

ESF SCH-SCSS Exploratory Workshop

**Understanding Actions and Minds: Integrating recent advances from Philosophy of Mind, Cognitive Neuroscience, Psychology of Language and Communication, Developmental and Comparative Psychology, and Artificial Intelligence**

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## Scientific Report

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## 1. EXECUTIVE SUMMARY

### Aims and Academic Context of the ESF Workshop

The central aim of the ESF Exploratory Workshop was to explore from an explicitly and systematically interdisciplinary point of view the recent cutting-edge research advances and the variety of newly emerging research methodologies that currently converge on the intensive study of two closely related research topics: 1. *The production, representation, and interpretation of intentional actions in biological and artificial systems*, and 2. *The inferential and representational mechanisms specialized for understanding intentional mental states of others*. Different aspects of these highly complex and many-faceted issues are currently hotly debated both in Europe and in the US by scientists of an impressively wide range of different fields of study whose particular theoretical approach, characteristic and often new methodology and specific scientific contributions to the same family of questions are either unknown or, at best, conceptually only ‘semi-transparent’ to each other. The different disciplines in which the unifying topics of our ESF Workshop are presently at the center of scientific research interest include philosophy of mind, history of psychology, cognitive neuroscience, psychology of language and communication, cultural and evolutionary psychology, developmental and comparative study of social cognition, brain research on the pathologies of intentional action and theory of mind as in childhood autism and schizophrenia, and artificial intelligence modeling simulating evolutionary processes and conditions leading to emergent properties of intentional organization of behavior in learning systems. Therefore, the primary goal of the ESF Workshop was to bring together the *leading experts* of these new research directions from a wide range of European centers of research of excellence and to facilitate informal dialogue between them with the intention to help to

integrate the many-faceted newly emerging novel approaches to these focal questions of scientific investigation.

The second, but equally important, aim of the meeting was to provide a possibility for *highly promising young (mostly post-doctoral) scientists* at the beginning of their career, who are working in a variety of European countries and in different scientific disciplines, to present their work to and interact in-depth with the leading experts of these neighboring fields in an informal but intensive setting. Our idea was that such a meeting will also provide a useful forum for building bridges and planning joint, multi-site (and possibly multi-discipline) research projects that will usefully integrate the research efforts and resources of the different European research centers represented.

Thirdly, we had a further specific integrative aim in mind when organizing such a meeting in Hungary, an Eastern European country that had only very recently joined the European Community: namely, to provide access to the most representative and cutting-edge research of European science for those promising researchers who come from and work in the still less developed and relatively culturally as well as institutionally isolated Eastern and Southern European countries. We thought that such a meeting could function as a highly useful occasion that would present for these participants a forum and an opportunity to establish scientific contacts and plan cooperative European research projects that would foster and fasten the process of scientific and cultural integration and mobility within the framework of the 'new unified Europe'.

This last aim was also well-served by organizing immediately following the ESF Workshop a high-level research-oriented Summer School on the same topic as that of the Workshop. The two events were jointly hosted by the Central European University (CEU) in Budapest. With the generous permission of the ESF Organizers, the 30 or so doctoral-level students of the Summer School coming from a wide variety of European countries (as well as from Japan and the US) had simultaneous access arranged in an adjacent room to the proceedings of the informal meetings and discussions of the ESF Workshop, and, on several joint social events they could consult in-depth with the experts participating in the ESF meeting.

## Background and Organization

The Workshop was convened by Professor György Gergely on the part of the Hungarian Academy of Sciences and the Eötvös Lóránd University of Budapest and it was organized at, and with the generous help of the Central European University of Budapest. The CEU has housed the event in the spacious, beautiful and technically well-equipped lecture rooms of its Business School at the center of the city. The organizational, administrative, and technical staff of CEU provided excellent support throughout the meeting, including the organization of several well-panned social events (such as a farewell boat trip on the Danube). Thus, with the generous support of the ESF and the additional financial, institutional, and organizational support provided by the CEU, the Workshop turned out to be a memorable scientific event with excellent technical and social organization. With the help of the extensive European scientific contacts of the convenor and due to the timeliness of and great current interest in the interdisciplinary scientific topic of the proposed Workshop, the large majority (90%) of the senior experts and young scientists originally invited from a wide range of European centers of research have accepted our invitation and participated actively throughout the Workshop. All in all, 25 participants (15 senior and 10 young scientists, and one representative of the ESF Standing Committee) from 11 different countries (Austria, England, France, Germany, Holland, Hungary, Italy, Romania, Slovakia, Spain and the US) took part during the three days of the highly successful meeting. CEU - with the full agreement and support of the ESF Standing Committee – has arranged for the audio-taping of the conference proceedings (both talks and discussions) and collected electronic copies of the powerpoint as well as the poster presentations. These then were made restrictedly available to the participants of the Summer School following the ESF Workshop to be used as (part of their) teaching material. CEU Business School has also arranged for the live projection of the Powerpoint presentations of the Workshop and their verbal discussions to the students of the Summer School seated in a separate conference room. This ingenious arrangement made it possible to keep the intense and informal small group setting of the ESF Exploratory Workshop intact, while making the proceedings available in their totality and full spontaneity for the larger group of 30 or so Summer School students as well.

## **2. SCIENTIFIC CONTENT OF THE EVENT**

### **2.1. Structure and Format**

The organizational structure of the three-day meeting reflected the interdisciplinary character of the Workshop: it consisted of 7 sub-sections organized around 7 different sub-fields and methodological approaches all converging on the major unifying topic of the Workshop, that of *understanding intentional action and intentional minds* (of others as well as of the self). Each of the 7 sub-sections consisted of two or three 30-minute presentations each followed by a 15-minute discussion period. These 7 sub-sections all ended with a 60-minute long general discussion session.

There were three additional scientific events included in the Workshop: 1. An *introductory talk* by Hrafnhildur Ragnardóttir on the part of the ESF Standing Committee in which the aims, organizational structure, and different programmes and activities organized by and available within the framework of the ESF were discussed. 2. On the second day a two-hour afternoon *poster session* was organized, where the participating young scientists displayed their own on-going research work on posters and discussed it at length with the senior research participants as well as with each other. This poster session was followed by an approx. 60-minute long general discussion that was devoted to the presented research work of the young scientists. 3. The last afternoon session of the Workshop was divided into two halves: a) a *General Discussion of the Workshop proceedings*, and b) a *Cooperative Planning Session* that was devoted to discussing newly emerging collaborative research projects and possibilities including the planning of the publication of an edited scientific book that would consist of a series of scientific papers followed by discussions, based on the Workshop presentations and written by the participants of the meeting.

### **2.2. Scientific content of the contributions**

The 7 major topical sub-sections covered the following areas of research interests:

1. *Cognitive neuroscience and artificial intelligence approaches to generating and perceiving intentional actions.*
2. *Brain and behavioural research on pathologies of intentionality and mind: Autism, Schizophrenia, and Williams syndrome.*
3. *Brain and behavioural research on infants' understanding of action and mind.*
4. *Actions, Minds, Artifacts, and Intentionality: Theoretical integration of*

*advances in philosophy, cognitive neuroscience, developmental and comparative studies, and artificial intelligence.*

5. *Comparative approaches to understanding actions, minds, and artifacts.*
6. *Developmental approaches to understanding actions, minds, and artifacts.*
7. *Teleological and mentalistic understanding of communication and reference: Efficiency, rationality and relevance. Evolutionary, developmental, and linguistic perspectives.*

The workshop started by the convenor, György Gergely's brief greetings of the participants that included a summary sketch of the major aims of the meeting and its particular structure of organization. This was followed by kind words of introduction given by Hrafnhildur Ragnarcdóttir on the part of the ESF Standing Committee in which the aims and organizational structure of the ESF were described, and the programmes and activities sponsored by the ESF were briefly introduced.

The first session entitled '*Cognitive neuroscience and artificial intelligence approaches to generating and perceiving intentional actions*' was chaired by *Csaba Pleh* (Center for Cognitive Science, Budapest, Hungary) and included three excellent talks and a lively and substantial general discussion. First, *Andreas Wohlschläger* (Max-Planck Institute, Munich, Germany) spoke about an 'old theory in new bottles', describing and analyzing the major claims of the "ideomotor principle", or, in other words, the general concept that the perception of actions stimulates the execution of related actions. He summarized new behavioural and related neurophysiological evidence on action perception, action imitation, and the relation between the two arguing that both lines of evidence support and further specify the ideomotor principle with respect to the role of *action goals and action intentions*. He then presented the results of a set of fascinating on-going new studies demonstrating and measuring the subjective *the phenomenon of 'intentional binding'* during the perception of intentional actions (resulting in temporally delayed effects) performed either by the agent herself or by an other person observed. The studies apply in a novel way the Libet-clock methodology of estimating the phenomenologically experienced temporal lag between the initiation of behaviours and their external effects as a function of the perceived (or inferred) intentionality of (agent-initiated) actions versus corresponding non-intentional (externally-induced) manual behaviours that are perceived as not being under intentional control. The results indicate that the perceived intentional control of behaviour induces an illusionary 'shrinkage' of the subjectively perceived time interval between action initiation and effect occurrence (the

intentional ‘binding’ phenomenon). Wohlschlagler went on to describe how the same method can be combined (in collaboration with Patrick Haggard in London) with using localized electro-cranial brain stimulation to directly induce manual activity. He then discussed recent neurophysiological research showing that the brain of higher mammals is equipped with specific structures (in primates particularly premotor and parietal structures) which support action perception. Since a central characteristic feature of some of these structures is that they participate in action perception as well as in action execution, Wohlschlagler concluded that these structures may constitute the functional basis of the ideomotor principle.

The next speaker, *Harrold Bekkering* (NICIS, Holland) talked about the basic organizational and control principles that are involved in generating intentional actions (as in recent ‘forward models’ of the production of goal-directed actions) and how these principles may be also involved in the perceptual analysis and interpretation of the actions of others. In principle, we generate goal-directed actions to change our environment, he argued, and so the intention behind an action is to perceive the environmental consequences of a specific motor act. A big puzzle for cognitive scientists is the question how these anticipated perceptual consequences could be realized by the motor system. Bekkering then reviewed recent behavioural, developmental, as well as neuroimaging experiments (EEG) on action production, perception, and imitation that provide new ways to investigate the neurocognitive mechanisms underlying the perceptual and motor organization and segmentation of behaviour in terms of means and goals in intentional actions and in human tool use.

The final talk of the first session was given by the young French brain imaging scientist, *Julie Grezes* (Wellcome Department of Imaging Neuroscience Institute of Neurology, London, UK), who explored the issue of how far simulation theories and the brain mechanisms potentially mediating simulation processes can account for our ability to make judgments about mental states of others is critical to social interactions. She argued that our remarkable ability to perceive and predict other people's intentions from their non-verbal behaviour is likely to be achieved by processes of motor simulation, particularly in cases where the information available is not easily encoded into language. Simulation theories assume that when we observe others, we mentally automatically simulate the motor actions that we see others perform. Grezes argued that recent behavioural and neuroimaging results indeed suggest that action observation automatically triggers action simulation, a mechanism that could be at the basis of action understanding. She went on to discuss the fact that humans are not only able to recognize actions from observation; but they can also predict and infer the underlying mental causes of such actions in terms of intentions and beliefs based on the

observation of the behaviour of others. She argued that the information directly available that provides the basis for such inferences consists mostly of the movements of the agent in space and time in the physical or social environment. She then presented two neuroimaging studies that explored the neural basis of the everyday human competence to make judgments about non-trivial mental states (such as pretending with the intention to deceive) through the observation of the non-verbal behaviour of other people. These studies also aimed to clarify to what extent this ability relies on simulation, as social interactions also involve expression, emotions and other cognitive states which may not be reducible to motor simulation.

A central theme in the general discussion related to the potential pitfalls in the currently rampant overemphasis on (and often distorted factual portrayals of) the role and functions of the so-called ‘mirror neurons’ (that are specifically activated by both the perception and the production of particular goal-directed intentional actions) as the underlying brain mechanism of simulation processes that many researchers suppose to be sufficient to explain our basic ability for mindreading during interpreting the intentional actions of others. Numerous theoretical doubts about the general plausibility of this approach as well as concrete evolutionary objections and sobering factual clarifications were offered, while others took a more optimistic view on the viability and generalizability of these relatively newly discovered neural mechanisms of action perception.

The first afternoon session was devoted to the topic of ‘*Brain and behavioural research on pathologies of intentionality and mind: Autism, Schizophrenia, and Williams syndrome*’, and was chaired by the young Romanian cognitive neuroscience researcher, *Agnes Kovacs* (SISSA, Trieste, Italy). The first talk by *Uta and Chris Frith* (UCL and Institute of Neurology, London, UK), delivered by Uta Frith provided a challenging overview of recent behavioural and brain imaging research about the specific, but differentially pathological functioning of mentalizing or theory of mind capacities and their corresponding brain structures in childhood autism and schizophrenia and how these systematic differences in the pattern and level of activation of mentalizing brain areas may help explain the intriguing patterns of similarities and differences in the symptomatology of these respective disorders. Frith has proposed that in autism the core social communication deficit is well explained by *underactive* mentalising. By contrast, in schizophrenia, the delusions of control and paranoid delusions can be explained by *overactive* mentalising. She reviewed recent evidence from a large range of behavioural and brain imaging studies in support of this general conclusion.



The second talk by *Agnes Lukacs* and *Csaba Pleh* (Center for Cognitive Science, Budapest, Hungary) explored the nature and relative degree of cognitive deficit in the language of social and spatial cognition in the rare genetic disorder called Williams Syndrome, which is characterized by a strong dissociation between a surprisingly functional and spared linguistic competence on the one hand, and serious and wide ranging cognitive deficits (especially in the sphere of spatial cognition), on the other. As Pleh has pointed out, the issue of social skills and their organization have been a constantly hot issue in research on Williams syndrome (WS) children who at first were assumed to have intact social cognition and language skills as contrasted to a general weak ability for spatial cognition.

In the talk Pleh reviewed evidence from three new studies on Hungarian speaking WS children that exploit the special structural properties of this agglutinative language, free-word order language with a highly generative case-marker system to encode spatial as well as abstract non-spatial conceptual relations that are, nevertheless, marked by spatial suffixes. These studies provide evidence suggesting that the picture of the cognitive and linguistic aspects of the deficit in WS children is more complicated than was initially thought. Some studies examined the pragmatics of world learning in WS children – relying e.g. on gaze patterns – that is a central domain regarding social skills involved in language. The results indicate that Hungarian speaking WS children follow the normal cognitive developmental pattern showing an intact ability to follow and interpret the gaze of their communicative partner, and they strongly contrast in this regard with subjects from the autistic spectrum.

In another set of tasks, however, that tested anaphora interpretation, the intact social cognition hypothesis would have predicted that WS subjects should be able to successfully rely on relevant social cognitive pragmatic knowledge such as responsibility taking rather than on formal linguistic features in order to resolve the semantic ambiguity when interpreting sentences such as *Frank criticized John because he forgot to mail the letter*. This prediction, however, was clearly not borne out by the findings, a fact that can be interpreted as evidence showing lower linguistic performance that is due to the existence of limitations of at least such relatively higher-order aspects of social cognition that are related to the mental impairment of WS children.

A further complication for the intact social versus damaged spatial cognitive abilities is evidenced by the finding that the relative difficulty of processing purely spatial versus non-spatial, social mentalistic interpretations of analogous linguistic expressions such as *He fell in the hole* versus *He fell in love* shows the same asymmetry in WS children than what is characteristic of normal subjects, namely, that the latter, social-mental use is always more

demanding and secondary to the literal, spatial use. In a sentence completion task it was found that – despite their well-documented deficit in spatial cognition (and allegedly intact social cognition) - the spatial meanings were more available and easier to process even in the case of WS children. In conclusion, Pleh argued in favour of multi-layered theories of social cognition, and for the usefulness of data from genetically impaired populations showing specific patterns of dissociations to unravel the intricacies of this multiplicity.

During the lively general discussion the most debated focal question concerned whether the neurologically and genetically plausible, but possibly overly global and unidimensional factor of differential over- vs. underactivation of the brain circuits specialized for mindreading is sufficient to account for such more specific characteristics of the symptomatology of abnormal mentalization skills as, for example, the contextual insensitivity of mentalistic attributions, or the dominantly self-referential fixedness of attribution contents in schizophrenia or the temporal shifts from dominantly persecutory to dominantly idealizing mental contents that such patients attribute to other minds.

The final section of the first day of the workshop was devoted to ‘*Brain and behavioural research on infants’ understanding of action and mind*’ and was chaired by the Italian infant psychologist, *Luca Surian* from the University of Trieste. The first talk was given by *Teresa Farroni* (Wellcome Trust, CBCD, Birkbeck College, London), who discussed the age-old question of the origins of social perception in humans by summarizing a fascinating set of novel findings on eye- and gaze-perception in neonates, infants, and adults. As she pointed out, the question of what newborn human infants know about other human faces has been central to debates in several fields, including developmental psychology and cognitive neuroscience. While some have argued for an innate cortical module for face processing, others have proposed that cortical specialisation for face processing is acquired through experience. Evidence from newborns and early infancy is critical for this debate, argued Farroni, and proceeded to review evidence from recent neurophysiological and behavioural studies with both adults and infants on the processing of direct and averted gaze. Her and others’ recent results suggest that mechanisms underling the use of averted gaze for shifting attention are present from very early in life, and is likely to be innate. With regard to direct gaze, recent studies show that even newborns prefer to look at faces that engage their mutual gaze. Further, electrophysiological evidence from Farroni’s lab showed that, at least from 4 months of age, faces with direct gaze receive enhanced processing by infants when compared to faces with averted gaze. She concluded by speculating on the nature of the neural

mechanisms that underlie these early abilities, and suggested that they provide the foundation for later more complex social cognition.

The last talk of the day was given by the Italian cognitive neuroscience researcher, *Luca Bonatti* (SISSA, Cognitive Neuroscience, Trieste). Bonatti started with the general question of how young infants use information about the featural properties of the human species to individuate and track individuals in the world. He then elaborated the Human First Hypothesis (HFH), which posits that infants innately possess information about their conspecifics and can use it from very early on to identify and count objects within such a category domain. Bonatti contrasted this view with the highly influential theory and experimental work in the tradition of Xu and Carey (1996) that suggests that object individuation in terms of feature binding is a rather late maturing capacity that appears only at the end of the first year of life. Bonatti described a series of experiments using the Xu & Carey object individuation paradigm with cross-species objects exhibiting human versus non-human features that indicate that the special status of human features can be used for object individuation much earlier than features of other object kinds. He finally developed a theoretical analysis of how the special neural mechanisms dedicated to the detection of human properties can be recruited for object individuation arguing for the Human First Hypothesis over Xu and Carey's Object First Hypothesis.

The general discussion concentrated on the complex issues of early brain specialization and modularization processes contrasting theories of neural constructivism and theories of modular hard-wiring of dedicated cognitive-perceptual systems.

The second day started by the session devoted to the topic of '*Actions, Minds, Artifacts, and Intentionality: Theoretical integration of advances in philosophy, cognitive neuroscience, developmental and comparative studies, and artificial intelligence*' and was chaired by the young comparative psychologist, *Hannes Rakoczy* (Max-Planck Institute for Evolutionary Anthropology, Leipzig, Germany). The first talk was given by the philosopher of mind, *Johannes Roessler* (University of Warwick, UK), who raised the stakes by analyzing and making explicit some of the troublingly contradictory conceptual claims that can be identified (but typically go unnoticed) in the developmental psychological literature on the early development of the mentalistic understanding of intentional action, on the naïve causal theory of the mental causes of actions, or on the role of inferential principles such as rationality of action in inferring mental attitude states such as desires and (false) beliefs. Roessler argued that according to a widely held view, 2-year-olds think of themselves and others as intentional agents. He pointed out that one general problem raised by this view is

that it seems to be inconsistent with two other prima facie plausible claims: (1) Understanding intentional actions requires appreciating that ‘from the agent’s point of view there was, when he acted, something to be said for the action’ (Davidson), where, specifically, this involves knowing something about the agent’s purpose, and her beliefs as to how to achieve that purpose. (2) The concept of belief is normally not fully mastered until the pre-school years. In trying to resolve this paradox, Roessler focused on the interpretation of early imitation, and explored some illuminating parallels with the case of proto-declarative joint attention.

The next talk was given by the Canadian infant psychologist, *Renée Baillargeon* (University of Illinois at Champaign-Urbana, US) on her most fascinating and widely discussed new experimental results on young infants’ sophisticated non-verbal reasoning abilities in the domain of action understanding and belief attribution. Recent research on the development of psychological reasoning suggests that infants, like adults, attribute goals to others: they construe at least some of the actions they observe as goal-directed. For example, infants who see a human agent repeatedly approach and grasp an object typically interpret her actions as directed toward the goal of obtaining the object. Can infants take into account not only the goal but also the perceptions and beliefs of an agent when reasoning about her actions? And can infants do so even when the agent’s perceptions and beliefs differ from their own? Baillargeon went on to describe her new violation-of-expectation experiments that began to address these questions. Her results suggest that (1) 12-month-old infants are able to distinguish between their own and others’ perceptions of a situation, and take into account others’ perceptions—even when incomplete—to interpret their actions; and (2) 15-month-old infants can keep track of their own and others’ beliefs about a situation, and take into account others’ beliefs—even when incorrect—to interpret their actions. Together, Baillargeon has concluded, these results suggest that infants’ psychological reasoning is more sophisticated than was traditionally believed.

The general discussion was strongly inspired by both of these thought-provoking and excellent talks. Some comments focused on the different possible interpretations of the conceptual problems unearthed by Roessler’s perceptive theoretical analysis of the implicit or explicit contradictory assumptions of current-day infant cognitive developmental literature on theory of mind development, often trying to rescue one of their favorite theories, while using Roessler’s arguments to undermine others. Baillargeon’s revolutionary results – that provided excellent new examples to be critically examined from the point of view of Roessler’s conceptual concerns - evoked excited, often enthusiastic, but sometimes cautious and mildly

critical comments, as can be expected when faced with new findings that contradict much of the currently standard accepted view of infant's early understanding of other's minds.

The next session concentrated on primate research and its implications for human development being devoted to '*Comparative approaches to understanding actions, minds, and artifacts*'. It was chaired by the young Hungarian ethologist specializing in comparative research on dogs, wolves, and children, *Jozsef Topal* (Department of Ethology, ELTE University, Budapest). The first talk was given by the Spanish primate researcher, *Josep Call* (Max-Planck Institute for Evolutionary Anthrology, Leipzig, Germany). He focused on accumulating new evidence from primate research that raises again the question whether and to what degree our closest relatives understand the mental states of other con-specifics. As Call noted at the beginning, there is ample evidence that animals react and adjust to the behavior of their conspecifics. Much less is known about whether animals also react and adjust to the psychological states of their conspecifics. Apes and dogs have received a considerable amount of research attention regarding their social cognition. There is a substantial body of evidence that suggests that apes and dogs interpret the perceptions of others from a psychological perspective and they are capable of at least level I perspective taking. Some recent evidence briefly summarized by Call also suggests that chimpanzees seem to know what others intend. Call argued that these data are not easily explained by invoking a purely behavioral dimension based on detecting behavioral cues and statistical regularities. At the same time, however, he cautiously concluded that at present they do not necessarily constitute sufficient evidence of a mentalistic dimension either that would involve metarepresentational mechanisms such as false belief attribution.

Call's lecture was followed by the talk of another Spanish primate researcher, *Juan Carlos Gomez*, from the University of St. Andrews, Scotland. Gomez started his evolutionary analysis of the origins of understanding intentionality with a mythological example of a lesser known Greek God's, Momo's problem. Momos' problem is the issue of how we can know and deal with mental states if they are unobservable and internal to the bodies of organisms. A traditional solution to this problem is positing an ability to infer mental states from behavioural cues —the so called theory of mind. Gomez developed arguments against the received view pointing out that its basic assumption that all mental states are unobservable and internal might be wrong. He used examples from primate research to illustrate his contention that some mental states are, in fact, overtly observable, and developed the theoretical claim that one fundamental property of the mind —intentionality in the sense of *aboutness*— may have evolved as an observable property of overt behaviour. Gomez then

reviewed evidence that primates have evolved ways of displaying and computing their behaviour as intentionally related to targets of actual or potential action. He ended up proposing that this fundamental form of mentalism is one of the components with which human mentalism is built.

The two talks were followed by a commentary by the Hungarian ethologist, *Adam Miklosi* (Department of Ethology, ELTE University, Budapest), who provided a very useful metaanalysis comparing pros and cons of the differences between the comparative methodologies and conceptual strategies of animal researchers in the ethological tradition and those of infant and child developmentalists working with young humans. The afternoon session was devoted to the presentation and discussion of 6 posters in which the participating young scientists have presented their on-going research work. The posters dealt with a wide range of exciting research projects whose summaries are provided in the abstracts below (Appendix 1). Their individual discussion during the poster session was followed up by a general discussion session in the late afternoon chaired by the young German infant psychologist, *Henrike Moll* (Max-Planck Institute for Evolutionary Anthropology, Leipzig).

The first session of the final day of the ESF Workshop was devoted to the topic of *Developmental approaches to understanding actions, minds, and artifacts*. The first talk was given by the German experimental and theoretical psychologist, *Wolfgang Prinz* (Max Planck Institute for Human Cognitive and Brain Sciences, Munich/Leipzig), who presented a new theory of ‘prospective coding’ in event representation. He provided an insightful conceptual analysis of experiments investigating the role of anticipatory and memory processes in different types of tasks of human information processing. He argued that the perception and generation of events is subserved by event representations. He then illustrated by analysing patterns of experimental data that event representations must contain information about present states of affairs as well as both past and future states of affairs. Prinz, at the end of his talk, focused on the issue of which role is being played by (representations of) future states of affairs in event perception and generation (prospective coding). He then concluded by reviewing and discussing a number of central theoretical issues and paradigms that are relevant for both of these domains.

The second talk was given by the Austrian cognitive developmental psychologist, *Josef Perner* (University of Salzburg, Austria) on his new theory and experimental work on young children’s objective notion of desire and emotions. As a good example showing that cognitive development is more than just an increase in processing capacity but consists of profound changes in how we understand the external world and the world of our minds, he started out

by presenting the claim that children up to 4 years lack an understanding of subjective points of view and have an objective notion of desire and emotions. This means that they understand feelings on the basis of what kind of situation a person is in. The most basic distinction between happy and unhappy (sad) corresponds to being in a desirable (good) or undesirable (bad) situation. This claim excludes an understanding of subjectivity of emotion, i.e., that one person feels happy and another person unhappy about the same situation. Perner argued for this position by reviewing several studies that claim to show an understanding of subjectivity before the age of 4 (as early as 18 months) arguing that these data can be explained by the fact that people are in different situations, but that the situations are seen as objectively good or bad. This approach to emotion and desires, however, meets its limit with competitive situations, where one has to understand that winner and loser will have opposite feelings about one and the same situation: the outcome of the interaction. Consistent with this claim, argued Perner, is the fact that existing investigations show that young children have problems understanding conflicting desires and competitive games. Such understanding only emerges with the appreciation of perspective differences in the case of beliefs at about 4 years. Perner ended his talk by pointing out that his theory provides a nice continuation of Gergely's claim (see Gergely and Csibra, 2003) that much younger children have a theory of (objectively) rational action.

The final talk of this session was given by the infant social cognition researcher, *Malinda Carpenter* (Max-Planck Institute for Evolutionary Anthropology, Leipzig, Germany) on early understanding and sharing of intentions in human infants. She started her argument by reviewing evidence showing that by age 14 months, infants already have relatively complex intention-reading skills. She then examined the implications of new research findings from her lab aiming to identify which aspects of others' intentional action infants understand and when. She discussed different types of observable information infants can use to work out what others' unobservable goals and intentions are. These intention-reading skills, Carpenter went on to argue, give humans and other animals who have them tremendous social advantages in terms of being able to explain and predict others' behavior. However, she concluded that the currently available evidence is best explained by the assumption that it is infants' motivation for *sharing* intentions with others that is the key to the development of uniquely human forms of cultural cognition.

The three talks were followed by a general discussion in which the most dominant issues concerned whether the motivation of sharing intentions is indeed a primary human

adaptation that forms the basis of human cultural evolution: a position that was both questioned and defended by several participants. Perner's proposal of a situational externalist construal of desires and emotions was discussed from the point of view of its conceptual relation to Csibra and Gergely's theory of an initially non-mentalistic teleological stance in early infant reasoning about rational action. Some of the philosophical problems raised by Roessler the day before were raised again as relevant for the current discussions.

The final scientific session of the workshop was devoted to the topic of 'Teleological and mentalistic understanding of communication and reference: Efficiency, rationality and relevance. Evolutionary, developmental, and linguistic perspectives'. The session was chaired by the young Slovakian cultural anthropologist, Martin Kanovsky (Faculty of Social Sciences, Bratislava, Slovakia). The first of the two talks was given by the Hungarian infant cognitive developmentalist and brain scientist, Gergely Csibra (Centre for Brain and Cognitive Development, Birkbeck College, London, UK) about his new theory developed together with the convenor of the workshop, Gyorgy Gergely (Csibra and Gergely, 2004) about the hypothesis that the uniquely human characteristics of cultural learning and social cognition can be seen as the result of a primary human adaptation for 'pedagogy'. Csibra started his argument by pointing out that many theorists have proposed that human culture was made possible by one or more specific evolutionary adaptations that radically changed the cognitive capacities of humans, such as tool making, linguistic communication, or theory of mind. In contrast to these previous approaches, he proposed that a further human-specific ability, namely pedagogy, plays an even more fundamental role in the evolution and ontogenesis of individuals living in rich cultural environments. Pedagogy is a teacher-guided learning process whereby arbitrary associations, a characteristic of most cultural knowledge, can be formed quickly and effectively. We argue that the human-specific inclination to teach each other (i.e., to transmit relevant knowledge to conspecifics) is complemented by a human-specific receptivity to benefit from teaching. Human infants are equipped with specialized cognitive resources that enable them to learn from infant-directed teaching: they are sensitive to cues that indicate teaching contexts, they tend to interpret actions occurring in these contexts as referential, they expect the "teacher" to provide relevant information about referents, and they fast-map such information to the referred object. Many phenomena of early social cognition, like proto-conversations, gaze following, pointing, social referencing, or imitative learning can be re-conceptualized in this framework, argued Csibra. Furthermore, while these phenomena are usually interpreted as manifestations, or precursors, of mentalistic



interpretation of others, which then allow the child to engage in communication, according to the present alternative theory it is rather the early ability to expect and receive information by teaching, or more generally, to exchange information with others, that forms one of the sources for the later developing theory of mind.

The final talk of the workshop was given by the French cognitive cultural anthropologist, *Dan Sperber* (Institut Jean Nicod, EHESS and ENS, France) with the title ‘Verbal comprehension as a form of mindreading’. Sperber provided a lucid summary of his and D. Wilson’s relevance theory of pragmatic interpretation of verbal communicative utterances. He argued that while verbal comprehension is a form of mindreading, it is nevertheless performed not by a general mindreading ability or ToM module but by a more specialised inferential comprehension module that has evolved for the purposes of linguistic communication. He then described the economic cognitive principle of ‘communicative relevance’ that drives and constrains the interpretative process of verbal communication in terms of an economic trade-off between the relative amount of cognitive effort invested into the recovery of the intended meaning, and the degree of relevance for the addressee of the message thus recovered. Sperber then made a systematic distinction between the concepts of ‘communicative intention’ and ‘referential intention’. The latter refers to the speaker’s intended meaning to be cognitively reconstructed by the addressee on the basis of the speaker’s verbal and/or non-verbal behaviour through the inferential process of contextually-based pragmatic interpretation. In contrast, the concept of ‘communicative intention’ refers to the speaker’s ostensive communicative behaviour addressed explicitly to the listener, whose function is to inform the addressee about the fact that the speaker intends to communicate something to her. Such ostensive behavioural acts of expressing one’s communicative intent serve to establish the mutual and explicit knowledge between the speaker and the addressee that the speaker’s verbal utterance or non-verbal behavioural gesture is going to manifest for the addressee sufficient information about his intended meaning to trigger in her the modular inferential process of contextual pragmatic interpretation that – constrained by the principle of communicative relevance – will allow her to reconstruct the speaker’s intended meaning in her mind with the least cognitive effort necessary to secure the relevant interpretation.. Sperber ended his talk by speculating about the evolutionary origins of the modular inferential comprehension system specialized for inferring the intended meanings of speakers’ verbal utterances and its likely relation to the general mind reading mechanism that had probably emerged before linguistic communication. He also touched upon the questions of how these systems of communicative inferential understanding unfold during early childhood and to

what extent can the understanding of pre-verbal referential communicative gestures be already governed by these innate principles of communication in infancy before the emergence of language in ontogenetic development.

The discussion of the two talks generated a lively debate about the conceptual relationships and differences between Sperber's model of verbal communication as a specialized form of mindreading, and Csibra and Gergely's theory of pedagogy as the basis of cultural learning that would precede both theory of mind and language in the history of human evolution.

### **3. ASSESSMENT OF THE RESULTS, CONTRIBUTION TO THE FUTURE DIRECTION OF THE FIELD**

The workshop turned out to be a veritable success exceeding all the expectations of the organizers and fulfilling all the major aims that the workshop attempted to achieve. First, the level of scientific expertise represented by the participants coming from a relatively large number of different domains of specialization as well as their preparedness and level of motivation to learn from each other was clearly and constantly very high throughout the sessions. The meeting succeeded not only in attracting a group of experts from the cutting-edge of their respective fields of European science, but also identified a clearly well-formed and unifying topic of general interest that made most participants highly motivated and intellectually genuinely excited about conducting a dialogue of separate but interfaceable minds. The other aspect of the workshop that was agreed by all participants to be clearly and unexpectedly successful was the genuinely friendly and relaxed intellectual atmosphere that the Workshop has managed to create. Without losing on the depth or sharpness of arguments, the meeting avoided any unnecessary personal clashes, rivalry or animosity that are sometimes characteristic of such small scale and intensive scientific gatherings of experts of different theoretical orientation. The mix of high-quality and promising young scientists and already established senior experts seemed also just right, as was the involvement of many participants coming from the less developed parts of larger Europe. The latter aspect probably worked because even from these less developed European countries we had sufficiently large number of quality applicants and invitees from whom we could select a representative, highly trained, and talented group of young researchers. They were not 'secondary citizens' in any sense in these meetings and could profitably contribute to the discussions throughout.

The meeting was also a clear success in terms of the number of collaborative project plans that have surfaced throughout the days of discussions and that solidified during the last general session devoted to make our plans explicit and even more focused. We are certain that several of these plans will eventually be realized and that in a few years joint ESF and EU project applications that originated from the workshop will be submitted and hopefully receive funding. The general aim of scientific integration and mobility in the new and enlarged free Europe seems to have gained impetus and momentum in the particular cross-section of fields of interdisciplinary interest that was the focus of the Exploratory Workshop in Budapest. There are also serious and promising plans in the working concerning the publication of a high-quality edited book of scientific papers that most participants have already agreed to contribute manuscripts to.

The combination of holding the workshop in a joint structure with the subsequent SUN summer school on the same scientific topic also turned out to be highly successful and certainly extremely popular with the students. Fortunately, the carefully organized format of the meetings involving the two simultaneous or at least partially overlapping events allowed for not inflating the intimacy and informal small group setting of the ESF Workshop, while also providing sufficient access to its contents and proceedings through the successfully and smoothly working technical arrangement of live projection of the workshop activities in an adjacent room for the students participating at the Summer School. One can only praise the careful and enthusiastic attitude of the CEU organizers and the flexibility on the part of the ESF Standing Committee for making this new and unique format of the two meetings viable and realizable.

## **Posters**

**TANYA BEHNE**

### **INFERRING COMMUNICATIVE INTENT: INFANTS' USE OF COMMUNICATIVE CUES IN A HIDING GAME**

This study explored infants' ability to infer communicative intent as expressed in non-linguistic gestures. Sixty children aged 14, 18, and 24 months participated. In the context of a hiding game, an adult indicated for the child the location of a hidden toy by giving a communicative cue: either pointing or alternating gaze toward the container containing the toy. To succeed in this task children had to do more than just follow the point or gaze to the target container. They also had to infer that the adult's behaviour was relevant to the situation

at hand - she wanted to inform them that the toy was inside the container toward which she gestured. Children at all three ages successfully used both types of cues. We conclude that infants as young as 14 months of age can, in some situations, interpret an adult behaviour as a relevant communicative act done for them.

**ÁGNES M. KOVÁCS**

**BILINGUALS' ADVANTAGE IN UNDERSTANDING OTHER MINDS. WHAT DOES THIS BENEFIT MEAN?**

The studies investigate how bilingual and monolingual children understand situations that involve mental states of others. We explore whether bilingualism promotes success in theory of mind tasks. This may be possible because bilingual children switch between their languages as a function of the addressee's language. According to our proposal this language selection requires an insight into the others' mind. If this is the case, bilinguals develop a theory of mind earlier than matched monolinguals. In the first study 3 years old bilingual and monolingual children performed a standard theory of mind task, a modified theory of mind task and a control task for general information processing. Results show that success in theory of mind develops faster in bilinguals than in monolinguals while they do not differ in the control task. The second study investigates the mechanisms, which might underlie the observed phenomena. The questions we address are the following: 1. Are bilinguals really better in ToM or they are just better in inhibiting a prepotent response (the reality bias)? In order to study this, in addition to the standard ToM tasks we used tasks that lack the strong bias by decreasing the saliency of last event or increasing the saliency of previous event. 2. Are the differences in ToM ability due to better grammatical abilities of the bilinguals? We measured performance in understanding tensed complements that involved mental or communication verbs, with or without a prepotent response. 3. How long does the bilingual advantage last? (comparing 3 and 4 years old) The results show that the bilingual advantage is not due to better grammatical abilities and the differences between monolinguals and bilinguals disappear at the age of four. Furthermore, it seems that the young bilingual advantage is only restricted to the standard ToM tasks, which involve a prepotent response.

**HENRIKE MOLL**

**WHEN CAN YOUNG CHILDREN IMAGINE WHAT SOMEONE ELSE SEES WHEN THAT DIFFERS FROM WHAT THEY SEE?**

Infants know that others see things that they do not from around the first birthday, as evidenced, for example, by their gaze following behind themselves or barriers. In the current study we asked the question: at what age do young children know the actual content of what others see? An adult entered the room searching for an object. One candidate object was out in the open, whereas another was visible for the child but behind an occluder from the adult's perspective. When asked to help the adult, 24-month-old children, but not 18-month-old children, handed him the occluded object, whereas in a control condition they showed no preference for the occluded toy. Success in this task provides evidence for Level 1 perspective-taking, when it is properly defined, and this is the youngest age at which this understanding has been demonstrated.

## HANNES RAKOCZY, FELIX WARNEKEN & MICHAEL TOMASELLO

### THREE-YEAR-OLDS' UNDERSTANDING OF DIFFERENT PEOPLE'S INCOMPATIBLE DESIRES

Young children can predict and explain actions and emotions based on volitional attitudes (preferences, desire etc.) of actors well before they can do so on the basis of cognitive attitudes, especially beliefs (e.g., Wellman, 1990). However, it has recently been argued that young children do not possess an adult-like notion of desires as subjective and perspectival attitudes until 4 when they master false belief and other tasks standardly taken as indicative of understanding the perspectival nature of mental states (Moore et al., 1995; Perner, 2004).

A crucial test case for this theory is children's understanding of incompatible (i.e., not jointly satisfiable) desires in different persons, because understanding that two people can want different incompatible events to happen in the same situation requires a notion of the subjectivity of desires. The only study on this topic published to date seems to speak in favor of this theory: Moore et al. (1995) showed that 3-year-olds were poor (as poor as on a false belief task) at saying what another persons wanted to happen when this conflicted with what they themselves wanted to happen.

However, in this study the child herself was one of the desirers. It thus remains unclear whether poor performance was due to a conceptual deficit regarding incompatible desires per se, or rather due to a broadly executive challenge in disengaging from first person desires. To explore these possibilities, therefore, in three studies we tested young 3-year-old children (n=72) on third person versions of incompatible and compatible desires tasks.

In the incompatible desire stories two puppet characters A and B wanted incompatible events to happen and quarreled. In the compatible desire stories A and B wanted different but compatible events to happen. Importantly the desires were implicitly expressed (e.g., "p should happen!") and not explicitly stated by the characters. Then one of the desired events happened. Two sorts of test questions were then asked: (Q1) "What did A and B want?" and (Q2) "Are A and B happy or sad now?".

Results were as follows: (1) In none of the studies were there any difference between compatible and incompatible desire tasks. (2) Regarding Q1, in all studies, children were very good at inferring both characters' incompatible and compatible desires. (3) Regarding Q2, children were very good at saying that A and B were happy and sad, respectively, depending on the (non-)fulfillment of their desires in both desire tasks. Overall, children were significantly better on Q1 and Q2 in each desire task than on false belief tasks (Wilcoxon tests,  $ps < .05$ ).

These findings speak against the theory tested here and suggest (a) that young children have a notion of desires as subjective perspectival attitudes before they have a corresponding grasp of the subjectivity of beliefs, and (b) that the findings by Moore et al. (1995) might be accounted for by broadly executive problems in disengaging from first person desires. Ongoing research will test this directly by contrasting performance on third and first person versions.

**MOTION PERCEPTION AND OBJECT INDIVIDUATION AT 10 MONTHS OF AGE**

Two experiments were carried out to evaluate infants' ability to use agency cues in object individuation processes. The procedure was similar to Xu and Carey (1996) and involved a fixed series of occlusion events involving a screen and two pairs of objects followed by either an expected (two-objects) outcome, or an unexpected (one-object) outcome. Infants were shown computer generated animations on a 19" monitor while seating on their mothers' lap. In Experiment 1, 16 10-month-olds were tested in the Agent Motion condition and 16 infants were tested in the Baseline condition. In the Agent Motion condition, the objects (a pair of squares or disks) were identical in shape, colour and size, but exhibited contrasting behaviours: one object in each pair moved autonomously like a caterpillar, with repeated expansions and contractions. The other object remained always rigid and passive and was moved by a hand. All events started with 4 introductory trials, followed by 4 test trials. In the Agent Motion condition the test trials consisted of a familiarization phase followed by a test phase. In the Baseline condition there was no familiarization phase, in order to assess infants' spontaneous preference for one- vs. two-object displays. Results showed a significant Condition x Outcome interaction. In the Baseline condition infants looked more at the two-object than at the one-object outcomes while in the Agent Motion condition they showed the opposite pattern, suggesting that they generated correct numerical expectations on the basis of agent motion cues only. In Experiment 2, 32 10 month-old infants were tested in either the Basic Level Contrast condition or the Baseline condition. In the Basic Level Contrast condition, objects were pairs of animals that could be identified by shape, colour, object kind and motion pattern (jumping vs. crawling). Results showed no significant main effects or interactions, suggesting that they were unable to infer the correct number of objects involved in the events. These results expand previous findings and suggest that, in order to generate numerical expectations, 10-months old infants are able to use sortals that are more specific than the concept OBJECT and broader than basic level concepts. Implications for current models on the development of individuation processes are discussed.

**TOPÁL, J., VIRÁNYI, ZS. & MIKLÓSI, Á.,**

**DEDUCTIVE INFERRING IN DOGS: ONLY WHEN CUES ARE SOCIALLY MEDIATED.**

One of the widely accepted hypotheses in the study animal mind is, that social cognition evolved as an adaptive response to social and physical environment. This suggests that highly developed social species – similarly as hypothesised in humans – have gained capacity for creative reasoning including different types of inferential reasoning (e.g. deductive inferring) in the solution of species-specific social problems. Despite that inferential reasoning has been demonstrated in several species as the mechanism implicated the solution to a variety of problems, the domain-specificity (with especial regards to social domain) has not yet been experimentally tested. Up to now we have no convincing answer to the question whether the (social)domain-specificity of reasoning mechanisms mirrors general rule for the emergence of social cognition or is a unique trait of our species.

A number of our recent studies have suggested an unusual competence of dogs in social interactions with humans and shed light on some domestication-related changes in the evolution of dog behaviour. The aim of this study was to test whether (I) dogs' are able to

show deductive inferring when search for their toy and (II) whether this ability functions better when task is embodied in a social context.

The choice behaviour of 22 adult dogs was observed in a series of two-way choice tasks, when they were allowed to explore one of the two identical plastic bowls. The experimenter placed the dog's favourite toy under one of the bowls and then provided some information via manipulating the bowls: lifted both bowls ('Both' condition), only the baited ('Baited Only' condition) or only the empty ('Empty Only' condition) one. Dogs met with all three conditions in two basically different contexts: firstly one in which the informing cues regarding the whereabouts of the toy was mediated socially by the communicative gestures of the experimenter (manipulating by hand accompanied with gazing - 'Social mediation') and secondly one in which dogs could rely on 'asocial' way of cuing (lifting the bowls remotely by a fine string - 'Asocial mediation').

Results show that dogs could not solve a simple two-way choice task when they received 'asocial' indirect information about the location of their toy (only the empty container is lifted remotely by a string) but they showed evidence of deductive inferring when the same indirect information is mediated in a social context (active contribution of a human informant). The dogs' apparent tendency to make deductive decision when search for the toy in the social-communicative task but in 'asocial' situation suggests the existence of context specific reasoning mechanisms in dogs.

## 4. FINAL PROGRAMME

# PROGRAMME

## Sunday 4 July 2004

Evening

*Arrival and Dinner at Retorta*

## Monday 5 July 2004

09:30

**Greetings and Introduction**  
**György Gergely** (Convenor)

**Presentation of the European Science Foundation (ESF)**  
**Hrafnhildur Ragnarsdóttir** (Standing Committee for the Social Sciences)

9:45 – 10:00                      Short coffee break

10:00 – 12:30

**Cognitive neuroscience and artificial intelligence approaches to generating and perceiving intentional actions.**

Chair: **Csaba Pléh** (Center for Cognitive Science, Budapest, Hungary)

*Three 30-min talks each followed by an approx. 15 min discussion period.*

**Andreas Wohlschläger** (Max Planck Institute for Human Cognitive and Brain Sciences, Munich, Germany): **The ideomotor principle in imitation and action perception**

**Harold Bekkering** (Nijmegen Institute for Cognition and Information, Holland): **Intentional action: The interplay between goals and means**

**Julie Grezes** (Wellcome Department of Imaging Neuroscience Institute of Neurology, London, UK): **From the intriguing contagion of movements to social attribution**

12:00 – 12:30

General Discussion of the Morning Session

12:30

*Lunch*

14:00 – 15:30

**Brain and behavioural research on pathologies of intentionality and mind: Autism, Schizophrenia, and Williams syndrome.**

Chair: **Agnes Kovacs** (Romania; International School for Advanced Studies – Cognitive Neuroscience, Trieste, Italy)

*Two 30-min talks each followed by an approx. 15 min discussion period.*

**Uta Frith and Chris Frith** (University College London, UK): **Theory of mind in autism and schizophrenia**



**Csaba Pléh** (Center for Cognitive Science, Budapest, Hungary):  
**Social cognition in Williams syndrome**

15:30 – 16:00

*Coffee-break*

16:00 – 18:00

**Brain and behavioural research on infants' understanding of action and mind**

Chair: **Luca Surian** (University of Trieste, Italy)

*Two 30-min talks each followed by an approx. 15 min discussion period.*

**Teresa Farroni** (Italy, Centre for Brain and Cognitive Development, Birkbeck College, London, UK): **When does communication start?**

**Luca Bonatti** (International School for Advanced Studies – Cognitive Neuroscience, Trieste, Italy): **Humans and other things**

18:00 – 18:30

General Discussion of the Afternoon Session.

19:00

*Dinner at Café Kör*

## Tuesday 6 July 2004

09:00 – 10:30

**Actions, Minds, Artifacts, and Intentionality: Theoretical integration of advances in philosophy, cognitive neuroscience, developmental and comparative studies, and artificial intelligence.**

Chair: **Hannes Rakoczy** (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany)

*Two 30-min talks each followed by an approx. 15 min discussion period*

**Johannes Roessler** (University of Warwick, UK): **Young children's conception of intentional action**

**Renée Baillargeon** (Univ. of Illinois at Champaign-Urbana, US): **Infants' Reasoning about Others' Goals, Perceptions, and Beliefs**

10:30 – 11:00

*Short Coffee-break*

11:00 – 12:45

**Comparative approaches to understanding actions, minds, and artifacts.**

Chair: **József Topál** (ELTE University, Dept. of Ethology, Budapest, Hungary)

*Two 30-min talks each followed by an approx. 15 min discussion period.*

**Josep Call** (Spain; Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany) : **Taking a comparative psychological stance: How apes and dogs interpret the perceptions and actions of others**

	<b>Juan Carlos Gomez</b> (Spain; University of St. Andrews, Scotland): <b>Solving Momo's problem: evolving an intentional view of the world</b>
12:30 – 12:45	<i>Commentary:</i> <b>Ádám Miklósi</b> (ELTE University, Dept. of Ethology, Budapest, Hungary)
12:45	<i>Lunch</i>
14:00 – 15:00	General Discussion of the Morning Session.
15:00 – 17:00	<b>Poster Presentations by the Young Scientists</b>
	<b>Tanya Behne</b> (Department for Comparative and Developmental Psychology, Max-Planck-Institute for Evolutionary Anthropology): <b>Inferring Communicative Intent: Infants' Use of Communicative Cues in a Hiding Game</b>
	<b>Ágnes M. Kovács</b> (International School for Advanced Studies (S.I.S.S.A.) Trieste, Italy): <b>Bilinguals' advantage in understanding other minds. What does this benefit mean?</b>
	<b>Henrike Moll</b> (Department for Comparative and Developmental Psychology, Max-Planck-Institute for Evolutionary Anthropology): <b>When can young children imagine what someone else sees when that differs from what they see?</b>
	<b>Hannes Rakoczy, Felix Warneken &amp; Michael Tomasello</b> (Department for Comparative and Developmental Psychology, Max-Planck-Institute for Evolutionary Anthropology): <b>Three-year-olds' understanding of different people's incompatible desires</b>
	<b>Luca Surian &amp; Stefana Caldi</b> (Department of Psychology, University of Trieste): <b>Motion perception and object individuation at 10 months of age</b>
	<b>József Topál, Zsófia Virányi &amp; Ádám Miklósi</b> (Department of Ethology, ELTE University Budapest, *Comparative Ethology Research Group, Hungarian Academy of Sciences): <b>Deductive inferring in dogs: Only when cues are socially mediated.</b>
17:00 – 17:15	<i>Short Coffee Break</i>
17:15 – 18:15	General Discussion of the Poster Session Chair: <b>Henrike Moll</b> (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany)
19:00	<i>Dinner at CEU Japanese Garden</i>

## Wednesday 7 July 2004

09:00 – 11:30	<b>Developmental approaches to understanding actions, minds, and artifacts.</b> Chair: <b>Tanya Behne</b> (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany) <i>Three 30-min talks each followed by an approx. 15 min discussion period.</i>
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**Wolfgang Prinz** (Max Planck Institute for Human Cognitive and Brain Sciences, Munich, Germany): **Prospective Coding in Event Representation**

**Josef Perner** (University of Salzburg, Austria): **Young children's objective notion of desire and emotions**

10:30 – 10:45 *Short Coffee-break*

10:45 – 11:30 **Malinda Carpenter** (Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany): **Understanding and Sharing Intentions in Infancy**

11:30 – 12:15 General Discussion of the Morning Session.

12:45 *Lunch*

14:00 – 15:30 **Teleological and mentalistic understanding of communication and reference: Efficiency, Rationality and Relevance. Evolutionary, Developmental, and Linguistic Perspectives.**

Chair: **Martin Kanovsky** (Slovakia, Faculty of Social Sciences, Bratislava)

*Two 30-min talks each followed by an approx. 15 min discussion period*

**Gergely Csibra** (Hungary, Centre for Brain and Cognitive Development, Birkbeck College London, UK): **Learning and social cognition: The case of pedagogy**

**Dan Sperber** (Institut Jean Nicod , EHESS and ENS, France)  
**Verbal comprehension as a form of mindreading**

15:30 – 16:00 *Coffee-break*

16:00 – 18:00 **General Discussion and Planning Collaborative Research Possibilities**

Chair: **György Gergely** (Institute for Psychological Research, Budapest, Hungary)

19:00 *Dinner and boat trip on the Danube*

**Thursday 8 July 2004**

Departure

## 5. FINAL LIST OF PARTICIPANTS

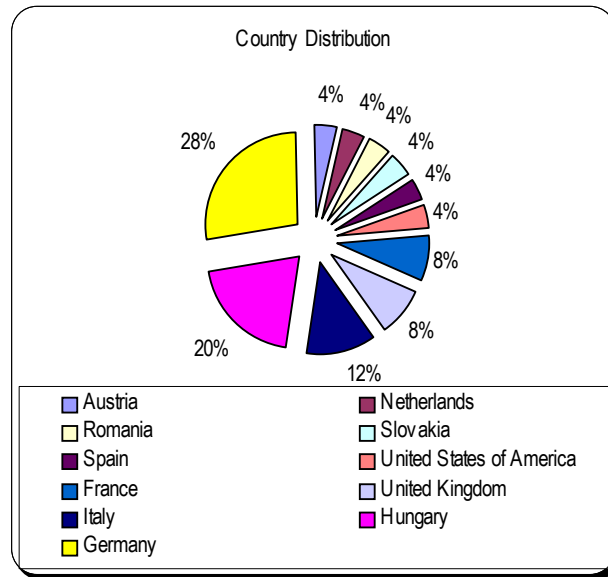
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21	Roessler	Johannes	Male	United Kingdom	Research Fellow	University of Warwick	Philosophy	United Kingdom	Warwick	CV4 7AL		(44) 02476 523421	J.Roessler@warwick.ac.uk	
22	Sperber	Dan	Male	France	Director of Research	Institut Jean Nicod , EHESS and ENS		France	Paris	75007	1bis av. Lowendal	+33 (0)1 53 59 32 80	dan@sperber.com	
23	Surian	Luca	Male	Italy	Associate Professor	University of Trieste	Psychology	Italy	Trieste	34134	Via St. Anastasio 12	39 040 5582703	surian@psico.units.it	
24	Topal	Jozsef	Male	Hungary	Assistant Professor	Eotvos Lorand University of Sciences	Ethology	Hungary	Budapest	H-1117	Budapest Pázmány P. sétány 1/c	(36) 1 3812179	topalj@freemail.hu, kea@axelero.hu	1964-Oct-18
25	Wohlschlaeger	Andreas	Male	Germany	Senior Researcher	Max Planck Institute for Psychological Research		Germany	Munich	D-80799	Amalienstrasse 33	49 89 38602-160	wohlschlaeger@psy.uni-muenchen.de, wohlschlaeger@mpipf-muenchen.mpg.de	

## 6. STATISTICAL INFORMATION ON PARTICIPANTS

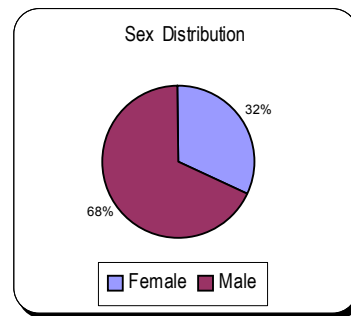
### Country Distribution

Austria	1
Netherlands	1
Romania	1
Slovakia	1
Spain	1
United States of America	1
France	2
United Kingdom	2
Italy	3
Hungary	5
Germany	7
<b>Total</b>	<b>25</b>



### Sex Distribution

Female	8
Male	17



### Position

Assistant Professor	2
Associate Professor	2
Lecturer	1
Ph.D Student	2
Post-Doctoral Fellow	2
Professor	8
Research Fellow	5
Researcher	3

