perception. Ethanol has dramatic effects on the cerebellum but its effects on conditioning and timing are unknown.

Medium term: (1) We will study pathological conditions such as autism and dyslexia, both

of which have been tied to cerebellar abnormality (Courchesne, 1997; Nicholson et al., 2001). A few studies of blink conditioning in patients with autism and dyslexia have been published (e.g. Nicholson et al., 2002, Coffin et al., 2005), which confirm the cerebellar connection, but the results are only tentative and can be greatly improved upon. We will also work together with Sahlén's group, which has access to advanced and well-tested techniques for studying speech and language impairments. (2) If we can identify timing abnormalities in cannabis users, we will together with Sahlén's group test such subjects for speech and language impairments to see if we can relate impairments of timing and language. (3) Studies parallel to those described above should be done on subjects with autism and ADHD. (4) Recent work by Lindgren and his associates (Moberget et al., 2007) has shown that the ERP technique can also be used to address these issues. Cerebellar patients have abnormal predictive responses (mismatch negativity) and the same technique could be used as an additional test in people with speech and language impairments.

Long term: (1) Tests of anticipation described in connection with internal simulation will enable us compare impairments in timing and language with cognitive deficits in anticipation. (2) The eye-blink conditioning paradigm can only detect global cerebellar abnormalities or lesions in the area controlling blink. We will develop conditioning paradigms for other cerebellar areas.

3.6 Temporal aspects of cognition modelled as internal simulation

A crucial component of simulation models is the ability to generate sensory activity internally, that is, without external sensory input. Although there is plenty of evidence that something like this occurs when we predict or anticipate important events, nothing is known about the source of such sensory simulation.

Short term: An important question to investigate is how complex learned models need to be to support internal simulation. We want to use computational modelling to look at the relative merit of complex models compared to multiple simple models. Instead of learning a single model that accounts for all relations between an action and its outcome it is possible to instead learn a larger number of simpler models that each can account for some smaller part of the interaction with the environment (Wolpert, Doya and Kawato, 2003). The critical question is how the context is used to select between the different simpler models and how to know when to learn a new model instead of extending one that is already available. We have developed a model of smooth pursuit that is able to learn multiple models by looking for unexpected events as predictors of model change (Balkenius and Johansson, 2007). However, this model only uses internal models for anticipation and not for simulation, and one topic for further research it to try to extend this type of model to internal simulation.

Short term: A particular cognitive task that is a form of intersubjectivity is the ability to take the perspective of someone else. This is an important step in Piaget's theory of child development and it is necessary for many forms of communication. Perspective shifts require the ability to simulate how the world looks like from someone else's view (e.g. Piaget's three mountain task). Modelling this involves shifting the world-view of the subject by some form of coordinate transformation. Gärdenfors is currently collaborating with one group at Sydney Technical University who works with collaborating robots and another group at Palermo Technical University who has constructed a guiding robot that can take the perspective of the onlookers. Gärdenfors and Balkenius will expand the mathematical modelling and the robot experimentation concerning perspective shifts in collaboration with the Sydney and Palermo groups.

Medium term: To explore the idea that the frontal lobe learns to activate sensory cortex (cf.

2.6 above), we have begun designing an experimental paradigm and have performed some pilot experiments using the ERP technique. A subject is trained to associate a specific movement, such as pressing on a series of buttons, with a specific sensory consequence, such as a visual stimulus appearing on a computer screen. The latter stimulus will elicit a well-timed evoked potential. Our expectation is that the movement will also elicit a response corresponding to the expected stimulus even when this is omitted. In order to develop this into a workable setup, we will need to refine both the test stimuli and the measurement variables. If this can be done, an objective is to extend the paradigm in several ways, for instance to imagined movements, verbal responses, various temporal relations between movement and sensory consequence etc.

Long term: In a more general form, taking the perspective of someone else is fundamental for dialogue as well. The role of intersubjectivity in language comprehension has recently come into focus (Bloom 2000), but the temporal processes of intersubjectivity in communication have not been studied. The two participants in a dialogue must update their models of the other's mental world on the run. This relates to the alignment discussed by Pickering and Garrod (2004), but they do not sufficiently consider the timing aspects of the continuous mind-reading. Gärdenfors' group, based on the work in Wolpert, Doya and Kawato (2003), Decety and Chaminade (2003) and Gärdenfors (2007), would expand the control-theoretic modelling to the intersubjectivity involved in dialogues. The aim is to generate a mathematical model that can be used to predict various aspects of the alignment process in a dialogue, for example when the dialogue is hampered by disturbances or cognitive or sensory limitations of the participants. This modelling work would tie in tightly with the studies presented in section 3.4.

4. Existing research environment and organisation of the group

4.1 Existing research environment

With generous support from the Crafoord Foundation and the Wallenberg Foundation, Lund University and the Faculties of Humanities and Theology have built a unique laboratory environment, the "Humanities Laboratory" to support cross-disciplinary research on cognition, communication and learning. The laboratory, which will play a key role in the proposed research program, has interfaces to behavioural sciences, natural sciences, medicine and technical sciences and it forms the core research environment of the BMB group. It houses

- a phonetic/acoustic unit with an anechoic chamber developed in cooperation with the Department of Phonetics;
- an eye-tracking unit established in cooperation with the Division of Cognitive Science;
- an electrophysiological unit for measuring activity distribution in the cortex (EEG/ERP) developed in cooperation with the Departments of Neuropsychology and Neurophysiology;
- a body-motion tracker and virtual reality (VR) Laboratory developed in cooperation with the Division of Ergonomics and Aerosol Technology, Department of Design Sciences, both at the Faculty of Engineering, Lund University.
- a tactile lab with the world's first automatic finger-tracking system for the study of reading strategies and tactile picture viewing in the blind, developed in cooperation with Certec, Division of Rehabilitation Engineering Research, Lund University;
- a writing unit in cooperation with the Department of Linguistics, Lund University, the CNRS/LASCO laboratory at the University of Poitiers, and the Centre for Reading Research, Stavanger University;

- a unit for ingestion of data (both visual and auditory) from various storage media to hard disk) built in cooperation with Phonogramm Archive, Vienna.

In 2005 a new research and screening unit targeting children and adolescents with language impairment or reading and writing difficulties was set up in the Humanities Laboratory. The unit was established in cooperation with the Department of Logopedics, Phoniatics and Audiology, and will facilitate for clinicians to cooperate with specialists in the laboratory, whenever they want to extend their standard screening procedures with tests requiring eye-tracking equipment, body-tracking equipment, etc.

4.2 Synergies within Lund University

The various strands in this research environment will yield considerable synergy effects within and between the research groups connected to the proposed environment. Nevertheless, there is a need for continued efforts to strengthen the interaction between the different research groups and the rest of the university. We intend to hold regular meetings or seminars with the following aims:

- In depth presentations of the individual projects followed by continuing presentations of research results so that all groups are immediately informed about the progress of the others and made aware of findings that can be helpful to the others.
- Seminars with invited guests intended to educate all the participants in other fields relevant to the common aims. Examples would be international experts on the neurobiology of timing, semantic memory, anticipation, etc.

We also plan a special program for PhD students recruited to the research in the projects to work full-time with one of the other groups in the environment for a period of at least three months in order to facilitate the spread of knowledge and ideas throughout.

In 2005, the BMB group organised a series of workshops and open lectures which can be seen as a first step towards a more systematic joint organization of theoretical and methodological seminars, educational modules and training opportunities in research projects and lab environments across the member teams of the BMB initiative. As a continuation of this, we plan to support our research environment and provide for a long-term recruitment of young researchers to our cross-disciplinary field by:

- Creating joint modules – theoretical and methodological – across our respective graduate educational programs.
- Providing training opportunities (practitioner periods) in each other's projects or labs for advanced students in connection with their graduation papers.
- Seizing the Bologna opportunity to construct a masters program offering a broad perspective on the Brain-Mind-Behaviour field with options to specialize in one of the key disciplines of the BMB initiative (linguistics, cognitive science, psychology, logopedics, neuroscience etc).
- Organizing international summer schools to graduate students and post docs.
- Forwarding exchange programs with teachers, students and post docs in thematically related departments and labs of universities in other countries. Here, the network of experts constituted by the 2005 BMB workshops will play a key role.

4.3 Organisation and management

The research environment will be managed by a board, consisting of a chairman (the principal investigator), two senior researchers, one post-doc and one doctoral student. The project will be managed economically at the Philosophy Department, which has a well-functioning administrative unit. The principal investigator will have a manager responsible for practical project management and economy issues. The manager will also function as secretary of the

board. The board will renew its members after five years. After five years, there will also be a succession of the principal investigator.

The research environment will receive advice and support from an international reference group. Candidate members of this group are Patricia Churchland (UC San Diego), Kim Plunkett (Oxford), Dorothy Bishop (Oxford), Paul Bloom (Yale), Friedemann Pulvermüller (MRC, Cambridge) and Michael Mauk (Austin, Texas). We also wish to recruit a member of the strategic council of Lund University to the reference group. The role of the reference group is, among other things, to help the board with SWOT analyses, to give strategic advice, and to facilitate international contacts and cooperation.

4.4 Added values

The proposed research environment will bring together experts and lab resources from different parts of Lund University, creating a platform and meeting place for those researchers and students who investigate the complex area of cognition, communication and learning and who typically lack a interdisciplinary platform for their research and education today. The research environment is therefore conducive to the goals of the strategic plan of Lund University in that it provides:

- An environment for innovation in a number of areas: (a) the new combinations of researchers and lab resources will yield new opportunities for research and also generate new ideas for multidisciplinary research; (b) it will generate new ideas for educational programs, especially, perhaps, on the masters level (the international Bologna Masters).
- An environment for raising new generations of young research leaders: the long-term quality of the initiative makes it possible to enhance the careers of young talented researchers and promote them as leaders of research groups. In the existing systems for the acquisition of research project grants, the major meriting factor is what you have already produced and this mechanism is detrimental to the careers of young researchers.
- A host environment for young researchers. We will raise new generations of doctoral students and offer opportunities for visiting scholars and guest researchers in relation to our research initiative. We will also arrange national and international summer schools, and develop exchange and mobility programs with other research groups and institutes on an international basis.
- A resourceful environment for taking on new research challenges in the broad area of cognition, communication and learning. We expect external research missions to become a major source of funding and joint venture in the future.
- A platform for interaction with schools, knowledge industry and other areas of society in issues related to cognition, communication and learning.

4.5 National and international cooperation

On the national level we cooperate with and will continue cooperation with Linköping University (Jerker Rönnerberg) on studies of language impairment and with Skövde University College (Tom Ziemke) on simulation models. (Research leader within parentheses). We will profit from our wide international network of research partners in forwarding the proposed research program, in recruiting doctoral students and guest researchers, in organizing conferences, workshops and summer schools. International cooperation of special importance include Oxford University (Dorothy Bishop and Kim Plunkett), University College London (Christopher Yeo), Institut Jean Nicod in Paris (Joëlle Proust), University of Amsterdam (Robert van Rooij and Johan van Benthem) Max-Planck institute for Evolutionary Anthropology in Leipzig (Josep Call), Stanford University (Mark Schnitzer), UC Berkeley (Dan Slobin), Jyväskylä University (Heikki Lyytinen), Carnegie-Mellon University (Brian

MacWhinney), Université Lumière Lyon (Harriet Jisa), Poitiers (Denis Alamargot), Paris (Jean Louis Lebrave), Háskola Islands (Hrafnhildur Ragnarsdóttir), UC San Diego (Judy Reilly), Stavanger (Per Henning Uppstad), Tel Aviv (Ruth Berman), Max Planck Institute for Psycholinguistics, Nijmegen (Marianne Gullberg), Sydney Technical University (Mary-Anne Williams), ISCT in Rome (Christiano Castelfranchi) and University of Palermo (Antonio Chella). On the national level, our research initiative is of particular interest to cognitive science, linguistics and psychology and measures will be taken to increase our interaction with research groups and departments representing these disciplines.

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VETENSKAPSRÅDET
THE SWEDISH RESEARCH COUNCIL

Kod

Name of applicant

Date of birth

Title of research programme

Appendix B

Curriculum vitae

Appendix B**Thinking in Time: Cognition Communication and Learning****Curriculum vitae for Peter Gärdenfors**

Peter Gärdenfors, Professor
Lund University Cognitive Science
Kungshuset, Lundagård, SE-222 22 Lund
Telephone: +46-46 222 48 17
Fax: +46-46 222 44 24
e-mail: peter.gardenfors@lucs.lu.se

Professional preparation

B.Sc. 1970 at Lund University (mathematics, philosophy, computer science).
Ph.D. in Philosophy 1974, Lund University. Dissertation: Group Decision Theory.

Appointments

Various positions at Department of Philosophy, Lund University, 1970-1980.
Associate Professor in Philosophy of Science at Umeå University parts of 1975-1977
Associate Professor at the Department of Philosophy, Lund University, 1980-1988
Chair in Cognitive Science at the Swedish Council for Research in Humanities and Social Sciences, 1988-1994.
Professor of Cognitive Science at Lund University, since 1988, 20% time for research (currently 50% thanks to a grant from VR)

Visiting positions

Visiting Fellow, Princeton University 1973-1974. Visiting Scholar, Stanford University 1983-1984. Visiting Professor, Auckland University September 1986. Visiting Fellow, Australian National University, 1986-1987. Visiting Professor, Universidad de Buenos Aires, November 1990. Visiting Professor, École Normale Supérieure, Cachan, June 1992. Visiting Professor, Rome University La Sapienza, May 1995, Visiting Scholar, CREA, Paris, October 1999, Fellow at SCASSS, Uppsala 2003-2004. Visiting Scholar, University of California at San Diego, January-February 2005, British Academy scholarship, Oxford University April 2005, Visiting professor, Ca' Foscari University of Venezia, May 2005. Visiting professor, Sydney Technical University, January 2006.

Distinctions

Awarded the Rausing prize in humanities in 1996.
Member of the Royal Swedish Academy of Letters, History and Antiquities since 1996.
Awarded a Senior Individual Grant from the Swedish Foundation for Strategic Research in 1997.
Member of Academia Europaea since 1999.
Presented with the electronic Festschrift *Spinning Ideas* on my 50th birthday.
Member of Leopoldina Deutsche Akademie für Naturforscher since 2004.

Doctoral students

Nils-Eric Sahlin, 1984, Agneta Gulz, May 1991, Kenneth Holmqvist, April 1993, Christian Balkenius, June 1995, Tom Andersson, May 1994, Robert Pallbo, Nov. 1997, Simon Winter,

Nov. 1998, Henrik Gedenryd, Dec. 1998, Jana Holsanova, May 2001, Mikael Johannesson, Sep. 2002, Annika Wallin, June 2003, Lars Kopp, June 2003, David de Léon, Oct. 2003, Lars Hall, June 2004, Pierre Gander, March 2005 (15 in total).

Postdoctoral researchers

Jordan Zlatev, Nils Dahlbäck.

National and international assignments

Member of the board for the Interactive Institute 2001-2004

Various committees in VR, RJ and SSF

Qualifications with respect to collaboration based on and communication of research results

A large number of appearances on Swedish radio and TV, including a number of programs for Fråga Lund, Filosofiska Rummet and Vetenskapsradion.

Curriculum vitae for Germund Hesslow

Germund Hesslow
Department of Experimental Medicine, Lund University
BMC F10
SE 221 84 LUND
Sweden

Professional preparation

University studies at BSc and MSc level in Philosophy, Psychology and Medicine
PhD in philosophy, Lund University, 1984. Thesis: *A Deterministic Approach to Causality*.
PhD in physiology, Lund University, 1988. Thesis: *Studies on the Olivo-Cerebellar System*.

Appointments

Associate professor in theoretical philosophy, Lund University, 1986
Research associate in Medical behavioral science at the Swedish Medical Research Council
1991 - 1994
Lecturer in neuroscience 1995
Professor of neuroscience 2001

Visiting positions

Visiting fellow 1989-1990, University College London

PhD students

5 students: Magnus Ivarsson, PhD Oct, 1998; Pär Svensson, PhD March, 2000; Jan Tullberg,
PhD 2002; Fredrik Bengtsson. PhD March 2005; Dan-Anders Jirenhed. PhD April 2007.

Postdoctoral collaborators

Cristopher H. Yeo, University College London 1989-2007
Tom Ziemke, Högskolan i Skövde 2002 -2007

National and international assignments

Member of scientific advisory board *Society for Research on Cerebellum*.
Member of the committee for neuroscience of Stiftelsen för strategisk forskning

Reviewer of scientific paper. E.g., Nature, Nature Neuroscience, Neuron, Journal of Neuroscience

Reviewer of grant applications. E.g., The Wellcome Trust, Biotechnology and biological sciences research council, UK. Riksbankens jubileumsfond

External PhD Examiner: *University College London, 2001 and 2002, Royal Inst. Technology, Stockholm, 2007*

Communication of research results

Numerous appearances on Swedish radio and TV, including a number of programs for Fråga

Lund, Filosofiska Rummet and Vetenskapsradion. About a hundred articles (e.g. book reviews) in newspapers and non-academic magazines.

Curriculum vitae for Magnus Lindgren

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Department of Psychology, Lund University
Paradisgatan 5, SE-221 00 Lund
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Fax: +46-46 222 42 09
e-mail: magnus.lindgren @psychology.lu.se

Present appointments

Nov 2004- Associate professor of neuropsychology, Lund University, Sweden.(20% research time)

Jan 2006- Adjunct professor of neuropsychology, University of Oslo, Norway. (10% appointment)

Previous appointments

1988 – 1999 Various clinical positions, mostly concerning child neuropsychology

1999 - 2001 Clinical psychologist, Neuropsychiatric child unit, Central Hospital, Karlstad, Sweden

2000 - 2001 Part-time (50%) post-doctoral fellowship, funded by The Bank of Sweden Tercentenary Foundation. Department of Clinical Neuroscience, Lund University.

2001 - 2002 Associate professor of neuropsychology, Department of Psychology, University of Oslo, Norway.

2003- Nov 2004 Professor of neuropsychology, Department of Psychology, University of Oslo, Norway.

Nov 2004- Associate professor of neuropsychology, Lund University, Sweden.

Jan 2006- Adjunct professor of neuropsychology, University of Oslo, Norway

Professional preparation

M.Sc. (Psychology), Lund University, 1988

Board License, Psychology 1989

Ph.D. (Psychology), Lund University, 1999

Docent (Psychology), Lund University 2002

Professor of neuropsychology following evaluation (*opprykk*), University of Oslo, 2003

Other relevant qualifications

Ph.D. students

Marianne Ors, 2003-09-12. Specific language impairment: Neurophysiological studies of children and their parents, Lund University

Petra Björne, 2007-05-07. *A Possible World: Autism from Practice to Theory*. Lund University. (Co-supervised with Christian Balkenius)

Ongoing supervisions

Lund University

Anne-Cecile Treese. Bias phenomena in emotional memory.

Petter Kallioinen. ERP correlates of serial position effects. (Co-supervised with Sverker Sikström)

Gerd Waldhauser. Cognitive control and memory
University of Oslo

Janne Cecilie von Koss Torkildsen. ERP correlates of semantic and communicative
development in the second year of life.

Marianne Lövstad: Mechanisms of cognitive control in frontal lobe patients

Curriculum vitae for Birgitta Sahlén

Birgitta Sahlén, Associate Professor
Department of logopedics, phoniatics and audiology
Lund University Hospital
SE-221 85 Lund
Telephone: +46-46-17 15 34
Fax: +46-46-17 1 732
e-mail: birgitta.sahlen@med.lu.se

Professional preparation

1977 Licensed speech and language pathologist, Lund University
1991 DMSc, PhD in logopedics, Lund University

Appointments

1977- Clinical speech pathologist and clinical supervisor at the speech pathology program, Lund university
1977-1982 Assistant lecturer, Lund University
1989-1993 Senior lecturer, Lund University
1994 -1999 Assistant professor, Lund University
1999- Associate professor, Lund University
1995 - Staff member and fascilitator at the MIL Institute for leadership training
2006- Vice Head of the Department of Logopedics, Phoniatics and Audiology, Lund universi

Educational activities and administration

Member of the board for the department of logopedics, phoniatics and audiology (-2004).
Member of the board of Audiologist and Speech pathologist programmes (2005 -).
Member of the board for rehabilitation programmes (NRU), Lund University 2006.
Lecturer and supervisor of graduate essays (MSc) in speech and language pathology.
Assistant supervisor for three doctoral students (Lund, Stockholm and Linköping) and main supervisor for three doctoral students (PhD), Lund university. Chair and member of several advisory boards for dissertations (Lund, Gothenburg) and final seminar opponent, Linköping.

Other activities**Referee in the journals: Folia Phoniatica, Logopedics, Phoniatics and Vocology and**

Acta Paediatrica, Clinical Linguistics. Reviewer of grant proposals for the former Swedish Council of Social research (SFR) and the Swedish Council for Working Life and Social Research (the FAS) and the Scientific Council (VR).

Member of the former network Communication and Cognition (SFR, the Swedish Council of Social Research) and leader for the National network for researchers in children with CI (the FAS, dnr 2005-1401) and for the network, NORPCI (Nordic Researchers in Pediatric Cochlear Implants) financed by the NuH.

Research grants (2001-)

2001-2004 In pursuit of the words. The bank of Sweden Tercentenary Foundation (dnr 2000-0171:01)
2001-2004 Speech and language development in children with cochlear implants

- The Stinger Foundation (dnr 2001-24)
- 2004-2007 Cognition, reading and verbal communication in severely hearing impaired and deaf children with cochlear implants (The FAS, 2003-0497)
- 2004-2008 Postlingually deaf children with cochlear implants in conversation with normally hearing peers. Sunnerdahl's Disability Foundation
- 2005- 2007 Children with hearing impairment – oral and written narration. The Stinger Foundation.
- 2007- 2010 Together with Löfqvist, Ors, Lindgren and Lyxell: Neurophysiological studies of children with CI. VR (medicine).

Curriculum vitae for Sven Strömquist**Sven Strömquist, Professor**

General Linguistics, Lund University

Helgonabacken 12, SE-223 62 Lund

Telephone: +46-46 222 03 89

Fax: +46-46 222 42 10

e-mail: Sven.Stromquist@ling.lu.se

Professional preparation

Undergraduate studies in Slavic languages, Scandinavian languages, and literary science resulting in a BA 1976; post graduate studies first in Russian (MA in Russian 1978), then in general linguistics; Ph.D.diss in general linguistics 1985, associate professor (oavlönad docent) 1987

Appointments

Lecturer of Swedish at Charles University, Prague, 1977; of Russian and general linguistics at the University of Uppsala 1977-1981; senior lecturer of general linguistics at the University of Gothenburg 1984-87; associate professor 87-96, professor 1996-; visiting professor at the Institute of Psychology, University of Århus, Denmark 1989-90; guest researcher at the Max-Planck Institute for Psycholinguistics for short periods 1981, 1987 and 1994; Professor of language acquisition at the University of Lund 1999-; affiliate professor of the Center for Reading Research, Stavanger 1999-

Distinctions

Winner of the Einar Hansen price for research in the humanities 2001; named Iwan Bolin lecturer, 2001, Folkuniversitetet; subject of bibliographical record in *Who's Who in the World, 20th Edition* 2003 and consecutive editions; Doctor Honoris Causa, University of Jyväskylä, 2004; winner of the Rausing prize for research in the Humanities 2006.

Doctoral students

Ulla Richthoff (May 2000), Åsa Nordqvist (March 2001), Ulla Veres (June 2004), Per Henning Uppstad (September 2005), Astrid Skaathun (September 2007)

Doctoral students at present:

Rui Alves, Gabriela Furtenyi, Ingrid Nilsson, Teresa Strandviken, Marcus Uneson

Post docs

Björn Breidegard, Per Henning Uppstad, Åsa Wengelin

Commission of trust

Head of dept at the dept of linguistics, Univ. of Göteborg 1990-1998; Editor of the Nordic Linguistic Bulletin 1981-84; secretary of the Assocation Suèdoise de linguistique appliquée (ASLA) 1992-95; member of the executive committee of the International Association for the Study of Child Language (IASCL) 1996-2002; Chair of the Swedish Braille Commission 2000-; President of Sweden's National Committee for the European Year of Languages 2001; Dean of the Faculty of Humanities, Lund University 2003-; member of Lund University's Cultural Forum 2003- ; member of Lund University's Council for strategic research 2006-

scientific director of the Humanities Laboratory at Lund University 2006-, vice-chair of the Wallenberg Global Learning network 2006-

Doctoral committees at the universities of Göteborg, Jyväskylä, Linköping, Lyon, Lund, Odense, Oslo, Stockholm, Tilburg, and Umeå; expert reviewer for the Swedish Research Council for the Humanities and Social Sciences, The Swedish Tercentenary Foundation, The Swedish Social Research Council, The Research Council of Norway, The Sweden-America Foundation, The Guggenheim Foundation, and the American Council of Learned Societies; expert mission for the Swedish Ministry of Education, and for the Dutch Ministry of Education; Consulting editor for Linguistics, Language and Cognitive Processes, Journal of Pragmatics, Journal of Child Language, Child Development, International Journal of Applied Linguistics, and Nordic Journal of Linguistics; Sweden's delegate in COST Action A8 "Learning disabilities as a barrier to human development" (concerning severe reading and writing disabilities) 1995-1999; member of the editorial board of Written Language and Literacy 2003-; member of the editorial board of Journal of Child Language 2006-;

Networks in academia and industry

"Language development - a Scandinavian perspective" (The Nordic Council, 1994-1996), "Reading and writing strategies of disabled groups" (Swedish Council for Social Research, 1996-2002); Scandinavian part of "Developing literacy in different contexts and in different languages" (principal investigator Ruth Berman, Tel Aviv, Spencer Foundation, 1997-), "The Dynamics of Production and Perception during Text Writing" (together with Kenneth Holmqvist, Department of Cognitive Science, Lund; Swedish Research Council, 2001-) "European Cultural Heritage Online" (principal investigator Jürgen Renn - together with several European partners, including three Max Planck institutes; 5th framework programme); "Reading with the hands – reading strategies in the blind" (together with Bodil Jönsson, Centre for technical rehabilitation research, Lund University). Initiator and Nordic coordinator for the research network "Nordic Language Acquisition Research Initiative" (sponsored by the Nordic Research Academy), which organizes the international conference series "Northern European Language Acquisition Seminar" (NELAS) and summer schools in language development; one of the initiators and delegates of COST Action A8 "Learning disabilities as a barrier to human development"

Entrepreneurial achievements

Instigator and leader of the development of ScriptLog, a computer tool for research on online writing used in more than 15 countries. See: www.ScriptLog.net

Publications

150 items (published or accepted for publication).



VETENSKAPSRÅDET
THE SWEDISH RESEARCH COUNCIL

Kod

Name of applicant

Date of birth

Title of research programme

Appendix C**Thinking in Time: Cognition Communication and Learning****List of publications 2003 – 2007****Peter Gärdenfors****Peer-reviewed articles and conference contributions**

1. 2003b (together with Ingar Brinck) "Co-operation in apes and humans", pp. 367-376 in *On Mind and Consciousness*, Selected papers from the MiCon 2002 Conference, ed. by Ch. Chakraborti, M. K. Mandal and R. B. Chatterjee, Indian Institute of Advanced Study, Shimla.
2. 2003c (together with Mary-Anne Williams) " Building rich and grounded robot world models from sensors and knowledge resources: A conceptual spaces approach ", Proceedings of AMIRE 2003.
3. 2003h "Visualizing the meanings of words", in *Language and Visualization*, , edited by Y. Eriksson and K. Holmqvist.
4. 2003j (together with Ingar Brinck) " Co-operation and communication in apes and humans ", *Mind and Language* 18 , pp. 484-501.
5. 2003k "Inductive reasoning: From Carnap to cognitive science", in Proceedings of the International Conference on Theoretical Neurobiology , ed. by N. C. Singh, National Brain Research Centre, Manesar, pp. 93-109.
6. *2004b " Cooperation and the evolution of symbolic communication ", in *The Evolution of Communication Systems* , ed. by K. Oller and U. Griebel, MIT Press, 2004, pp. 237-256.
7. *2004d " How to make the Semantic Web more semantic ", pp. 19-36 in *Formal Ontology in Information Systems* , ed. by A.C. Varzi and L. Vieu, IOS Press.
8. 2004e "Conceptual spaces as a framework for knowledge representation", *Mind and Matter* 2 , pp. 9-27.
9. 2004i "Emulators as sources of hidden variables" commentary on "The emulation theory of perception" by Rick Grush, *Behavioral and Brain Sciences* 27:3 , p. 403.
10. 2005i "Cognitive semantics and image schemas with embodied forces", paper presented at the Cassirer conference on Embodiment, Gothenburg, May 2004.
11. 2005j "Understanding cultural patterns", to be published in *Global Understandings: Learning and Education in Troubled Times*, ed. by M Suarez-Orozco, University of California Press.
12. 2005l (together with Jordan Zlatev and Tomas Persson) "Triadic bodily mimesis is the difference!", commentary on Tomasello et al. "Understanding and sharing intentions: The origins of cultural cognition" *Behavioral and Brain Sciences* 28:5, pp. 720-721.
13. 2005j "Understanding cultural patterns", in *Learning in the Global Era: International Perspectives on Globalization and Education*, ed. by M. Suárez-Orozco, University of California Press, pp. 67-84.
14. 2005n (together with Mary-Anne Williams) "Multi-agent communication, planning and collaboration based on representations and simulations, to appear in the proceedings of the ILCC 2004 conference, ed. by D. Khlenthos and A. Schalley, Benjamins.
15. 2005o "Reasoning in conceptual spaces", to appear in *Reasoning: Studies of Human Inference and Its Foundations*, ed. by J. Adler and L. Rips, Cambridge University Press.
16. 2006f (together with Massimo Warglien) "Cooperation, conceptual spaces and the

evolution of semantics”, in *Symbol Grounding and Beyond*, ed. by P. Vogt, Y. Sugita, E. Tuci and C. Nehaniv, Springer, Berlin, Heidelberg, pp. 16-30.

17. 2006g "A representation theorem for voting with logical consequences", *Economics and Philosophy* 22, pp.181-190.

18. 2006k (together with Sverker Johansson and Jordan Zlatev) "Why don't chimps talk and humans sing like canaries?" Commentary on Locke and Bogin "Language and life history", *Behavioral and Brain Sciences* 29:3, pp. 287-288.

19. 2007e (together with Werner Kuhn and Martin Raubal) "Cognitive semantics and spatio-temporal ontologies", *Spatial Cognition and Computation*, 7, no. 1, pp. 3-12.

20. 2007f (together with Mathias Osvath) "What are the evolutionary causes of mental time travel?", to appear as a commentary on T. Suddendorf and M. C. Corballis "The evolution of foresight: What is mental time travel and is it unique to humans?", *Behavioral and Brain Sciences*.

21. *2007d "Mindreading and control theory", *European Review*. 15, no. 2, pp. 223-240.

Overviews and book chapters

1. *2000e " Concept combination: a geometrical model ", pp. 129-146 in L. Cavedon, P. Blackburn, N. Braisby and A. Shimojima (eds) *Logic language and Computation Vol 3* , CSLI, Stanford, CA.

2. 2004c (together with other members of a committee) " The learning brain, the learning individual, the learning organisation ", report from a committee for a Swedish research program on learning processes.

3. 2004g "Conceptual spaces", Ch. 3 in *Espacio y Tempo en Gestion y Análisis Social* , ed. by Roger Churnside, Universidad de Costa Rica.

4. 2004l "Representing actions and functional properties in conceptual spaces", to appear in *Body, Language and Mind* ,ed. by T. Ziemke and J. Zlatev.

5. 2004m "Category representation, concept learning and non-monotonic reasoning" to appear in *Handbook of Categorization* , Elsevier.

6. 2005a " The detachment of thought ", pp. 323-341 in *Mind as a Scientific Subject: Between Brain and Culture* , ed. by C. Erneling and D. Johnson, Oxford University Press.

7. 2005c (together with Petter Johansson) "Introduction to Cognition, Education and Communication Technology" pp. 1-20 in *Cognition, Education and Communication Technology* , ed. by P. Gärdenfors and P. Johansson, Lawrence Erlbaum Publishers, 2005.

8. 2005k (together with Mathias Osvath) "Oldowan culture and the evolution of anticipatory cognition", *Lund University Cognitive Studies* 122 , Lund.

9. 2005m (together with Mary-Anne Williams, Alankar Karol, John McCarthy and Christopher Stanton) "A framework for evaluating groundedness of representations in systems: From brains in vats to mobile robots", manuscript.

10. 2005n (together with Jordan Zlatev and Tomas Persson) "Bodily mimesis as "the missing link" in human cognitive evolution", *Lund University Cognitive Studies* 121 , Lund.

11. 2005i "Likhet och sannolikhet i beslutsfattande och begreppsbildning" (Similarity and probability in decision making and concept formation), pp. 103-121 in *Risk och det levande mänskliga*, ed. by I. Brinck, S. Halldén, A.-S. Maurin, and J. Persson, Nya Doxa, Nora.

12. 2005k (together with Mathias Osvath) "Oldowan culture and the evolution of anticipatory cognition", *Lund University Cognitive Studies* 122, Lund.

13. 2005m (together with Jordan Zlatev and Tomas Persson) "Bodily mimesis as 'the missing link' in human cognitive evolution", *Lund University Cognitive Studies* 121, Lund.

14. 2005q (together with Mathias Osvath) "The evolution of anticipatory cognition as a precursor to symbolic communication", to appear in the proceedings of the Morris symposium on the Evolution of Language, Stony Brook, October 2005, Cambridge University Press, Cambridge.
15. 2005r (together with Mary-Anne Williams, Alankar Karol, John McCarthy and Christopher Stanton) "A framework for evaluating groundedness of representations in systems: From brains in vats to mobile robots", manuscript.
16. 2006l "On the evolution of intersubjectivity", to appear in *Consciousness Transitions - Phylogenetic, Ontogenetic and Physiological Aspects*, ed. by H Liljenström and P. Århem, Elsevier.
17. 2006m "Evolution and semantics", to appear in *Cambridge Encyclopedia of the Language Sciences*, Cambridge University Press.
18. *2007b "The cognitive and communicative demands of cooperation", in the electronic Festschrift *Hommage à Wlodek: Philosophical Papers Dedicated to Wlodek Rabinowicz* (<http://www.fil.lu.se/hommageawlodek/>).
19. 2007c "La intuición como conocimiento implícito" (Spanish translation of 2000d), *Revista de Filosofía de la Universidad de Costa Rica*, XLIII, no. 108, pp. 51-55.
20. 2007i (together with Massimo Warglien) "Semantics, conceptual spaces and the meeting of minds", manuscript.
21. 2007k "Cognitive semantics and image schemas with embodied forces", pp. 57-76 in *Embodiment in Cognition and Culture*, ed. by J. M. Krois, M. Rosengren, A. Steidele and D. Westerkamp, Benjamins, Amsterdam.
22. 2007l "The social stance and its relation to intersubjectivity", to appear in the *Proceedings of the IIS Congress in Stockholm 2005*.
23. 2007m "The role of cooperation in the evolution of cognition and communication", to appear in the *Proceeding of a Penn State Museum conference on the Origins of Mind, Language and Culture*.

Books

1. *1988 *Knowledge in Flux: Modeling the Dynamics of Epistemic States*, Bradford Books, MIT Press, Cambridge, MA.
2. *2000 *Conceptual Spaces*, Bradford Books, MIT Press, Cambridge, MA. (Paperback edition published 2004.)
3. *2003 *How Homo became sapiens: On the evolution of thinking*, Oxford University Press. (Paperback edition 2006. Original Swedish version 2000. Translated into Japanese 2005 and Spanish 2006, French 2007. Translation into Polish under preparation).
4. *2005 *The Dynamics of Thought*, Springer, Berlin.
5. 2005 *Tänkens vindlar: Om språk, minne och berättande*, Nya Doxa, Nora.
6. 2006 *Den meningssökande människan (The Meaning-seeking Human)*, Natur och Kultur, Stockholm.

Edited Books (8 volumes in total):

7. 2005 *Cognition, Education and Communication Technology*, ed. by P. Gärdenfors and P. Johansson, Lawrence Erlbaum Publishers, 2005.

Popular-scientific articles and activities

1. 2003f "Personligheten och den kemiska soppan" (Personality and the chemical soup), *Svenska Dagbladet August*, 2003.
2. 2003e "Inläringen följer inga tayloristiska checklistor" (Learning does not follow Tayloristic check lists), *Svenska Dagbladet*, April 15, 2003.

3. 2003g (together with Christian Balkenius) "Intelligenta lösningar behöver inte vara mänskliga" (English web version available as "Machines with ghosts"), *Axess*, No. 4, pp. 35-37.
4. 2004a "Längtan leder stegen mot framtiden" (Longing leads the steps towards the future), review of J.-F. Dortier: *L'homme - cet étrange animal*, Science Humaines Editions, Paris, 2004, *Svenska Dagbladet* May 2, 2004
5. 2004f "Kvinnan från Flores", (The woman from Flores) *Sydsvenska Dagbladet*, 13 October 2004
6. 2004j "Att skapa gemensamma visioner: Om språkets roll i människans utveckling" (Creating common visions: On the role of language in human evolution), *Axess*, No. 2.
7. 2005d "Människan - det förutseende djuret" (Man - the anticipatory animal), pp. 198-212 in *Arkeologi och naturvetenskap*, Gyllensstiernska Krappersstiftelsen.
8. 2005e "Leken gör oss till människor" (Playing make us human), *Svenska Dagbladet* March 16, 2005.
9. 2005g "Om djurs lekar - och människors" (On the play of animals - and humans), pp. 21-28 in *Ting för Lek, Kulturens Årsbok 2005*.
10. 2005p (together with Mathias Osvath) "Quand les hommes inventèrent l'avenir", *Science Humaines*, December 2005, pp. 58-63.
11. 2006c "Vi berättar för livet" (We tell for life), *Forskning och Framsteg* 3:2006, pp. 28-31.
12. 2006d "Det yttre landskapet som stöd för minne och tänkande" (The outer landscape as support for memory and thinking), *Bild i Skolan* 2:06, pp. 13-14.
13. 2006e "Kan Darwin förklara Gud?" (Can Darwin explain God?), *Svenska Dagbladet*, July 4.
14. 2006h "En tornsvala i tankens laboratorium" (A swift in the laboratories of thinking), *Svenska Dagbladet*, August 11.
15. 2006i "Religion ur ett evolutionärt perspektiv" (Religion from an evolutionary perspective), *Humanisten* 3:2006, pp. 27-30.
16. 2006j Review of Daniel Dennett, *Breaking the Spell* (Allen Lane 2006), *Annex* 7:2006. Also published in *Humanisten* 5:2006, pp. 30-32.1
17. 2007a "Audiens hos schimpanser och gorillor" *Forskning och Framsteg* 1/07, pp. 56-57.
18. 2007g "Grottans språk och den andra världen" (The language of the cave and the other world), *Svenska Dagbladet*, July 8.
19. 2007h "We and they", *Framework*, No. 7, June '07 (Special Nordic issue on "Nationality in Context"), pp. 14-15.
20. 2007j "Lucifereffekten är en del av evolutionen" (The Lucifer effect is a part of evolution), *Svenska Dagbladet*, August 18.
21. (together with Jana Holsanova) "Kommunikation med och utan teknik" (Communication with and without the use of technology), to appear in a volume on research on communication.
22. A large number of appearances on Swedish radio and TV, including a number of programs for *Filosofiska Rummet* and *Vetenskapsradion*.

PUBLICATIONS 2003-2007 plus most important papers
Germund Hesslow

Refereed publications

1. * Andersson G, Garwicz M, Hesslow G (1988), Evidence for GABA-mediated cerebellar inhibition of the inferior olive in the cat, *Experimental Brain Research* 72:450-456
2. * Hesslow G (1994), Inhibition of conditioned eye-blink responses by stimulation of the cerebellar cortex in the cat. *Journal of Physiology* 476:245-256.
3. * Hesslow G, Svensson P and Ivarsson M (1999) Learned Movements Elicited by Direct Stimulation of Cerebellar Mossy Fiber Afferents. *Neuron*, 24: 179–185.
- 4.* Hesslow, G. (2002) Conscious Thought as Simulation of Behaviour and Perception. *Trends in Cognitive Sciences*, 6:242-247
5. Bengtsson, F., Svensson, P and Hesslow, G. (2004) Feedback control of Purkinje cell activity by the cerebello-olivary pathway. *European Journal of Neuroscience* 20: 2999–3005
6. Hesslow, G. (2005) The Dangers of the Therapeutic Culture. In *Modernity and Its Discontents: Sceptical Essays on the Psychomedical Management of Malaise*. Petteri Pietikainen (ed.), Stockholm: Ax:son Johnson Foundation 2005
7. Ziemke T, Jirnhed D-A & Hesslow G (2005) Internal Simulation of Perception: A Minimal Neuro-Robotic Model. *Neurocomputing*. 28:85-104
8. Svensson, P, Bengtsson, F and Hesslow, G (2006) Cerebellar inhibition of inferior olivary transmission in the decerebrate ferret. *Experimental Brain Research* 168:241-53.
- 9.* Bengtsson,F. and Hesslow,G. (2006). Cerebellar Control of the Inferior Olive. *Cerebellum* 5: 7-14
- 10.* Jirnhed D-A, Bengtsson F, & Hesslow G (2007). Acquisition, Extinction, and Reacquisition of a Cerebellar Cortical Memory Trace. *Journal of Neuroscience* 27: 2493-2502
- 11.* Bengtsson F, Jirnhed D-A, Svensson, P and Hesslow G (2007) Extinction of conditioned blink responses by cerebello-olivary pathway stimulation I. *Neuroreport* 18:1479-82
12. Hesslow G and Jirnhed D-A (2007) The inner world of a simple robot. *Journal of Consciousness Studies*. 14:85-96
13. Hesslow G and Jirnhed D-A (2007) Must Robots be Zombies? *AAAI proceedings. Forthcoming*
- 14.* Hesslow, G. Can the simulation theory explain the inner world? (2007) *Submitted*
- 15.* Svensson, P and Hesslow, G (2007) Timing of simple spike inhibition in Purkinje cells of classically conditioned ferrets. *Submitted*

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- 1.* Hesslow, G. & Yeo, C.H. (2002) The Functional Anatomy of Skeletal Conditioning. In Moore, J.W. (ed), *A Neuroscientist's Guide to Classical Conditioning*. Springer, pp. 86-146.
2. Hesslow, G. (2007) Hjärnan och medvetandet. I *Hjärnan*. Olsson, L. och Österberg, K. (red.), Karolinska Institutet University Press. *In press*.
3. Jämställdhet eller likformighet. I Nerbrand, S. (red.) *Samtida feminism*. Axel och Margaret Ax:son Johnsons stiftelse, Stockholm, 2007.

Popular science

Through the years more than a hundred articles such as book reviews, opinion articles and popular science in daily press and magazines, most recently for instance "Lycka är inte allt" (Happiness is not everything) in *Magasinet NEO* nr 2, 2007

List of publications 2003-2007**Magnus Lindgren****Selected relevant peer-reviewed publications**

- 1.* Stenberg G, Lindgren M, Johansson M, Olsson A, Rosén I (2000). Semantic processing without conscious identification: evidence from event-related potentials. *Journal of Experimental Psychology-Learning, Memory, and Cognition*, 26(4), 973–1004.
2. Lindgren M, Stjernqvist K, Ors M, Rosén I (2000). Event-related potential findings in healthy extremely pre-term (< week 29) children at age 10. *Child Neuropsychology*, 6, 77-86.
3. Hansson M, Lindgren M (2001). Multiple window spectrogram of peaks due to transients in the electroencephalogram. *IEEE Biomedical Engineering*, 48(3), 284 –293.
- 4.* Ors M, Lindgren M, Berglund C, Hägglund K, Rosén I, Blennow G (2001). The N400 component in parents of children with selective language impairment. *Brain and Language*, 77, 60-71.
- 5.* Ors M, Lindgren M, Blennow G, Nettelbladt U, Sahlén B, Rosén I (2002). Auditory event-related brain potentials in children with specific language impairment. *European Journal of Paediatric Neurology*, 6(1), 47-62.
- 6.* Johansson M, Stenberg G, Lindgren M, Rosén I (2002) Memory for perceived and imagined pictures – an event-related potential study. *Neuropsychologia*, 40(7), 986-1002.
7. Ors M, Lindgren M, Blennow G, Rosén I (2002). Auditory event-related brain potentials in parents of children with specific language impairment. *European Journal of Paediatric Neurology*, 6, 249-260.
8. Ors M, Ryding E, Lindgren M, Blennow G, Rosén I (2005). SPECT findings in children with specific language disorders. *Cortex*, 4, 316-326.
9. Sandberg J, Hansson M, Lindgren M (2005) Detecting MMN in Infants EEG with Singular Value Decomposition. *Proceedings of the 2005 IEEE Engineering in Medicine and Biology 27th Annual Conference*. Shanghai, China, September 1-4, 2005, 4227-4230
- 10.* Von Koss Torkildsen, J, Sannerud, T, Syversen, G, Thormodsen, R, Simonsen, H G, Moen, I, Smith, L, Lindgren, M. (2006) Semantic organization of basic level words in 20-month-olds: An ERP study. *Journal of Neurolinguistics*, 19, 431-454
- 11.* Von Koss Torkildsen J, Syversen G, Gram Simonsen H, Moen I, Smith L, Lindgren M (2007). Electrophysiological correlates of auditory semantic priming in 24-month-olds *Journal of Neurolinguistics*, 20, 332-351
- 12.* Stige S, Fjell A M, Smith L, Lindgren M, Walhovd K B (2007): The development of visual P3a and P3b. *Developmental Neuropsychology*, 32, 563-584.
- 13.* Von Koss Torkildsen J, Syversen G, Gram Simonsen H, Moen I, Smith L, Lindgren M (2007). Brain responses to lexical-semantic priming in children at risk for dyslexia. *Brain and Language*, 102, 243-261.
- 14.* Roll M, Horne M, Lindgren M (2007) Object Shift and Event-Related Brain Potentials. *Journal of Neurolinguistics*, 462-481
- 15.* Von Koss Torkildsen J, Friis Hansen H, Svangstu JM, Smith L, Gram Simonsen H, Moen I, Lindgren M (2007) Productive vocabulary size predicts ERP correlates of fast mapping in 20-month-olds. *Journal of Cognitive Neuroscience*, in press
16. Henriksen C, Haugholt K, Lindgren M, Aurvåg AK, Rønnestad A, Grønn M, Solberg R, Moen A, Nakstad B, Berge RK, Smith L, Iversen PO, Drevon CA (2007): Beneficial effect of early supplementation of docosahexaenoic acid and arachidonic acid to very-low birth weight infants on cognitive function. A randomized, clinical trial. *Pediatrics*, in press.

Selected peer-reviewed conference presentations and overviews

1. Solbakk A-K, Reinvang I, Lindgren M (2003). Event-related potentials i klinisk nevropsykologi, *Tidskrift for Norsk Psykologforening*, 40, 109-118
2. J von Koss Torkildsen & M Lindgren (2005). Neural correlates of semantic processing in 20-month-olds. Paper presented at the *Xth International Congress for the Study of Child Language*. Berlin, Germany. July 25-29.
3. Melinder A, Endestad T, Lindgren M (2005): Children's Remembrance and Confidence-Ratings of Aversive and Neutral Pictures. *XIVth Conference of the European Society for Cognitive Psychology, Leiden, The Netherlands*, August 31st - September 3rd 2005
4. Sandberg J, Hansson M, Lindgren M (2005): Detecting MMN in Infants EEG with Singular Value Decomposition. *27th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Shanghai, China, September 1-4, 2005.
5. J von Koss Torkildsen & M Lindgren (2006). Productive vocabulary size predicts receptive recall of novel words in toddlers. *Latsis colloquium of the University of Geneva: Early Language Development and Disorders*. Geneva, Switzerland. January 26-28.
6. Syversen, G, Smith, L, von Koss Torkildsen, J, Lindgren, M (2006). Investigating early semantic priming: event-related potentials as a window into the organization of semantic memory in children at age 24 months. *International Conference on Infant Studies*, Kyoto, Japan, June 19-23, 2006.
7. Hövel, H, Lindgren, M, Rosén, I, Westas, L, Stjernqvist, K, Fellman, V (2007): Late difference positivity in auditory event-related potentials (aERP) is correlated with cognitive performance in extreme prematurity, *ESPR- 48th Annual Meeting of the European Society for Paediatric Research*, Prague, 6-8 Oct 2007

List of publications 2003 2007**Birgitta Sahlén****Original papers in refereed journals**

- 1.* Sahlén, B., Nettelbladt, U.(1993) Context and Comprehension. A neurolinguistic and interactional approach to the understanding of semantic-pragmatic disorder. *European Journal of Disorders of Communication*, 28:117-140.
- 2.* Sahlén, B. Reuterskiöld-Wagner, Nettelbladt U., Radeborg, K. (1999a) Nonwordrepetition in children with language impairment. Pitfalls and possibilities. *International Journal of Language & Communication Disorders*, vol 34, 3, 337-352.
- 3.* Reuterskiöld Wagner, C., Sahlén, B., Nettelbladt, U. (1999) What's the story? Narration and comprehension in Swedish preschool children with language impairment. *Child Language Teaching and Therapy*, vol 15, no 2.
- 4.* Reuterskiöld Wagner, C., Sahlén, B., Radeborg, K., Tideman, E. (2000) Speed and context. The effect of a sentence prime on naming speed in children with language impairment. *Clinical Linguistics and Phonetics*, 14,5, 369-385.
- 5.* Ors, M., Lindgren, M, Blennow, G. , Nettelbladt, U., Sahlén, B., Rosén, I.(2001) Auditory event-related brain potentials in children with specific language impairment. *European Journal of Paediatric Neurology*, 2002;6, 47-62.
- 6.* Reuterskiöld Wagner, C., Nettelbladt, U. Sahlén, B. (2001). Giving the crucial information: Performance on a referential communication task in Swedish children with LI. *International Journal of Language and Communication Disorders*, vol 36, no 4, 433-445
- 7.* Reuterskiöld Wagner, C., Nettelbladt, U. Sahlén, B. (2001). Giving the crucial information: Performance on a referential communication task in Swedish children with LI. *International Journal of Language and Communication Disorders*, vol 36, no 4, 433-445.
8. Reuterskiöld-Wagner, C., Sahlén, B., Nyman, A. (in press) Non-word repetition and non-word discrimination in Swedish preschool children. To appear in *Journal of Clinical Linguistics and Phonetics*.
9. Sahlén, B., Hansson, K., Ibertsson, T., Reuterskiöld Wagner, C.(2004) Reading in children of primary school age – a comparative study of children with hearing impairment and children with specific language impairment. *Acta Neuropsychologica*, vol 2, nr 4, 393-407.
- 10.* Willstedt-Svensson, U., Löfqvist, A., Almqvist, B., Sahlén, B. (2004) Is age at implant the only factor that counts? The influence of working memory on lexical and grammatical development in Swedish children with cochlear implant. *International Journal of Audiology*; 43:506-515.
- 11.* Hanson, K., Forsberg, J., Löfqvist, A., Mäki-Torkko, E., Sahlén, B.(2004) Verbal working memory and novel word learning in children with hearing impairment and children with specific language impairment. *International Journal of Language and Communication Disorders*, 39, 3,401-422.
12. Radeborg, K., Barthelom, E., Åkesson, M., Sahlén, B. (2006) A Swedish nonword test for preschool children. *Scandinavian Journal of Psychology*,47, 187-192
- 13.* Sahlén, B., Hansson, K. (2006). Novel word learning and its relation to working memory and language in children with mild-to-moderate hearing impairment and children with specific language impairment. *Journal of Multilingual Communication Disorders*,4,2,95-107.
14. Hansson, K., Sahlén, B., Mäki-Torkko, E. (2007) Can a 'single'hit' cause limitations in language development? A comparative study of Swedish children with hearing impairment

and children with specific language impairment. *International Journal of Language and Communications Disorders*, 42,307-323.

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1. Lilja, Å, Sahlén, B. (2003) Action reflection learning – a cognitive method.. In Rohlin, L. And Nilsson G. Eds: Leadership and Learning, MiL Publishers, Studentlitteratur, Lund.
2. Nettelbladt, U., Samuelsson, C. Sahlén, B. Ors, M. Willstedt-Svensson, U, Mäki-Torkko, E. m.fl (in press) Logopediboken (eds Hartelius, L. , Nettelbladt, U.), kap II.2, II.3.1., II.5.1. Lund: Studentlitteratur.

Other publications - tests

1. Nettelbladt, U., Radeborg, K. Sahlén, B. (2003) Svenska CCC – Childrens Communication Checklist. Department of Logopedics, Phoniatics and Audiology, Lund university, Lund.
2. Radeborg, K., Barthelom, E., Åkesson, M., Sahlén, B. (2006) A Swedish nonword test for preschool children. *Scandinavian Journal of Psychology*,47, 187-192

List of publications 2003-2007**Sven Strömquist****Peer-reviewed articles and conference contributions**

1. *Breidegard, B., Jönsson, B., Fellenius, K. and Strömquist, S. (2006) Disclosing the Secrets of Braille Reading – Computer-Aided Registration and Interactive Analysis. *Visual Impairment Research*, 8:49–59.
2. Broeder, D., Declerck, T., Romary, L., Uneson, M., Strömquist, S. and Wittenburg, P. (2004) A Large Metadata Domain of Language Resources. <http://www.mpi.nl/echo/tech-report-list.html>
3. Ragnarsdóttir, H. and Strömquist, S. (2005) The development of generic *maDur/man* for the construction of discourse stance in Icelandic and Swedish. *Journal of Pragmatics*.
4. Strömquist, S., Crasborn, O., Eklund, Godelier, M., Karadimas, D., Kieven, E., Renn, J., Uneson, M., Wittenburg, P. (2004) State-of-art review on humanities, social sciences, and cultural heritage knowledge bases. <http://echo.mpiwg-berlin.mpg.de/home/publicRelation/reports> and http://www.ling.lu.se/projects/echo/state_of_art/index.html
5. *Strömquist, S., Holmqvist, K. and Andersson, R. (in press) Thinking-for-speaking and channelling of attention – a case for eye-tracking research. In J. Guo, E. Lieven, S. Ervin-Tripp, N. Budwig, K. Nakamura (Eds.) *Crosslinguistic approaches to the psychology of language: Research in the tradition of Dan Isaac Slobin*. Mahwah, New Jersey: Lawrence Erlbaum Associates Publishers.
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7. *Strömquist, S. and Ragnarsdóttir, H. (2000) On the acquisition of verb argument structure. *Linguistics* 38-3:523-543.

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1. Alves, R., Castro, S.L., de Sousa, L. and Strömquist, S. (2006) The cognitive cost of execution in written composition. In D. Galbraith, M. Torrance and L. Van Waes (Eds.) *Recent Developments in Writing Process Research* Vol. 1. Kluwer.
2. Andersson, B., Dahl, J., Holmqvist, K., Holsanova, J., Johansson, V., Karlsson, H., Strömquist, S., Tufvesson, S. and Wengelin, Å. (in press) Combining keystroke logging with eye tracking. In L. van Waes, M. Leijten and C. Neuwirth (Eds.) *Writing and Digital Media*. Kluwer.
3. Holmqvist, K., Holsanova, J., Johansson, V. and Strömquist, S. (2005) Perceiving and producing the frog story. In D. Ravid and H. Bat-Zeev Shyldkrot (Eds.), *Perspectives on language and language development*. Dordrecht: Kluwer.
4. *Plunkett, K. and Strömquist, S. (1992) The Acquisition of Scandinavian Languages, in D. I. Slobin (ed.), *The Crosslinguistic Study of Language Acquisition*, Vol 3, Hillsdale, New Jersey: Lawrence Erlbaum, pp 457-556.

5. Ragnarsdóttir, H. and Strömqvist, S. (2004) Time, Space and Manner in Icelandic and Swedish. In S. Strömqvist and L. Verhoeven (Eds.). *Relating events in narrative – typological and contextual perspectives*. Mahwah, New Jersey: Lawrence Erlbaum Associates Publishers, 113-141.
6. Strömqvist, S (2003) Barns tidiga språkutveckling. I L. Bjar och C. Liberg (red.) *Barn utvecklar sitt språk*. Lund: Studentlitteratur, 57-78.
7. *Strömqvist, S (2003) Language acquisition in early childhood. In G. Rickheit, Th. Herrmann and W. Deutsch (Eds.) *Psycholinguistics - An International Handbook*, Berlin: Walter de Gruyter.
8. Strömqvist, S (2003) i G. Ransbo (ed.) 2003. Språklig mångfald och språkinläring i början av 2000-talet. In *Ut dicitur – Till språkets lov*. Kungliga Humanistiska Vetenskaps-Samfundet i Uppsala, 37-48.
9. Strömqvist, S. (2004) Olika språk – olika berättelser? Om kognitiva och kommunikativa konsekvenser av språklig mångfald. In Å. Bergren, S. Arvidsson and A.-M. Hållans (Eds.) *Minne och myt*. Nordic Academic Press, 11-21.
10. Strömqvist, S. (2004) A picture of linguistic diversity. In Y. Eriksson and K. Holmqvist (Eds.) 2004. *Language and Visualisation*. Lund University: Department of Cognitive Science, 9-30.
11. *Strömqvist, S. (2006) Learning to write: a window on language, communication and cognition. In J. Bernicot (Ed.) *Pragmatique Développementale: Perspectives Européennes*, special edition of *Le langage et l'Homme* Vol. 41 2006/2.
12. Strömqvist, S., Hellstrand, Å. and Nordqvist, Å. (2000) From child speech to literary art. In P. Broeder and J. Murre (Eds.) *Language and Cognition*, Tübingen: Gunter Narr, 5-28.
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14. Strömqvist, S., Nordqvist, Å. and Wengelin, Å. (2004) Writing the frog-story: developmental and cross-modal perspectives. In S. Strömqvist and L. Verhoeven (Eds.). *Relating events in narrative – typological and contextual perspectives*. Mahwah, New Jersey: Lawrence Erlbaum Associates Publishers, 359-394.
15. *Strömqvist, S., Ragnarsdóttir, and Richthoff, U. (2001) Input and production in the acquisition of function words. In B. Höhle, and J. Weissenborn (Eds), *Approaches to Bootstrapping: Phonological, Syntactic and Neurophysiological Aspects of Early Language Acquisition*. Language acquisition and language disorders, Volume 2. Amsterdam: John Benjamins, 157-177.
16. Wengelin, Å. and Strömqvist, S. (2005) Text-writing development viewed through on-line pausing in Swedish. In R. Berman (ed.) *Language Development across Childhood and Adolescence*, Trends in Language Acquisition Research (TILAR series) Volume 3, Amsterdam: John Benjamins, 177-190.

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1. *Strömquist, S. and L. Verhoeven (Eds.). (2004) *Relating events in narrative – typological and contextual perspectives*. Mahwah, New Jersey: Lawrence Erlbaum Associates Publishers
2. Verhoeven, L. and Strömquist, S. (Eds.) (2001) *Narrative development in a multilingual context*. Amsterdam: John Benjamins.

Popular-scientific articles and activities

1. Strömquist, S. (2004) Språk- och litteraturcentrum vid Lunds Universitet. Crafoordska stiftelsens årskrift 2004, 1-5.
2. Strömquist, S. (2004) The Centre for languages and literature at Lund University. *Language Archive Newsletter* Vol. 1 No. 3, 2-3.

Därutöver ett stort antal tidnings-, radio- och teveintervjuer och –program om Humanistlaboratoriet och dess forskning; bland annat i Sydsvenska dagbladet, Sydnytt, Vetenskapsradion, Vetenskapslandet, Språket, Kulturnyheter, samt intervjuer i finsk, norsk och jordansk radio och teve.



VETENSKAPSRÅDET
THE SWEDISH RESEARCH COUNCIL

Kod

Name of applicant

Date of birth

Title of research programme

Appendix U

REQUIREMENTS FOR IMPLEMENTATION

Lund University hereby proposes Thinking in Time: Cognition, Communication and Learning, CCL, as a strong and excellent research environment to be funded by the Swedish Science Council (VR) under the Linnaeus Grant programme. According to the University's strategy we shall focus our efforts on our strong areas. A research area must fulfil the following criteria in order to be defined as a strong area:

- high or very high international recognition,
- good leadership,
- critical mass,
- adequate external funding,
- scientific collaboration internally as well as externally and
- potential for development.

We feel that CCL is an excellent candidate and we expect that it will contribute substantially to further strengthen the University's profile as an internationally leading research university.

In the appendices A, B and C we describe the solid scientific foundation that this initiative builds on, our expertise, our vision and objectives, as well as an outline description of our strategy for reaching the ambitious goals. In this appendix, we present the financial basis of this initiative. The University is fully prepared to make the necessary organisational and financial contribution in order to support CCL, should VR decide to provide the additional funding that constitutes the Linnaeus Grant. The University will support each selected Linnaeus Grant with an additional of 1 million SEK per year in fresh research funding to be used in addition to the in kind support for e.g. salaries, premises, and infrastructure covered by the faculty grants. However, perhaps even more important for the successful development of this research centre is the rich intellectual setting that Lund University constitutes, in combination with its highly developed organisational structure that provides a number of dedicated support mechanisms that will be at service to the centre. These issues will be dealt with in detail in this document.

While this initiative mainly focuses on offering optimum conditions and sufficient critical mass for excellence in research, we are confident that it will generate knowledge and methods that in a medium- to long-term perspective will give rise to new pedagogical and clinical applications in this field. Therefore, we intend to operate the centre in close connection to the university's innovation system, which offers a coherent set of activities to support the innovation activities within the centre.

All in all, we present a coherent scheme of support activities that will cater for the favourable development and growth of the centre, and for its integration into our organisation, while at the same time giving it visibility as a centre of excellence in research, marketing and information activities.

In this annex we will, for simplicity, denote Thinking in Time: Cognition, Communication and Learning covered by the Linnaeus Grant application for *the Centre* or CCL.

Financial plan, the size of the research environment and required investments

1. Financial plan for the entire period (ten years)

The overall financial plan of CCL over the projected 10-year period is specified in Table 1. We apply for 7500tkr (7500 x thousand SEK) per year. Lund University provides additional funding 1000tkr per year, half of which comes from the University level and half from The Faculties of Humanities and Theology.

Cofunding amounts to between 70% and 92% of the total amount applied for during the funding period. It consists of salaries to 20 researchers working between 50% (three full professors) or 20% of their time in the project (ass. Professors and senior researchers) (which amounts to a total of 41716tkr over the 10-year period). The cofunding also includes corresponding percentages of office space for the researchers and 20% of the rent for The Lund Humanities laboratory, a high-end facility of 500 square meters with measurement instrumentation of crucial importance to CCL (amounting to a total of 7745tkr over the 10-year period).

The better part of the Linnaeus grant, 61475tkr over the 10-year period, will cover salary costs for 5 PhD students and 5 post docs per year. The sum also includes one project manager (50%), an expert in research methodology (25%) and a measurement assistant (25%). Minor parts of the grant will be used for renewal of equipment (1610tkr) and dissemination activities and travel (2000tkr).

The estimation of all salary costs is based on the assumption that there will be an average salary raise of 3% per year. The estimation of all costs for office or laboratory space is based on the assumption that there will be an average raise in costs of 2,5% per year. Administrative costs on salary costs and on office and laboratory space are estimated to 18% (which amounts to 19968tkr over the 10-year period).

Table 1. Financial plan for CCL**1. INCOME (1000 SEK)**

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>Linnaeus grant</i>	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	75000
<i>LU additional funding</i>	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	10000
<i>Faculty funding</i>	5714	5881	5487	4774	4277	4401	4530	4662	4798	4937	49461
<i>Sum estimated income</i>	14214	14381	13987	13274	12777	12901	13030	13162	13298	13437	134461

2. COSTS FINANCED BY LINNÆUS GRANT AND LU (1000 SEK)**PERSONNEL**

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>Researchers/ teachers</i>	3123	3216	3312	3412	3514	3619	3728	3840	3955	4073	35792
	3850	3966	3518	3623							34982
<i>Junior/ postdoctoral researchers</i>					3095	3188	3284	3383	3485	3590	
	2860	2946	3035	2252	2320	2390	2462	2536	2612	2690	26103
<i>PhD students</i>											6314
<i>Other personnel</i>	550	566	584	602	620	638	658	678	698	720	
SUM PERSONNEL	10383	10694	10449	9889	9549	9835	10132	10437	10750	11073	103191

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
PREMISES	691	708	726	744	763	782	802	822	843	864	7745

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Lund University

Appendix U

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>RESEARCH COMMUNICATION AND DISSEMINATION</i>	200	200	200	200	200	200	200	200	200	200	2000

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>EQUIPMENT (Depreciation cost)</i>				695	862						1557

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>OTHER COSTS FOR RESEARCH</i>											

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>SUM DIRECT COSTS</i>	11274	11602	11375	11528	11374	10817	11134	11459	11793	12137	114546

ADMINISTRATIVE COSTS

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
<i>Internal for the research environment</i>											
<i>Outside of the research environment</i>	1993	2052	2012	1914	1856	1911	1968	2026	2087	2149	19968
SUM ADMINISTRATIVE COSTS	1993	2052	2012	1914	1856	1911	1968	2026	2087	2149	19968

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>	<i>Year 6</i>	<i>Year 7</i>	<i>Year 8</i>	<i>Year 9</i>	<i>Year 10</i>	<i>Total</i>
SUM COSTS	13267	13654	13387	13552	13173	12728	13102	13485	13880	14286	134461
<i>Of which financed by Linnaeus grant</i>	7500	7500	7500	7500	7500	7500	7500	7500	7500	7500	75000
<i>Of which financed by money from LU</i>	6714	6881	6487	5774	5277	5401	5530	5662	5798	5937	6714
<i>% LU financing in relation to grant</i>	89%	92%	86%	77%	70%	72%	74%	75%	77%	79%	

2. The size of the research environment in its first year of activity

At the start of the first year the research environment will have a network of 20 (interconnected researchers across the following disciplines: Cognitive Science; Linguistics; Psychology; Logopedics, Audiology and Phoniatics; Experimental Medicine; Clinical Neuropsychology; Technical Rehabilitation Research; and Mathematics. 12 of these researchers are professors and 8 are post docs. Table 2 summarizes age, gender, titles and disciplinary affiliation this CCL Faculty group as well as how they are interconnected in terms of research cooperation within the CCL project areas. In addition, there are two doctoral students, one in Cognitive Science and one in Linguistics, who will enter the research environment on Faculty funding. At the beginning of the first year we will also have recruited 5 post docs and 5 PhD students and 1 half-time research manager by virtue of the Linnaeus grant.

Table 2. Researchers in CCL on Faculty funding

Senior researchers					
<i>Name and status</i>	<i>Age</i>	<i>Sex</i>	<i>Title</i>	<i>Discipline</i>	<i>Projects</i>
Christian Balkenius	41	Male	Associate professor	Cognitive Science	3.3, 3.5, 3.6
Agneta Gulz	44	Female	Associate professor	Cognitive Science	3.3, 3.6
Peter Gårdenfors, principal investigator	58	Male	Professor	Cognitive Science	3.1, 3.3, 3.4, 3.6
Germund Hesslow, applicant	58	Male	Professor	Experimental Medicine	3.4, 3.5, 3.6
Kenneth Holmqvist	44	Male	Associate professor	Cognitive Science, Humanities Laboratory	3.2, 3.4
Magnus Lindgren, applicant	46	Male	Associate Professor	Psychology	3.2, 3.3, 3.4
Anders Löfqvist	63	Male	Professor	Logopedics, Audiology and Phoniatics	3.4
Marianne Ors	63	Female	Associate professor	Clinical Neuropsychology	3.4
Birgitta Sahlén, applicant	54	Female	Associate professor	Logopedics, Audiology and Phoniatics	3.1, 3.2, 3.3, 3.4
Maria Sandsten	41	Female	Associate professor	Mathematics	3.1, 3.2
Sverker Sikström	43	Male	Associate professor	Cognitive Science	3.1, 3.2
Sven Strömqvist, applicant	53	Male	Professor	Linguistics, Humanities Laboratory	3.1, 3.2, 3.4
Postdocs					
<i>Name</i>			<i>Title</i>	<i>Discipline</i>	
Petra Björne	41	Female	Ph.D.	Cognitive Science	3.3, 3.3
Björn Breidegard	57	Male	Ph.D.	Technical Rehabilitation Research, Humanities Laboratory	3.2, 3.4
Kristina Hansson	51	Female	Ph.D.	Logopedics, Audiology and Phoniatics	3.3, 3.4
Jana Holsanova	45	Female	Ph.D.	Cognitive Science	3.3, 3.4
Dan-Anders Jirehed	32	Male	Ph.D.	Experimental Medicine	3.5, 3.6

Mikael Johansson	35	Male	Ph.D.	Psychology	3.2, 3.3, 3.4
Janne von Koss Thorkildsen	30	Female	Ph.D.	Psychology	3.3, 3.4
Åsa Wengelin	39	Female	Ph.D.	Linguistics	3.2, 3.4

From the first year onwards, the research environment will profit from the strong research infrastructure offered by the Humanities Laboratory at Lund University (see further section 3 below). CCL will profit from faculty funded researchers in the laboratory (Strömquist, scientific director of the laboratory; Holmqvist, technical director of the laboratory; and Breidegard; measurement and programming expert – c.f. table 2).

As a major player in the laboratory, CCL will also contribute extra time from experts in the laboratory by virtue of the Linnaeus grant: 25% of an expert in research methodology and 25% of a measurement assistant.

The five CCL applicants (Gärdenfors, Hesslow, Lindgren, Sahlén, Strömquist) have a number of externally funded research projects which are forerunners to the CCL initiative and all match the CCL profile. During 2007, the total income from these research projects was well over 6000tkr. See table 3. The level of external project funding of relevance to the CCL initiative is thus projected to be stable over time. Over the past five years, the applicants have performed at this level, and we expect a similar performance in the future. Several of the projects listed in table 3 extend over several years to come.

Table 3. Projects with external funding in 2007 by the five CCL applicants

Project name	Funding organization	Budget 2007	Project leader
Learning through imitation and motivation in play	Erik Philip Sörensen's Foundation	100 tkr	Gärdenfors
Longterm support to leading researchers	Swedish Research Council (VR)	922 tkr	Gärdenfors
Tactile reading	FAS	400 tkr	Strömquist
The influence of linguistic structures on cognition	The Bank of Sweden Tercentenary Foundation	750 tkr	Strömquist
Distributed archive management of language resources	EU	250 tkr	Strömquist
Longterm memory in small children	Swedish Research Council (VR)	900 tkr	Lindgren
Mechanisms of cognitive control in frontal lobe patients	Norwegian Research Council	600 tkr	Lindgren
Associative learning	VR, Söderberg, Med Fak	1850 tkr	Hesslow
Communication in children with Cochlear implants	VR	500 tkr	Sahlén
Total external project funding 2007		6272tkr	

3. Investment requirements for new equipment or the cost of maintaining and/or upgrading existing equipment.

The CCL initiative will profit from the Humanities laboratory at Lund University and become a major player in the laboratory. The 4th year of the initiative, we will help the laboratory

reinvest in the particular type of equipment which the CCL initiative uses most heavily: an eyetracker, a bodytracker and an EEG/ERP system. The cost for this investment is distributed over 2 years in table 3. The Linnaeus grant will be used for this targeted reinvestment cost. Costs for maintenance and technical support will be covered by faculty funding.

The research environment in a larger context

Lund University – the home of CCL

- Lund University is a research intensive and comprehensive university with eight faculties.
- Lund University has about 39200 students and more than 5500 employees
- The turnover is approximately 5000 million SEK. The research budget (faculty and external sources) is more than 3300 million SEK. More than half of all research at the University is externally funded.
- In 2006 the University had 581 professors, of which 15% were women.
- More than 2500 post-graduates work at Lund University, 46% of them are women. Most doctorates are awarded in the medical sciences, followed closely by engineering and the humanities.
- 389 new research students were accepted in 2006, 44% of them are women; 426 doctorates were awarded the same year.

From our strategic plan we can quote:

Rationality and quality shall permeate our University. Various opinions and discussions shall be encouraged and tolerated. Respect for different viewpoints and objectivity shall direct our activities. Critical and constructive thinking shall be encouraged. We shall develop an innovative, creative university environment, with space for change and employee development. Humour, constructive scepticism and humanism are key concepts.

We strongly feel that CCL is characterized by these basic values.

Our strong researchers are actively communicating and cooperating with colleagues within the international research community. This is seen by the many international publications and the activities e.g. at conferences throughout the world. Lund University is a member of the Universitas 21 organisation, a well developed framework for co-operation in research and education. The Universitas 21 network consists of 20 members, e.g. *University of Melbourne, University of British Columbia, University of Virginia, Fudan University, University College Dublin, University of Edinburgh, and University of Glasgow*. Lund University is also a member of LERU (League of the European Research Universities). Among the 20 participating universities are e.g. *University of Cambridge, University of Oxford, University of Helsinki, and Utrecht University*.

In accordance with the international policy, the University is actively collaborating with selected, excellent partner universities worldwide in research and exchange of faculty. CCL co-operates, for instance, with Berkeley, Carnegie-Mellon, Oxford, Stanford, and the Max Planck Institutes for Evolutionary Anthropology and for Psycholinguistics. There are agreements with about 660 universities (whereof more than 450 in Europe) in undergraduate

and graduate education. According to statistics, Lund University has the largest international exchange of all the Swedish universities among its teachers and researchers. Furthermore, Lund University makes substantial efforts, e.g. via its Research Services Office, to promote and facilitate international cooperation in research. This strategy has resulted in more than 500 co-operation projects with companies, research institutes, and universities within the European framework programmes over the last ten years. This makes Lund University the most prominent Swedish player in the European framework programmes for research.

The University's participation in many major research initiatives is usually characterized by a cross-disciplinary approach and the involvement of research groups from more than one faculty. This cross-faculty approach is an overall strategy stated in our strategic plan and is a trademark of Lund University, made possible by the close and successful co-operation between its faculties, especially in engineering, science, and medicine. One perhaps contributing factor that is often highlighted in international evaluations is that that most departments and important research facilities at the university campus are within walking distance. The researchers have found the cross-disciplinary approach so interesting that they themselves have initiated fora where they meet on a regular basis to present their research and thereby identify new possibilities and further development.

Lund University has a good track record in collaboration with the surrounding society. It is not by chance that Lund's business community represents an imposing number of knowledge-based companies with state-of-the-art competence. The ideas and products of many of these have grown directly from successful basic research. Three out of four companies in the Ideon science park have their roots at Lund University. They often continue to operate in close co-operation with researchers at the University. The proportion of research that is fully or partially funded by business and industry grows constantly.

In conclusion, we are confident that Lund University is the right place for this ambitious initiative and we are certain that *CCL* will contribute to the university's profile as a leading institution in research.

Organisation, management and leadership of the Centre:

At Lund University we have vast experience in setting up and running large, often interdisciplinary research centres. In addition we host large research infrastructures that have been selected for European Access by the European Community. Lund University also runs eight of the twenty research environments that till now have been selected under the Linnaeus grant scheme. Our ambition is to give all these programmes and centres good administrative support, for instance, the management of financial and personnel issues.

The majority of these centres has evolved into rather complex structures with funding from multiple sources. All of them call for and benefit from clear-cut organisation and strong management. Therefore, we expect that the majority of the supporting activities that are described in this appendix will need to be provided directly to, or at least channelled through, the management structure of the Centre.

Based on the gained experiences from previous and ongoing successful initiatives the proposed Centre *CCL* will be operated within the well established organisational structure of

Lund University. Therefore CCL will be affiliated to the Department of Philosophy, that will give CCL visibility as a centre of excellence in research in marketing and information activities. Moreover, the Department of Philosophy and the Faculties of Humanities and Theology will offer the Centre professional services regarding economy, staff related issues, and other services.

Peter Gärdenfors will be appointed centre coordinator. Professor Peter Gärdenfors has vast experience of building and leading successful scientific research cooperation. He is the instigator of the first department of cognitive science in Sweden, which he has developed since 1989 into a prosperous institution with some 20 staff. 1997-2002 he held an individual senior grant from SSF; 2001-2004 he was the chairman of a committee for research on learning, sponsored by The Swedish Tercentenary Foundation and KAW; he has held several visiting professorships in Europe, United States and Australia; he has an excellence grant from VR for leading researchers 2004-2010; he is a permanent non-resident fellow of SCAS and a member of several academies, including Leopoldina Deutsche Akademie für Naturforscher since 2004. See the enclosed CV in Appendix B for more details.

The research environment will be managed by a board, consisting of a chairman (the principal investigator), two senior researchers, one post-doc and one doctoral student. The project will be managed economically at the Philosophy Department, which has a well-functioning administrative unit. The principal investigator will have a manager responsible for practical project management and economy issues. The manager will also function as secretary of the board. The board will renew its members after five years. After five years, there will also be a succession of the principal investigator.

The research environment will receive advice and support from an international reference group. Candidate members of this group are Patricia Churchland (UC San Diego), Kim Plunkett (Oxford), Dorothy Bishop (Oxford), Paul Bloom (Yale), Friedemann Pulvermüller (MRC, Cambridge) and Michael Mauk (Austin, Texas). We also wish to recruit a member of the strategic council of Lund University to the reference group. The role of the reference group is, among other things, to help the board with SWOT analyses, to give strategic advice, and to facilitate international contacts and cooperation. The international reference group will meet once every year.

To ensure the full integration of the Centre into the University's organisation and to optimise its benefit to research, education and possibly the outcome of innovation activities, the centre coordinator will report regularly to the Dean of the Faculties of Humanities and Theology. We are confident that the management and organisation of the Centre is highly appropriate for its successful long-time operation.

We have a unique infrastructure, the Humanities Laboratory at Lund University, which provides the required high-end measurement equipment and the technical and methodological expertise for us to implement the experiments of our research programme. See Appendix A for more details.

Strategies and specific activities for fostering and supporting CCL

There is a number of components that is deemed necessary for ensuring the successful development of a research initiative with the proposed size and ambition. Here we give some major examples of services and activities within Lund University that will be offered to the

Centre. Some of these services are specifically targetted at the Centre organisation and should therefore be regarded as specific support to the Centre management. Altogether these measures will contribute substantially to the successful operation of the Centre.

Further, the Faculties of Humanities and Theology finances expertise staff in the Humanities Laboratory – its scientific director (Strömqvist, see table 2) and its technical director (Holmqvist, see table 2) , who will organize access and expertise support from the part of the laboratory to the CCL environment.

As outlined under the heading *Organisation and management* above, the University will guarantee that the Centre gets sufficient and professional administrative support, e.g. on financial, organisational and staff issues. This will be accomplished by coupling the Centre to the Department of Philosophy within the Faculties of Humanities and Theology which has the administrative skills and capacity for handling the proposed Centre's activities.

One set of activities that is not linked to the daily operation of the Centre, but of major importance to its long-term development is the measures devised for evaluation and quality control. This is described in the next section (*Processes for supporting and monitoring the management of the initiative*).

The Centre will get full support from the University's experts on e.g. IPR- and legal issues. These services are offered by legal experts at the University's Legal department.

The centre will also get support from specialists within Lund University Innovation System (LUIS), the recently formed dedicated structure for activities related to innovation- and entrepreneurship at Lund university. LUIS integrates the work of three units: *Lunds universitets utvecklings AB* (The holding company; LUAB), *Entreprenörskap* (entrepreneurship) and *Innovation* (technology transfer). It is mainly the latter unit that will give service to the centre.

Another important task for the University will be to strengthen the Centre by attracting additional external funding for its operation and by facilitating its participation in international research projects, e.g. within the European framework programmes, where the University has a long and good track record of co-operation with major European companies, research institutes, and universities. The University's Research Services Office will play an important role e.g. by promoting the Centre's participation in European research programmes, in particular the 7th framework programme.

One prominent feature is the integrated approach, with close cooperation between idea scouts and experts on patent issues (Innovation), experts on legal issues (Legal Department) and experts on research funding (Research Services Office). This approach has turned out to be very successful in a number of cases. Thus, good practice has been established.

Finally, the Centre will get assistance with issues that concern public relations, communication and dissemination of results. The University has elaborated an overall communication and dissemination strategy aiming at enhancing the visibility and outreach of its major research facilities, centres and strong research environments. The communication objectives are:

- Disseminate new research results to the international research community and to communicate the benefit of research, promote interest in and acceptance of the sciences and bring attention to the connection between research and society development
- Actively and deliberately contribute to ensuring that all strong research environments within Lund University gain the visibility and luminosity in Sweden and abroad that characterise a Centre of Excellence
- Communicate the work and results of strong research environments as an aspect of building and strengthening the University's image in accordance with the Lund University Strategic Plan and Communication Platform
- Increase the dialogue between researchers and society by various activities including identifying and creating meeting places, inviting participation in debate and informing and communicating research findings on the popular science level via various channels.

The results of research within our strong research environments shall be communicated by our researchers and as an integrated component of our strategic communication work at the university and faculty levels.

Channels and methods for communicating with target groups are: Scholarly publications, opinion pieces in newspapers, meeting places and open events directed at the public, popular scientific lectures, seminars, school partnerships, press releases and press conferences, the Lund University website, seminars for journalists, Expertanswer, the University web site and other web sites such as forskning.se, television, such as science programming presented by Swedish Television (on "Kunskapskanalen"), printed material, journals and newsletters. The combination of channels and methods will be adapted to the research environment. In accordance with the recommendations from SUHF and the Swedish Research Council to implement the Berlin Declaration on Open Access all publications should be registered and when possible also made freely available in full text in LU:research.

Communication planning for the University's strong research environments will be integrated with the annual communication plans prepared for the University as a whole and for each faculty. Communication plans will be evaluated every year. With respect to communication activities that apply to the University's strong research environments, the evaluation will be performed in close cooperation with the directors of each research group and in dialogue with University management.

Thus, the proposed Centre will have at its disposal a comprehensive "toolbox", for communication. The other main component of the Centres communication and dissemination strategy is how the results are communicated to the international research community and to specific stakeholders.

CCL – specific strategy for communication and dissemination of results.

CCL will use the various opportunities for communication and dissemination of results offered by Lund University (see above). Further, the CCL applicants all have a thorough experience with organizing scientific conferences and workshops as well as national and international summer schools. These types of activities will play a key role for the dissemination of results to the scientific community. Also, the applicants have extensive

experience with media, participating in radio and teve programs and interviews for newspapers and popular science magazines, and these channels will also be used for disseminating results to a broader public.

In addition, Strömquist and the Humanities laboratory has been partners in two European projects aimed at forwarding e-science for the humanities, the ECHO project (European Cultural Heritage Online; see http://www.ling.lu.se/projects/echo/state_of_art/ and <http://echo2.mpiwg-berlin.mpg.de/home>) and DAM-LR (Distributed Archive Management of Language Resources; see <http://www.mpi.nl/DAM-LR/>). From these projects a system allowing the research community to share research data and associated analysis tools on the web has emerged. The system currently houses some 150 000 entries (text, sound, pictures and films) from the Max Planck Institute for Psycholinguistics and some 5000 entries from the Humanities laboratory and the Centre for Languages and Literature at Lund University, including data relevant to the present Linnaeus proposal such as eyetracking data, body tracking data and keystroke logging data. In a new European initiative, CLARIN (see <http://www.mpi.nl/clarin/>), we will scale up the present system to serve some 100 institutes and universities in Europe. The system we have built has a joint metadata server in Lund through which research data which is distributed on servers across the world is searchable. The system will play a crucial role for distributing research data from CCL and for linking research data to scientific publications emerging from CCL. It will also be an important resource for future training of young researchers associated with CCL.

Processes for supporting and monitoring the leadership of the initiative

Human capital issues

We expect that CCL will become a highly attractive research environment in this area, and we therefore anticipate that a large number of researchers from Sweden as well as from abroad will want to participate in the Centre's activities. However, we are fully aware that this environment will also foster a number of researchers that are highly sought after at an international market. The University will have to be prepared for a substantial exchange of people and will need to provide firm support to the management of the Centre in e.g. recruitment issues. This support will be given mainly by the Department of Philosophy together with the faculty office at Faculties of Humanities and Theology, but also by experts at the University's personnel division. A new program for leadership/management has been developed at the University. This includes a well balanced collection of courses and tools for leaders at the university at different levels, from projects to upper management. The researchers in the Centre will be encouraged – and in some cases required – to take part in this program.

Lund University has several programmes for active enrolment of researchers and faculty members. Many research positions, especially at the post-doctoral level, are held by researchers from abroad, but the University also makes considerable investment to secure the internal supply of future research leaders. This is in line with our research strategy, but also with the University's gender policy. For instance, Lund University has established programmes for promoting the career of promising researchers, e.g. *LeKa* (a programme for strengthening leadership skills of senior researchers), *Future Faculty* (a mentor programme for post-doctoral researchers) and *Academic Traineeship* (a trainee programme for promising

doctoral students). As an example of specific measures, that indicates the University's commitment to gender equality is the set of activities for coaching the career of female researchers within the *AKKA* programme. In addition, Lund University has recently launched a programme for recruiting postdoctoral fellows. This initiative will enable the University to recruit an additional 35 promising young researchers per year during four years. The University intends to make use of these or other appropriate mechanisms for strengthening the skills and the career of the researchers and the doctoral students within the research environment. This will be done in consultation with the centre coordinator and will be implemented in accordance with e.g. the gender equality plan that is outlined in Annex V.

Quality assurance and quality control

Quality assurance is one of the four main strategies established in the University's strategic plan: A new quality assurance programme will be established for research, evaluating both results and focus. The evaluation will be adapted to the character and needs of each Faculty area. Starting in 2008, evaluation will be carried out at five-year intervals, using a combination of external panels and self-evaluation. Together with strategic assessments, the results will form the foundation for the establishment of university-wide and Faculty specific priorities, involving the development of new research areas, as well as the phasing-out of weaker ones.

The quality assurance system includes international scientific advisory boards (*SAB*) at both university and faculty levels. Advice from the *SABs* and the University's Council for research development is the basis for decisions on strategy and on budget allocation for research. Detailed plans for the research assessment in 2008 are currently being developed. In addition there is a policy for evaluation of all major centres and research projects.

In accordance with this, CCL will make use of the quality assurance and quality control mechanisms set up by Lund University. In addition, CCL will ask its own international reference group to perform biannual assessments and recommendations. Among many other things, assessments and recommendations concerning the administrative support and faculty level activities for fostering and supporting CCL will be of great importance. Mechanisms for improving this support dynamically will be vital, since no faculty of humanities has yet housed a Linnaeus environment. The results of such evaluation will be used as a basis for decisions on e.g. strategy, management, organisation and, eventually, on the continuation of the Centre's activities.

The relationship between Lund University's strategic priorities and the proposed research environment

The University's overall goal is to attain the highest quality in both education and research: All undertakings shall maintain a competitive, international standard. While a number of areas shall attain the highest international class, the University as a whole shall be one of the absolute foremost in Europe and all undertakings shall be ranked among the national leaders in their fields. It is especially important to utilise the diversity at Lund University. Cross-disciplinary collaboration in both education and research shall be the characteristic of our university. Together with other leading universities, our university shares the ambition of attaining the highest quality, whereas Lund University shall distinguish itself through an

emphasis on cross-disciplinary collaboration (From the *Strategic plan of Lund University 2007–2011*)

The strategic plan devices the following four strategies to achieve the overall goal:

- Quality assurance
- Cross-disciplinary collaboration
- Internationalisation
- Leader, teacher and employee excellence

Lund University is entitled to submit a comparatively large quota of the proposals in response to the present call for Linnaeus Grant applications. This allocation is based on the University's total income for R & D, which partly reflects the University's success in attracting external funding for research. As a rule, such external funding is rewarded in competition with other research institutions after peer review. The internal selection process has been very thorough and has resulted in a set of proposals that demonstrates the wide span of the University's research portfolio. Each individual proposal represents an ambitious research initiative that is fully in line with the University's research priorities and its strategy, as guaranteed by the thorough selection process led by the vice-chancellor. An important criterion for selection has been the potential to form a strong and coherent research environment that ensures the pooling of complementary scientific skills, while avoiding unnecessary duplication.

The initiative Brain Mind Behaviour (BMB) at Lund University (see Appendix A) is one of several manifestations of the university's consistent strategy to bring researchers from different disciplines together to delineate new areas for research cooperation. Brain Mind Behaviour is fostering cooperation across neuroscience, behavioural science and the Humanities. The applicants of the present Linnaeus proposal are all members of the BMB initiative and CCL is partly the outcome of strategic discussions and thematic workshops organized by the BMB group.

On a faculty level, the Faculties of Humanities and Theology would like to see more research cooperation across disciplines and faculties. And in a recent report to the Faculty of Medicine, its scientific advisory board suggests that researchers at the medical faculty should seek more cooperation with researchers in the Humanities. The Humanities laboratory is a perfect facility for such cooperation and CCL is an initiative which implements long-term scientific cooperation between, among other things, researchers from the Faculty of Medicine and the Faculties of Humanities and Theology. CCL has therefore a strategic role to play as an exemplar and model for future multidisciplinary programmes and environments.

We feel that CCL very well fits within the strategic research plan of the University and that it will contribute to the further development and excellence of Lund University.



VETENSKAPSRÅDET
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Kod

Name of applicant

Date of birth

Title of research programme

Appendix V

OTHER INFORMATION: GENDER EQUALITY PLAN FOR THE FIRST FIVE YEARS

The gender equality plan for CCL is based on and fully complies with the University's overall gender equality policy (2006 – 2010), that governs the University's efforts on gender equality-related issues at all levels (faculties, departments and divisions). The policy identifies five main areas where the university will focus its efforts to overcome inequality issues: *Recruitment and promotion; wage rates setting and other terms of employment; leadership; prevention of sexual harassment; and gender perspective and awareness of gender issues in teaching.*

The vice-chancellor has the overall responsibility for the University's target-oriented work on these issues, but the deans, heads of departments and heads of units answer for the implementation of the policy and for dealing with gender equality-related issues, e.g. measures to overcome gender inequality. Each year all faculties, departments and units are required to establish a gender equality plan. The work is supervised and evaluated by a steering group led by the University's Pro-Vice-Chancellor.

Gender aspects have been considered by the University when the candidates for the current round of Linnaeus grant proposals were selected. The University's gender equality policy is important when designing CCL. Accordingly, aspects on gender equality shall be considered when recruitment is planned and active measures will be taken to recruit researchers and graduates of underrepresented gender. Likewise, special attention will be paid to researchers of underrepresented gender in individual career support which will be given e.g. in the form of annual career development discussions, mentor programmes and leadership training.

CCL - the current situation

The project will be administered from the Department of Philosophy, where a gender equality group, comprising all factions of the staff as well as students, was established in 2004. The equality group has actively worked with equality issues, see <http://www.fil.lu.se/cms/section.asp?id=1342>

The Gender Equality Plan of the Department of Philosophy

In accordance with Lund University gender equality policy, the department of Philosophy investigated the distribution in terms of the distribution of the sexes among the staff as well as the students during the academic year 2004-2005. The report from 2005 was the foundation for creating an equality plan, which was confirmed by the board of the department of Philosophy on November 28, 2006:

- The department will have a gender equality group appointed by the board of the department.
- There should be a close cooperation between the student council and the group.
- The group should have at least one representative from each fraction: Teachers, PhD students, administrative personnel and students. The student representative is appointed by the student council.
- The group will continuously work in accordance with the Lund University equality policy.
- The group will put together an equality report every four years. Next status report will be conducted during spring term 2008.
- The group put forward and distribute information to the board and to give advice concerning

equality issues to staff and students.

This policy will be applied to the researchers of CCL as well. However, the gender equality of the group is quite good already. The following is a list of the researchers with a PhD or higher that are already involved in the research environment and whom we plan to employ in the program, at least during the first five-year period:

Senior researchers (professor or “docent”)

Christian Balkenius, 1966, man

Peter Gärdenfors, 1949, man, *principal investigator*

Agneta Gulz, 1963, woman

Germund Hesslow, 1949, man, *applicant*

Kenneth Holmqvist, 1963, man

Magnus Lindgren, 1961, man, *applicant*

Anders Löfqvist, 1944, man

Marianne Ors, 1944, woman

Birgitta Sahlén, 1953, woman, *applicant*

Sverker Sikström, 1964, man

Sven Strömquist, 1954, man, *applicant*

Postdocs

Petra Björne, 1966, woman

Kristina Hansson, 1956, woman

Jana Holsanova, 1962, woman

Dan-Anders Jirenhed, 1975, man

Mikael Johansson, 1972, man

Janne von Koss Thorkildsen, 1977, woman

Maria Sandsten, 1966, woman

Åsa Wengelin, 1968, woman

Although it is not exactly determined at this stage to what extent and during which periods these persons would work actively within the research environment, it should be clear from the list above that the project would employ almost an equal number of women and men.

CCL – five year objective and strategy for reaching the objective

In the event of new appointments within the research environment, for example appointing a new research group leader, appointing researchers to the project and appointing Ph.D. students the procedure will comply with the local gender equality plan of the department as well as Lund University overall gender equality plan. We intend to employ researchers from the list above where both genders are equally represented. In the appointment of new Ph.D. students we will strive for an equal representation of genders. We do not foresee any substantial difficulties in reaching this objective since we judge that the total body of master students (from Lund University or elsewhere) in Cognitive Science, Linguistics, Logopedics, Phoniatics and Audiology, Neuropsychology, and Neurophysiology, from which the Ph.D. students would be recruited, have an equal representation of genders. All appointments would follow the equality policies on the levels of the department, faculty and university.

The management of CCL will work actively to support the research careers of its researchers, female and male, and their career opportunities will be discussed during individual meetings between the researchers and the project managers.



VETENSKAPSRÅDET
THE SWEDISH RESEARCH COUNCIL

Kod

Dnr

Co-ordinator/Repr.of University

Date of birth

Reg date

Title of research programme

Repr.of University

Date

Clarification of signature

Telephone

Vetenskapsrådets noteringar

Kod