

Report on the international workshop "Processes of Communication" February 10-11, 2005 at Bielefeld University

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An international workshop on "Processes of Communication" was held at the Center for Interdisciplinary Research (ZiF, Bielefeld) from February 10-11, 2005. According to the interdisciplinary orientation of the organizing committee - the scholarship holders of the Graduate Program "Task Oriented Communication" (Bielefeld University) - the workshop brought together researchers from different disciplines around the common topic. The objective of the workshop was to discuss and understand the processes of communication as tackled in different disciplines. The invited researchers presented their different research methods and set forth the results they achieved with regard to three major areas: (1) Cognitive Processes in communication, (2) Human face-to-face interaction and (3) Human-robot/machine interaction.

1. Cognitive processes in communication

After the welcome statement by the Graduate Program's speaker *Dieter Metzger* (Bielefeld University, Germany), *Hans Strohner* (Bielefeld University, Germany) as the keynote speaker introduced the different perspectives of processes of communication focussing in an exemplary manner on metaphors and methods. In his talk he pointed out some aspects of communication which could help to build up an integrational model of communication. He presented different approaches and theories such as Mental Modal Theory, Construction-Integration Theory, and Partner Modelling Theories. He asserted that one should think about how the different theories could be integrated in the modelling of the communication process, which consists of situated mental as well as social processes. Finally, Strohner drew the audience's attention to the systemic approach which seems to be able to integrate these processes into a coherent conceptual framework.

Diana Van Lancker Sidtis (New York University, USA) examines formulaic expressions such as conversational phrases, idioms, expletives, and slang from a combination of linguistic, psychological, and neurological perspectives. These expressions make up to 25% of speech production. She gave an overview of two related proposals: the management of formulaic expressions, and the generation of novel sentences are two separate and justified processes in language use; formulaic and novel speech are stored and processed differently in neurological and mental systems.

Functional brain imaging with functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) has become a dominant approach to cognitive science. In spite of the enormous scientific growth, the interpretation of these data is still questioned. Various studies of *John Sidtis* (Nathan Kline Institute, New York, USA) on brain activity during speech production suggest that several common assumptions should be approached with caution, for example whether images received during complex behaviour can be segmented into useful subunits, and whether the grade of "activation" in a specific brain region is a mea-

sure of its importance. He remarked that finding the function often depends on asking the right question and that function is not automatically the brightest spot on the map.

The fundamental goal of *Roland Brünken's* (Goettingen University, Germany) research is to optimize complex learning material presented with multimedia. In doing this, one of the crucial points is to build referential connections (coherence formation) between different types of representation such as text, pictures and charts. After a short introduction to the Cognitive Model of Learning with media (Mayer 2001), he presented a new approach of modelling coherence formation based on Gentner's structure mapping theory (Gentner 1983). His empirical findings show that especially for learners with a medium level of prior knowledge, coherence formation can be successfully assisted by means of instructional designs, by reducing extraneous load, and by fostering germane activities.

2. Human face-to-face interaction

In his talk "Figuring objects: the interactional production of value in auction" *Christian Heath* (King's College London, United Kingdom) offered a detailed micro-analysis of the verbal and bodily activities involved in human face-to-face interaction. Combining the analytic methodology of Conversation Analysis and the broader perspective of Workplace Studies, he addressed the question of how valuable objects are constituted within interaction. On the basis of video-recordings from sales rooms in the UK, he examined the ways in which auctioneers characterise the object during bidding and the use of various techniques to elicit and escalate bids. After reconstructing the organisation of taking turns within auctions, Heath pointed out the practical relevance of the different communicational resources used by the auctioneer: The central issue of displaying the integrity of the bid (i.e. showing the presence of real bidders as opposed to fictive ones sometimes introduced for raising the price) is realized by systematic gaze-shifts on the different syllables of a single word and by gestures which transform their shape according to the bidder being demarcated by them.

Heike Behrens (Groningen University, The Netherlands) focused on "The Communicative Basis for Language Acquisition" and thereby situated her research within the area of emergentist or usage-based approaches. In this line, she presented her findings from a longitudinal case-study on German examining the interaction between a child (from age 2 to 4) and his parents which were continuously audio taped ("Leo-Corpus", 380 hours, MPI for Evolutionary Anthropology). On the basis of morphosyntactic coding, the distribution of parts of speech over time was compared in the samples of the child's speech to those of the adult speakers. Behrens was able to show that the grammatical and lexical information in the input that the child gets from his parents is very stable and reliable. She pointed out that the child makes use of this information because the distributional properties of his language exactly match those of the adults' language and concluded that it is the availability of related constructions that helps the child to widen his initially restricted linguistic knowledge. Looking to the future, she highlighted the necessity to specify the discourse mechanisms that help the child to pick up the relevant information.

3. Human-robot/machine interaction

Yet another perspective on the topic of "Processes of Communication" has been offered by research undertaken in the area of Human-machine interaction and robotics. Within the past few years, studies have focused on robots and other technical devices (e.g. cellphones, PDAs, etc.) as partners for human beings and thereby shown a special interest in communicative processes between the robot and the human being.

In these areas, one major topic is the question of joint attention. *Yukie Nagai* (National Institute of Information and Communications Technology, Kyoto, Japan) based her work on findings from infant studies on two kinds of cognitive developmental models of joint attention: (1) Interaction with a caregiver: A model by which a robot learns joint attention based on task evaluation from a caregiver; (2) Self learning: A model focusing on developing the robot's self learning capabilities. In the first model a caregiver provides evaluation corresponding with the robot's performance of joint attention while at the same time the robot develops its visual perceptual capability. The second model is an approach which develops the robot's ability of joint attention with a human caregiver based on visual attention and self learning mechanisms. The visual attention provides the ability to selectively gaze and attend to a salient object in the robot's view, and the self learning ability helps to acquire a sensorimotor coordination when the visual attention succeeds. Nagai reported that her experimental results show that both models enable a robot to acquire similar cognitive developmental processes of joint attention to that of infants.

Verena Vanessa Hafner (Sony Computer Science Laboratory, Paris, France) on the other hand, claims that true joint attention is much more than gaze following or simultaneous looking. Joint attention rather implies a shared intentional relation to the world. It requires skills of: Attention detection, attention manipulation, social coordination and intentional understanding. In relation to a developmental time line drawn from results in child studies, the talk discusses the current state-of-the-art in robotics and computational models of joint attention and identifies issues to be addressed. According to the survey, it appears that one of the most uninvestigated aspects of the challenges of joint attention is the modelling of the mechanisms responsible for the emergence of the intentional stance. Understanding these phenomena in child development is suggested as a crucial step that would open up the way to the creation of robots with a qualitatively different kind of awareness, making the problems of imitation and social learning easier and ultimately leading to the development of true joint attention. An illustration of robots' interactional behavior was presented to support the idea.

Another major topic is the actual cooperation between robots with human beings. *Cynthia Breazeal's* (Massachusetts Institute of Technology, USA) study consisted of an effort towards building humanoid robots that can work alongside people as cooperative teammates. The theoretical framework for this work is based on a novel combination of Joint Intention Theory and Collaborative Discourse Theory. A demonstration of how these theories are applied to allow a human to work cooperatively with a humanoid robot on a joint task using speech, gesture, and expressive cues was given. The experiment was conducted in such a way that naive human subjects socially guide a robot to perform a physical task. The results

obtained from behavioral analysis and self-report via questionnaire show that there is evidence that supports the hypothesis that non-verbal communication positively affects human-robot task performance with respect to understandability of the robot, efficiency of task performance, and robustness to errors that arise from miscommunication. The results also show that social cues serve a pragmatic role in improving the effectiveness of human-robot teamwork where the robot works as a cooperative partner.

Albert Van Breemen (Philips Research, Eindhoven, The Netherlands) demonstrated "iCat" which is a research prototype of personal robot for studying human-robot interaction in Philips Research Eindhoven. The research platform at Philips consists of the user interface robot "iCat" and the Open Platform for Personal Robots (OPPR) software environment. They have made a series of attempts to develop user-interface robots for home automation. Hence Lino I and Lino 2 were developed in 2000 and 2002-2003 respectively. "Interactive Cat" or "iCat", is the latest user-interface robot developed. Each of them was presented to users and feedback was collected which pointed to the developers that for their application, personality has more value than intelligence. iCat is small and lacks mobility; made with the intention of placing the focus solely on the robot-human interaction. iCat recognizes users, builds profiles of them and handle user requests. It can be connected to a home network to control devices such as VCR and TV and to use the Internet. iCat has 13 servos to move different parts of the head in order to create facial expressions. Preliminary investigations showed that facial expressions can reveal what iCat is thinking.

Roderick Murray-Smith (Glasgow University, United Kingdom) presented his studies on human-computer interaction. He demonstrated the interface design of mobile devices such as pocket PCs or mobile phones with regard to the underlying dynamics of interaction. Murray-Smith pointed out that it is possible to use dynamic movement primitive methods for gesture recognition and rhythmic interaction. How a holistic surface could contribute to improvements in interpersonal communication was demonstrated.

The depiction of underlying processes showed the necessity of an incorporating probabilistic model with a structure that can be learned. In his outlook he remarked that further research would have to deal with the Brain-Computer Interfaces such as the synchronisation theory in Human Computer Interaction.

The official part of the workshop was closed by a final discussion in which *Helge Ritter* (Bielefeld University, Germany) summarized the different approaches towards interaction and communication taken in linguistics and computer sciences. Then he asked for the possibilities of establishing a more global framework by identifying the interdisciplinary core questions of this important field of research. The participants generally agreed on the importance of the smooth functioning of the interaction, regardless of its modality (verbal or non-verbal) or its participants (humans or robots). In this respect, the display and recognition of emotion was considered to be one of the most central issues, irrespective of the question if the participants (especially the robot) actually experience qualia.

4. Pre- and post-workshop-sessions

The workshop was supplemented by several pre- and post-sessions which offered to the members of the Graduate Program "Task Oriented Communication" the opportunity to present and discuss in smaller groups specialized research questions, methodological approaches and data in their own projects with the invited scholars.

The *Interactional Linguistics* group organized a data-session with Christian Heath in which the participants analysed video-recordings of naturally occurring interaction in different workplace-settings. Their main interest was in the role of body display as a communicational resource and the use of objects within the unfolding sequential order of interaction. This multimodal focus on face-to-face interaction was directly linked to the Ph.D.-students' research which focusses on language, body and inscriptions within bilingual classroom interaction (K. Pitsch) or the development of symbolic abilities in the pretend play of preschoolers (B. Lange).

The ongoing research in *Clinical Linguistics* was presented to the participants in a poster-session. The presentation gave some insights into the question of the dichotomy of fluent and non-fluent acute aphasic speech production (M. Wittler) and the recognition of familiar voices after cerebral lesions (O. Kneidl) and was followed by methodological and theoretical discussions about the quasi-experimental research-design.

In yet another session, the *Neurolinguistics* group as well as the *Cognitive Linguists* showed their research laboratories: This is firstly an Electro-Encephalogram (EEG)-cabin. This experimental method is at the basis of the Bielefeldian studies on the comprehension of naturally spoken sentences (C. Berghoff) and the categorisation of different nouns in naturally spoken instructions (A. Wengenroth). Secondly, a demonstration of the eye-tracker-lab was made, in which the eye-movement of test persons is traced when fulfilling experimental tasks. This technical apparatus is used for research on modelling cognitive parameters, like e.g. cognitive demands and design parameters with regard to multimodal information (S. Folker).

Research in *Computational Linguistics* is also under way (S. Amsalu) in the graduate program. This work is aimed at constructing a generic tool that automatically extracts bilingual lexical information from Amharic-English parallel texts. To solve the problem of typological differences between the two languages, a morphological decomposition strategy for Amharic (Semitic language) that uses finite-state models has been designed. A productive discussion on how the challenges of complex non-linear concatenative Semitic morphology have been handled was held with Kenneth R. Beesley (Xerox Research Center Europe, France). Specific aspects of morphotactics and phonological alternations that are particularly attributed to vowel-intercalation, reduplication, consonant reduction, vowel insertion and vowel changes were addressed.

Most of the Ph.D.-projects in the area of *human-machine-interaction/robotics* are centered around the common goal of enabling a robot/a machine to interact with human beings in a natural environment. This involves the recognition of human posture and gesture (C. Lange, N. Hofemann), a robust understanding of speech within a multimodal human-robot-dialog (S. Hüwel), the modelling of

emotion in speech (T. Spiess), an automatic theme-context recognition (J.F. Maas), the attention-controlled acquisition of a qualitative scene model (A. Haasch), the detection of "Hot Spots" in communication (B. Wrede, PostDoc) as well as a dialog-system which brings together and co-ordinates these different components (I. Toptsis). In a post-workshop-session, the group presented their mobile robot "Biron", tested their recent developmental state by allowing the attendants to interact with it and discussed diverse aspects with their guests.

5. On the organizing committee

The workshop was organized by the scholarship holders of the Graduate Program "Task Oriented Communication" at Bielefeld University, in which Ph.D. students from the areas of linguistics and computer sciences work closely together. The main focus of the Graduate Program - funded by the DFG (German Research Foundation) from 1996 to 2005 - is on the combination and interplay of natural verbal communication, perception and action in practical task domains. It has generously supported about 50 young researchers during the preparation of their doctoral thesis and their time as Post-Doc with financial support as well as by providing a working environment that exposes students to the state of the art in the fields of linguistics and computer science, an interdisciplinary open mind and challenging discussions. More information about the currently fifteen Ph.D.-students and one PostDoc as well as the former members and their projects can be found at <http://www.techfak.uni-bielefeld.de/GK256/> and in the issue 25/2003 "Sprache, Computer, Roboter. Graduiertenkolleg Aufgabenorientierte Kommunikation" of the "Forschungsmagazin der Universität Bielefeld".

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Veröffentlicht am 21.3.2006

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