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ability action agent ai animal attention behavior beliefs brain
cognitive competence complex computational concepts
context control cultural development environment evidence
evolutionary existence experience experimental form formal function general
grammar human individual information input intelligence interaction
internal interpretation knowledge language learning
linguistic logical meaning mechanisms memory mental methods
mind models networks neural neurons neuroscience object operations
organization perception perceptual perspective phenomena philosophical philosophy physical principles
problem processing properties psychology
rational reasoning recognition reference relations relationship relatively represent
representations response science selection semantics sensation sense
sensory sentences social states structure subject symbolic
systems theory thinking thought understanding various vision visual words

COGNITIVE SCIENCE SEMINARS

CogSci in Germany, CogSci in Turkey

23 May 2014

**METU Cultural & Convention
Center-Hall A**

**[www.ii.metu.edu.tr/
cognitive-science-seminars](http://www.ii.metu.edu.tr/cognitive-science-seminars)**

09:00 - 19:00

The Scientific Committee

- Nazife Baykal, PhD
- Deniz Zeyrek Bozşahin, PhD
- Cem Bozşahin, PhD
- Erol Özçelik, PhD

The Organization Committee

- Annette Hohenberger, PhD
- Ceyhan Temürcü, PhD
- Murat Perit Çakır, PhD
- Cengiz Acartürk, PhD

PREFACE

The fifth of "METU Informatics Institute Cognitive Science Seminar" took place on May 23, 2014 at the Middle East Technical University (METU) Cultural and Convention Center KKM-A. The seminar had the title "CogSci in Germany, CogSci in Turkey". The seminar was conducted within the framework of German-Turkish Year of Research, Education and Innovation 2014. The seminar brought together cognitive science researchers from Turkey and Germany, and sowed the seeds of long-term research collaborations between Turkish and German Institutes. The speakers and attendees involved both senior researchers and junior researchers from both countries. Researchers and students from universities and research centers in Tübingen, Hamburg, Bielefeld, Potsdam, Osnabrück in Germany, and researchers and students from METU, Koç University, Yeditepe University, Marmara University, Şehir University were attended to the seminar, among many other institutions in Turkey. The seminar was conducted as a whole-day seminar, in which six speakers from Germany and seven speakers from METU Cognitive Science Department presented their research studies. The seminar also included 21 poster presentations from young researchers (graduate students at METU Cognitive Science Department) and 6 doctoral-level researchers from the universities in Germany. We hope that this seminar will initiate long-term collaborations between Turkish researchers and German researchers in cognitive science and related domains of research.

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Presentations

I. Cognition and Interaction

- **Interaction through Eye Movements**

Cengiz Acartürk, METU

Eye movement recordings have been employed as a measure of cognitive processes under certain framework assumptions since the past several decades. The robustness of eye movement data results in an intense use of eye movement protocols in various research domains, including reading, language comprehension, and multimedia learning. Moreover, the use of eye movements as a method of interaction has been gaining broader interest as the eye tracking technology makes eye trackers more accessible and affordable. In this talk, I will present theoretical and applied research conducted by three newly setup research groups at the Cognitive Science Program of METU Informatics Institute: (i) The Eye Tracking Research Group recently focuses on developing eye Movement event extraction and classification models by merging data from human annotators and data obtained through automatic clustering algorithms. (ii) The Multimodal Interaction Research Group focuses on human-computer interaction and communication through sensory modalities (vision, haptics) and communication by means of depictive representations (statistical graphs and diagrams). The group recently focuses on designing gaze-contingent interaction methods for simulation of haptic exploration by visually disabled persons. The group also conducts research on the role of gestures and graphical cues in multimedia learning environments. (iii) The Reading Research Group studies cognitive aspects of reading in Turkish. Recently, the group aims at developing a corpus of Turkish reading patterns for eye movement control modeling.

- **Geometric Concepts in Multimodal Interaction**

Christopher Habel, University of Hamburg

Spatial representations are essential for recognizing objects and events from different sensory channels, e.g., by visual, haptic or auditory perception. Locomotion and body movement are based on such information, as well. Beyond perception and motor action, higher cognitive capacities such as memory, problem solving, and planning are based on spatial representations. Furthermore, communication, which can be seen as production and comprehension of external representations, makes systematic use of spatial representations, for example in the communicational modalities of language, gestures, graphs, maps. In language, spatial expressions are used not only for communicating about space, but also in other domains, such as time and number. The pivotal role of spatial representations for connecting communication, cognition, and perception is based in their modal non-specific nature, described as 'amodal', 'heteromodal' or 'multimodal'. In the present paper I will argue for a layer of geometric representations of abstract spatial concepts to be used in integrating multimodal processing.

- **Embodied Cooperative Systems: From Tool to Partnership**

Ipke Wachsmuth, University of Bielefeld

One of the most basic mental skills is inferring intentions – the ability to see others as intentional agents and to understand what someone is doing – which, in conjunction with attentive processes, brings about shared intentionality. In this, different aspects of "mind-reading" abilities (Theory of Mind) are important. Understanding others' intentions and representing them as being able to understand

intentions, are relevant factors in coordinating actions, as is the ability to represent shared goals and coordinated action plans (joint intentions). The incorporation of all these levels of intentionality will also help endow technical systems with collaborative functionality. Such systems are often embodied as robotic agents or as humanoid agents projected in virtual reality ("embodied cooperative systems"). In these contexts, the view that humans are users of a certain "tool" has shifted to that of a "partnership" with artificial agents, insofar they can be considered as being able to take initiative as autonomous entities in cooperative settings. A central research question is how the processes involved interact and how their interplay can be modeled. For example, inter-agent cooperation relies very much on common ground, i.e. the mutually shared knowledge of the interlocutors. Nonverbal behaviors such as gaze and hand gestures are important means of coordinating attention between interlocutors ("joint attention"). We will outline these ideas taking the virtual humanoid agent "Max" as an example.

- **Computerized cognitive behavioral therapy in depression**

Didem Gökçay, METU

Depression is a debilitating disease declared as number four cause of disability by World Health Organization. Treatment of depression varies drastically based on the level and duration. Medication and therapy are two major treatment options. Problems in conflict resolution are among the prominent deficits reported in depression. Patients' incorrect interpretation of ambiguous – or conflicting – social situations create a vicious circle that feeds recurrent negative thoughts and mood. Our group METUNEURO has focused on investigating neural correlates of depression using neuroimaging techniques. Our main interest was revealing differences in the executive functioning circuits in the

prefrontal cortex and the limbic areas. We used DTI and fMRI techniques so far. In this talk, our involvement in a new EU project, MasterMind will be discussed. MasterMind consists of 21 partners from 8 countries in Europe that came together to develop and test computerized cognitive behavioral therapy modules in a wide population of 5000 participants. While therapy techniques vary from acceptance to behavioral modification, cognitive behavioral therapy focuses more on problem solving and revival of reduced executive functions. Unfortunately, administration of face to face cognitive behavioral therapy is not available for a wide set of patients. In this talk, the interactions involved during the course of cognitive behavioral therapy to improve problem solving abilities will be discussed. These interactions can be carried to computerized offline platforms, where messaging is the main facilitator of communication. During the presentation, efficiency and effectiveness of computerized versus face to face interaction will be elaborated and probable improvements in computerized interventions in problem solving will be suggested.

- **Multimodal Analysis of Joint Action and Distributed Cognitive Processes**

Murat Perit Çakır, METU

Joint action is a relatively new line of research in cognitive science that investigates how perceptual, motor and cognitive activities of two or more individuals are organized into coherent, coordinated action. Simultaneous recordings of eye gaze and neural activity with dual eye tracking and EEG/fMRI/NIRS hyperscanning techniques offer important empirical resources for the multimodal analysis of social interaction and its cognitive implications. This talk will provide a brief overview of our ongoing studies on joint action at ocular, neural and behavioral levels in

naturalistic computer-mediated dialog settings at the Cognitive Science Program of METU Informatics Institute. At the ocular level, we focus on how the degree of gaze overlap changes in relation to the use of linguistic devices such as referring expressions, which are used by interlocutors to mutually orient toward each other and to the relevant objects in the shared scene. At the neural level, we investigate circumstances in which inter-brain synchronization at the prefrontal cortex is modulated by joint activities that involve synchronization of actions at the behavioral level as well as their systematic distortion. At the behavioral level, we focus on longer episodes of collaborative problem solving activities where small groups of participants make meaning together by enacting the affordances of an online collaboration environment with shared drawing and chat features. The talk will summarize some of the preliminary findings from our ongoing studies on joint action across multiple levels and modalities, and briefly discuss the theoretical significance and methodologically challenging aspects of joint action research.

- **Mental model construction from text and pictures: Evidence for construction of a spatial scaffold**

Katharina Scheiter & Alexander Eitel, University of Tübingen

In research on learning from text and pictures (i.e., multimedia) it is assumed that learners first organize the information from both representational formats separately and then integrate them into one coherent mental representation. There is however no process data to support this view. Moreover, it seems implausible that learners will first attempt to understand each information source in isolation without making any use of the information represented in a complementary format. In the present talk, I will report on studies that challenge this

view by suggesting that there is interplay between text and picture processing and that this interplay affects comprehension. A first line of research on the use of signals to guide learning with multimedia suggests that the earlier students attend to the picture in learning with multimedia materials, the better their learning outcomes, thereby suggesting that information extracted from the picture affects subsequent processing. A direct test of this assumption was deployed in the second line of research, where we investigated how (brief) initial picture inspection facilitates the process of learning from text. A series of studies provided evidence for the assumption that a causal system's global spatial structure can be rapidly extracted from a picture and used as a mental scaffold to facilitate mental model construction from text (i.e., scaffolding assumption). In particular, the mental scaffold extracted from a pictorial representation was shown to be reactivated in memory during text processing, it lead to faster reading of verbal spatial information and resulted in deep comprehension compared to conditions in which no mental scaffold was available. In sum, the results are better with a notion of comprehension, where information from different codes are integrated into one mental representation from the very beginning.

II. Cognition and Language

- **The Dynamics of Eye Movements and Attention During Reading: Contributions of Cross-Language Comparisons**
Reinhold Kliegl, University of Potsdam

Differences between languages and how they are written give us unique opportunities to address three controversial issues in eye-movement

control during reading. The three issues are (1) whether the predictability of the next word influences fixation durations before the eye gets to the word; (2) whether we can get the meaning of words before we look at them; and (3) whether information other than initial letters and word length of the next word influence where we send the eyes. Eye movements collected from reading German, English, Spanish, Chinese (both simplified and traditional), and Uighur suggest affirmative answers to these questions.

- **Discourse annotation and discourse processing**

Deniz Zeyrek, METU

Discourse processing is the term used to describe natural discourse comprehension activity. Turkish Discourse Bank (TDB) research team is interested in discovering and identifying discourse components to the extent they are encoded by connectives (and, but, however, etc.). TDB is an annotation effort, where the starting point is that connectives have a discursive function, which can be determined by examining whether they link abstract objects (Asher, 1993). We annotate connectives as discourse-level predicates with (binary) arguments. Creating an annotated corpus is an iterative process and it is the linguistic goal which enables the research team to stay in focus. This talk will briefly mention our goals, the annotation cycle, and our gold standard. It will also give a quick overview of our current research on discourse structure.

- **Changing preference patterns for vowel harmony in Turkish infants in their first year of life**

Annette Hohenberger, Aslı Altan, Utku Kaya, Özgür Köksal Tuncer, Enes Avcu, METU

In a longitudinal study with 6- and 10-month-old monolingual Turkish infants we ask whether and if so, at what age, monolingual Turkish infants become sensitive to backness and rounding vowel harmony in morphologically complex stem-suffix sequences. Using a head-turn paradigm, listening times between 6 vowel-harmonic and 6 vowel-disharmonic lists are compared. Cross-sectional as well as longitudinal analyses on listening times and numbers of listening episodes reveal a significant interaction between age*harmony: 6-month-olds prefer listening to harmonic words (familiarity preference) whereas 10-month-olds prefer listening to disharmonic words (novelty preference). These results provide evidence that the acquisition of Turkish vowel harmony is readily discernable at 6-months of age and undergoes a significant change of preference towards the end of the first year. Theoretical implications of our findings are briefly discussed.

- **The role of sensorimotor processes in meaning composition**

Barbara Kaup, University of Tübingen

According to the embodied-cognition framework of language comprehension, sensorimotor processes play an important role for meaning composition: During language processing, comprehenders are assumed to mentally simulate the objects, situations and events referred to in the linguistic input. More specifically, it is usually assumed that words automatically activate experiential traces in the brain that stem from the comprehenders' interactions with the referents of these words. When words appear in larger phrases or sentences, the activated experiential traces are presumably combined to yield an experiential simulation consistent with the meaning of the larger phrase or sentence. Abstract concepts are assumed to be captured in these simulations by being metaphorically mapped onto more concrete

experiential dimensions, and linguistic operators such as negation or disjunction are typically considered to function as cues controlling specific integration processes.

I will report on-going research projects investigating these assumptions. If time allows, I will also present some preliminary results from experiments investigating developmental aspects, as well as from studies looking at second language processing, which shed further light on the embodied-cognition framework.

III. Philosophy of Cognitive Science

- **The Limits of Thought? Complexity, computation, and cognition**

Tarek R. Besold, University of Osnabrück

Starting out from the computer metaphor of the mind on the one hand, and the Church-Turing thesis on the other hand, the recognition that human minds/brains are finite systems with limited resources for computation has led researchers in cognitive science to advance what is known as the Tractable Cognition thesis: Human cognitive capacities are constrained by computational tractability. Of course, this thesis has far-reaching consequences for formal theories and models of cognition in areas such as cognitive modelling, philosophy of mind, and cognitive AI: New computational constraints on theories and models are introduced, possibly disqualifying hypotheses which might otherwise have been conceptually appealing.

In my talk, I will introduce the overall framework of the "Tractable Cognition thesis", present its currently most prominent form (based on notions from parameterized complexity theory), argue for the thesis' meaningfulness, and show several application examples. Finally, I will consider the implications acceptance of the thesis has not only for work

in (theoretical) cognitive science and cognitive modelling, but also for endeavors in cognitive AI.

- **Can Computation Give Rise to Meaning?**

Cem Bozşahin, METU

Computation is commonly regarded as a stand-alone formal mechanism. It does require an interpretive/executive substrate to do its work: a brain for humans and animals (if they are doing computation), and a virtual machine for computers, eventually reaching hardware. We know that the human brain is capable of causing meaning. We don't know whether computation in the abstract sense is capable of doing the same in all interpretive/executive substrates. Using examples from language, I try to show that natural and artificial minds might be facing the same problem of constructing meanings if their computations are supported by their own "right stuff", a mechanism which is capable of execution. This seems to require two channels of intake, rather than one as one would expect if computation were a stand-alone formal mechanism. We may not be able to look into wetware/hardware to see if there is any meaning in there, because it is a process rather than an object, but computationalism may be able to construct a causal history of how a form can come to be associated with a meaning.

- **Beyond what is said: Conventional implicature everywhere**

Ceyhan Temürcü, METU

Grice's (1975) mechanism of conventional implicature describes aspects of utterance meaning which are both (i) conditioned by linguistic strategies (i.e., associated with certain lexical items or grammatical

elements) and (ii) not part of what is what is said (i.e., what is explicitly conveyed). Grice originally applied this mechanism to the analysis of the English conjunction “but”, as directly expressing logical conjunction and implying contrast. Following this analysis, conventional implicatures have generally been limited to the implication of non-truth-conditional aspects of meaning.

In this talk I will try to show that a generalized notion of “conventional implicature”, as “deliberately signaling implications beyond what is said by conventional strategies”, provides us a valuable tool for semantic analysis, especially in the area of tense, aspect and mood (TAM). I will argue that this mechanism is associated with grammatical strategies for perfect and prospective aspects, inferential evidentiality, as well as all finite (assertive and directive) moods. More specifically, I will show that these grammatical strategies express, along with direct semantic content, causal, epistemic and intentional types of “current relevance” (CR). Among these, intentional CR will be argued to be involved in the communication of speaker’s illocutionary intentions, establishing a bridge from conventional mood indicators to illocutionary force.

- **Understanding the Meaning of What is Said**

Marcus Kracht, University of Bielefeld

According to the standard picture of semantics, understanding the meaning of a sentence involves unpacking the meanings of the words and inserting them into some representation. If that is so one wonders why certain meanings are impossible to “get” while others are unproblematic. In this talk I propose a theory of the process of understanding that makes this a little more plausible. According to this theory, hearers try to understand a sentence by seeing how they can arrive at a judgement that the sentence is either true or false. However,

there are limitations on how complex the mental routine can get. This leads to the following picture: while a representation can at least syntactically be as complex as one likes, it is not always possible to understand what it actually says.

Posters

- **Yes is right: Classification of /Yes/ and /No/ and Bimanual responses**

Irmgard de la Vega, Carolin Dudschig, Barbara Kaup, University of Tübingen

Recent investigation has hinted at a compatibility effect for the classification of the words yes / no and movement direction on a sagittal plane, which is interpreted as evidence for an embodiment of yes and no. A different line of research has found evidence for the association of positive and negative valence to the dominant and non-dominant hand. We investigated whether a compatibility effect when classifying yes and no emerges for the dominant and non-dominant hand. Right-handed participants classified the words yes and no by responding with their right or left hand. Shorter response times showed for classification of yes with the right hand, and for classification of no with the left hand. We discuss this compatibility effect between yes/no and the dominant versus the non-dominant hand within the embodiment framework, as well as in relation to the polarity correspondence hypothesis.

- **To be or not to be? The influence of negation of sensorimotor simulation processes during sentence understanding**

Carolin Dudschig, Irmgard de la Vega, Barbara Kaup, University of Tübingen

To date, converging evidence suggests that language understanding is closely coupled with sensorimotor processes. Here we investigated whether negation is automatically integrated in these simulation processes during language understanding. Participants read sentences describing entities either in an upper or lower location (e.g., “The kite flies in the sky”) or their negated counterparts (e.g., “The kite does not fly in the sky”). Subsequently, a colored dot was presented in the center of the screen, and participants responded by an upward or downward arm movement according to the color of the dot. In line with previous studies, responses were faster in conditions in which the response direction matched rather than mismatched the meaning of the location word in the sentence (e.g., an up response after reading a sentence mentioning “sky” compared to a sentence mentioning “ground”). However, importantly the negation operator modified this interaction between the location words and the response direction. These results suggest that participants automatically integrated the negation into their simulations during sentence comprehension. Implications for the simulation view of language understanding will be discussed.

- **Wind and Warmth in Virtual Reality**

Felix Hülsmann, Nikita Mattar, Julia Fröhlich, Ipke Wachsmuth, University of Bielefeld

Creating presence is one of the central points in Virtual Reality (VR) research. A high level of presence can be achieved for example due to

the reasonable combination of feedback modalities. In this area, issues like creating acceptable sound and graphics have been mainly solved. But how can further everyday sensations like an airflow during navigation tasks or the heat of a fire in a rescue scenario be also made perceivable in VR? First approaches proved to be able to increase user's presence, but only few work has been published in this field.

For filling this gap, first, a set of requirements concerning a possible hardware and software setup is described. The actual hardware setup, embedded in a three-sided CAVE environment, consists of eight fans for creating wind and six customized infrared lamps for creating heat stimuli. The applied software model basically extends a model for representing sound in VR developed by Fröhlich and Wachsmuth: Wind and warmth sources are handled as nodes in the application's scenegraph structure and are calculated similar to light sources in the Phong lighting model. The calculation of the influence of virtual wind and warmth sources on the scene and on the activation of the hardware devices is performed in a dedicated server. An evaluation highlights the technical functionality of the system: Requirements are satisfied and the system is able to simulate wind and warmth in realtime applications. A pilot study shows statistical trends indicating an increased level of presence due to the use of wind and warmth.

- **Analysing Human Face-to-Face Interactions in Shared Space**

Patrick Renner, Thies Pfeiffer, University of Bielefeld

To enable robots to solve complex tasks cooperatively with humans, they need to understand natural human communication. To achieve this, robots could benefit from a deeper understanding of the processes that humans use for successful communication. Especially gaze behavior

is important for implicitly communicating our attention and thus intention, so that a common goal can be reached. We, e.g., use the mechanism of joint attention or coordinate our gaze and gestures: Fixations to reaching targets are known to precede the gesture. To identify appropriate communication strategies which enable robots to communicate more robustly requires studying humans in free interaction. In our work, the focus lies on interactions in shared space. Here, we investigate face-to-face interaction in a route planning scenario: Participants are to plan paths to rooms on three different floors on floor plans located on a table between them. The difficulty of the task is increased by introducing blockings in the hallways: Detours have to be planned, which leads to more complex interactions. In the experiments, gaze and pointing directions were recorded as well as the head positions of the participants. As analyzing eye tracking data usually requires time-consuming manual annotation, an automatic approach was developed combining fiducial marker tracking and 3D modeling of stimuli in virtual reality. In particular, setup and task of the study will be presented on the poster as well as results in the area of manual interaction, gaze-based communication and role dynamics. These may serve as a starting point for implementing relevant behaviors on robots.

- **Learning with Digital Textbooks: Investigating the Effectiveness of Signaling Measures**

Juliane Richter, Knowledge Media Research Center (KMRC),
University of Tübingen

Increasing digitalization and therewith the omnipresence of digital devices, such as laptops or Tablet PCs (TPCs), impacts many areas of our life. Accordingly, they also find their way into the educational sector. This trend implies that students increasingly use digital textbooks rather

than the well-established paper-based variant. Therefore, it is crucial to know how well digital textbooks are suited to foster learning in general. When learning with digital textbooks the relevant information is distributed across two levels of organization – the microstructure, which contains multimedia content elements and the macrostructure, which comprises the global organization of larger content units. Successful learning with digital textbooks thus requires integrating multimedia elements on the microlevel and navigation between larger units on the macrolevel. The cognitive demands resulting from these integration processes may be too high. Therefore the first study of this dissertation project aims to investigate how signaling the relations between external representations on the microstructure may guide students in this effort. In further studies the effectiveness of macrostructure signals, such as an interactive graphical overview, will be investigated. The learning material for these studies was developed based on design recommendations derived from instructional design/multimedia and chemistry education research in the interdisciplinary DFG project “eChemBook”. The prototype consists of one textbook unit that provides an introduction to the Particle Model of Matters that is taught in introductory chemistry education.

- **Task demands in ambiguity resolution**

Pavel Logačev, Shravan Vasishth, University of Potsdam

Traxler et al. (1998) found that ambiguous sentences such as (1a) are read faster than their unambiguous counterparts, such as (1b). Van Gompel et al. (2001) proposed the unrestricted race model (URM) to explain this so-called ambiguity advantage. According to the URM, the parser tries to construct all permissible structures simultaneously in ambiguous conditions and terminates structure-building as soon as the

first parse has been constructed. Thus, the average attachment time is longer in unambiguous sentences, where only one structure can be constructed.

(1a) The son of the driver who had a moustache was pretty cool.

(1b) The car of the driver who had a moustache was pretty cool.

Swets et al. (2008) have challenged the URM. They argue that readers underspecify the representation of ambiguous sentences, unless disambiguation is required by task demands. When disambiguation is required, however, readers assign sentences full structure — and they provide experimental evidence seemingly supporting this conclusion. We show by simulation that Swets et al.'s findings are compatible with the URM. However, we found evidence for task-dependent parsing in a German self-paced reading study. We asked participants questions encouraging them to build multiple parses in the ambiguous condition and found that ambiguous sentences were read more slowly than their unambiguous counterparts. This finding suggests that the parser is susceptible to task-demands. Furthermore, we present the first quantitative model of task-driven disambiguation (the stochastic multiple-channel model of ambiguity resolution, SMCM), which subsumes the URM, and show that it can account for our findings.

- **Discourse connectives and lexical cohesion: an experimental investigation of bi-clausal sentence processing in Turkish**

Gökhan Gönül, METU

It is a widely accepted fact that coherent texts enable text comprehensibility. A major source of coherence is discourse cohesion (textual properties of the text). Lexical cohesion (e.g. synonymy) and discourse connectives are two major types of discourse cohesion. We investigate the contribution of these two types of cohesion to the

overall comprehension of bi-clausal sentences in Turkish. In a two-phase study, we ask the participants to judge the comprehensibility of sentences while we obtain eye-gaze data and then ask them to write recall protocols. We find that lexically cohesive sentences (labeled as high coherent) are judged more comprehensible and recalled better, and that in low coherent sentences (those lacking lexical cohesion), the fixation counts are high. This study shows that in short texts, lexical cohesion guides coherence and can be singled out as an important factor of discourse comprehension. The study concerns Turkish discourse and may have implications on discourse coherence and discourse comprehension in other languages.

- **Timing in the Dual-task Paradigm and Serial Bottleneck**

Halil Duzcu, METU

Serial bottleneck and capacity sharing accounts are rival theories on information processing in the human mind. Although both serial and parallel processing is well defined in general, there are still controversial theories regarding the timing mechanisms, i.e., whether a primary timing task can co-occur with central processing of some other task or not. The serial central bottleneck approach provides an explanatory background which is based on the PRP (Psychological Refractory Period) paradigm. On the other hand, the capacity sharing theory emphasizes parallel processing which explains some findings of dual-task interference about intentional attention resource allocation in timing. Two rival models on timing (internal clock and attentional gate model) will be discussed considering their roots in the previously mentioned information processing frameworks, namely serial bottleneck and capacity sharing. Research questions and a dual-task experiment will be proposed to investigate the nature of the timing mechanism.

- **Morphological Segmentation of Turkish with a Dirichlet Process**
Serkan Kumyol, METU

This research is based on morphological segmentation for the Turkish language. Turkish is an agglutinative language which makes it morphologically complex. Hence, the process of morphological segmentation of Turkish requires sophisticated methods in order to cope with the morphological complexity and understand the distribution of morphemes. This research addresses morphological segmentation by employing unsupervised and semi-supervised learning. We employ unsupervised learning for the baseline model, whereas we apply semi-supervised learning for our model. The research aims to show the following two points: (i) Learning by frequencies is a suitable model for Turkish language acquisition (ii) In the processing of Turkish morphemes a Dirichlet process is revealed.

- **A Computational Study on Learning Theories and the role of Planning in Maze-Learning Environments**
Ece Takmaz, Cem Bozşahin, METU

In the literature of maze-learning experiments, there exist different explanations of what the animals exactly learn when running around in a maze and finding paths to the rewards. One of the explanations for the learning behaviour is that it consists of conditioning and reinforcement in the presence of a reward. This kind of learning is response-learning in which the animals simply remember the sequences of movements they made and the responses they get from these movements. However, Tolman's place-learning experiments introduce a rather distinct idea, namely that organisms create and fill in cognitive maps representing the spatial layout of the environment. In this kind of

learning, which is supported by latent learning, reinforcement is claimed to be not necessary. According to the place-learning account, when the rats run the maze, they pick up information about the spatial layout and store them in certain kinds of representations, even when there is no reward at the end. One crucial claim we will take into consideration is that complex behaviour occurs with the help of prior planning and hierarchical organization, which indicates the compositionality of the learning and planning behaviour. In this study, these claims about the nature of the learning and planning behaviours taking place in simple maze-learning environments will be studied from a computational approach and an Artificial Intelligence perspective with the help of Planning with Knowledge and Sensing (PKS), a knowledge-based planner. Additionally, we would like to explore the contribution of certain landmarks or perceptual cues to the learning and planning processes.

- **The Investigation of Cognitive Processes in Reading: Development of a Corpus of Turkish Reading Patterns for Eye Movement Control Modeling**

Figen Beken, Emine Eren, Cengiz Acartürk , METU

In this project, a corpus of Turkish reading patterns through eye movements will be developed by eye-tracking techniques, which is of particular importance in the reading research area, especially for computational models of reading patterns. There are three major factors that influence reading which are “the frequency of the use of the word in daily language”, “the length of the word”, and “the predictability of the word in sentential context”. However, the research on the influence of word length is limited by the structural limitations of languages in constructing long words. As an agglutinating language,

Turkish provides an appropriate application environment for word length research, by allowing the construction of long words by means of adding suffixes to roots. The current study presents an investigation of the effects of word frequency and word length on fixation durations.

- **Understanding Conceptual Processes during the Resolution of Paradoxes**

Tuna Çakar, Annette Hohenberger, METU

This dissertation mainly focuses on human conceptual processing and how people reason during resolution of a given paradox, the ship of Theseus. This paradoxical problem has been described by several philosophers and related to the definition of “sameness” or “identity”. Subjects have initially been asked to approve or disapprove to a set of propositions which are directly related to the core concept involved in the paradox. A statistical model has been developed to predict the final decision of the participants given the approval or disapproval of these initial propositions. This empirical study also aims to demonstrate by means of behavioral experimentation the factors involved in conceptual and reasoning processes. In a series of behavioral tasks various factors have been studied that might affect subjects’ reasoning processes. Among them are spatiotemporal proximity of the original and reassembled ship, presentation of visual aids (via a visual illustration of the disassembly process), and bodily experience via two wooden model ships. The obtained results have so far shown that these manipulative factors have probably a milder level of impact on reasoning processes than initially expected. Furthermore, this research project also aims at studying the neural underpinnings of the reasoning processes and the acquired ERP markers during the assessment of core conceptual

propositions which might be used as indicators of the decisions of the participants.

- **A Semi-Supervised Algorithm for Eye Movement Event Detection**

Ozan Deniz, Cengiz Acartürk, METU

Various algorithms have been developed to detect eye movement events (e.g., fixations and saccades) from raw eye movement data. Recent state of the art algorithms mostly rely on rule-based algorithms that exhibit varying performance depending on the quality of the eye movement recording, as well as the characteristics of the stimuli (e.g., visual scene vs. written text). Those variations have led researchers to perform manual annotation of raw eye movement data because the human eye is the most efficient eye movement event detector itself. The performance of manual annotation can hardly be achieved by any available eye movement algorithms. However, manual annotation is a labor-intensive effort. In the present study we develop a semi-supervised method of analysis which merges human annotation with automatic clustering algorithms. Our initial analyses reveal satisfactory performance of the model under various stimulus conditions.

- **Investigation of Risk Taking Behavior and Outcomes in Decision Making with Modified BART**

Kemal Taşkın, METU

Responses to risky choices were collected and analyzed in a continuous, engaging and decomposable risk taking task; a slightly modified version

of BART (Balloon Analog Risk Task; Lejuez, et. al., 2002). Participants were also given a prior survey, which allowed monitoring of individual risk taking attitudes. A thorough analysis of responses indicates a dynamic system that guides the participant through risk taking or aversive states. Participants' actions was predictable from their individual natural risk-taking tendency, as well as previous actions and previous state of the experimental setup. These findings may lead to a model that fuses affective and cognitive aspects within risky uncertain decisions.

- **The development of episodic cognition and mental time travel in Turkish preschoolers: what, where, and when**

Gülten Ünal, METU

The purpose of this study was to investigate the development of episodic cognition and mental time travel and their underlying cognitive abilities in Turkish preschoolers (age range: 3-5 years). Children took part in two main tasks, a what-where-when (www) task and a future-prediction task. In addition, five additional tasks were used for predicting children's performance in the two main tasks: the Day-Night Stroop Task, the Corsi Block Tapping Task, a story-telling task to measure usage of future-tense, a counter-factual thinking task, and an episodic memory questionnaire. Results indicated that besides age, the www task could be predicted by the Day-Night Stroop task, the story-telling task, and the episodic questionnaire. This might show that the www task could depend on executive functions and language abilities as well as episodic cognition. The future-prediction task could be predicted interchangeably by the story-telling task and the counter-factual thinking task which might indicate that episodic future thinking requires linguistic and/or counterfactual thinking ability.

- **Towards a Turkish Psycholinguistic Database: A Corpus Based Study on Age of Acquisition and Imageability**

Elif Ahsen Tolgay, Deniz Zeyrek, Murathan Kurfalı, Cem Bozşahin, METU

Psycholinguistic databases are reliable and practical sources for research purposes, since they provide standardized stimuli for studies. Common variables used in psycholinguistic studies consist of but are not limited to: frequency, number of letters/phonemes/syllables, neighborhood, age of acquisition, imageability, concreteness etc. Because these variables seem to be language-specific, there is a need for a database for each language. The present study will be a starting point for a Turkish psycholinguistic database. Age of acquisition (AoA) and imageability ratings will be included besides quantitative variables (frequency, number of letters etc). Moreover, a corpus based comparison analysis with child literature and adult written sources will be conducted for AoA ratings in order to discriminate early and late acquired words. The corpus based analysis is expected to give an objective measure for AoA ratings. This poster will present the ongoing efforts towards constructing this database, such as the collection of child literature texts, the preparation of these texts for analyses, and preliminary analyses (e.g. word count, raw frequency).

- **Bottom-Up Parsing of Linear Indexed Grammars: Proposing a Generalized LR Parser**

Adnan Öztürel, METU

Automata theoretic approaches enable us to study cognitive faculties from a computational perspective, while having the potential to deliver working models of cognition as a whole when all unified together.

Inevitably, linguistic research have been greatly benefiting from automata theoretic explanations. However, recent studies also illustrate that cognitive faculties other than language, specifically planning, can also be studied and modeled using tools from automata theory. Linguistic research have illustrated that natural languages are not context-free since they exhibit limited cross-serial dependencies, which overshoots the power of context-free grammars, and since then interest in restricted formalisms that work beyond context-free grammars that can be used to analyze syntactic disposition of natural languages are of great interest. In parallel, within the planning literature it has been argued that particularly deliberative planning requires a device that is powerful than the class of automata that can recognize context-free string languages. These findings may illustrate a potential relation between language and planning in terms of automata-theoretic devices that are used by both faculties. In this work we propose a Generalized LR parser for Linear Indexed Grammars that can be used as a common-purpose tool for syntactic analysis of both natural language and planning, and maybe more. Particularly, it is proposed that growth of the graph-structured stack of the parser might be used as a novel metric for studying ambiguity in grammars of this type and that representing ambiguity within the parsing automaton might have potential implications in analysis.

- **Contour Exploration Procedures with Limited Field of View**

Ülkü Arslan Aydın, Cengiz Acartürk, METU

Even though visual perception is known as the main contributor for processing of contour information, tactual perception has, as well, an effect on object recognition by extraction of particular object properties such as shape, size, volume, and so on. Selection of appropriate contour

exploration procedure (CEP) depends on the given task. For instance, the goal of searching for a critical features of a contour requires processing of broad scope information in relatively low precision, whereas the goal of comparing contour parts of an object requires narrow scope information in a high precision. Scope and encoding precision of contour processing determines the parameters of CEP. These parameters are number of effectors, coordination between effectors, number of explored parts of an object and persistency of exploratory pattern. Visual perception and tactual perception have differences in sensory processing. Visual perception can be distal, instantaneous and global and also can produce high precision information. On the other hand, tactual perception is generally contiguous, sequential and local and also produce low precision information. These kind of differences might account for visual contour exploration being much easier than tactual contour exploration. But how would performance change, if visual stimuli is given in a limited field of view? We are planning to investigate visual contour explorations and whether tactual explorations can be modeled by using gaze-contingent moving window paradigm. According to moving window paradigm, only the parts are visible where participant is looking at and visibility change based on gaze locations.

- **Nouns-first, Verbs-first and Computationally-Easier first: A Preliminary Design to Test the Order of Acquisition**

Enes Avcu, Cem Bozşahin, Deniz Zeyrek, METU

Studies on early lexical development have largely focused on infant's early word production. The primary accounts for early lexical differences can be broken down into two distinct theoretical positions that either defend early noun acquisition or provide evidence that challenges this

account. Noun-first view states that verbs are cognitively more complex for children to acquire than nouns and this accounts for the difference in their acquisition across several languages. The counter evidence to noun-first view, which claims verbs can also appear early, reveal that the caregivers use significantly more verbs, and more salient cues to the category of the verb. This work is trying to bring a computational perspective to the problem of early lexical acquisition of words. It is a preliminary investigation to see if the underlying mechanism relates to computational complexity by which short, frequent and unambiguous words are supposed to be acquired first; and long, ambiguous or infrequent words (including nouns) are predicted not to be acquired early. This study assumes there is a computational bias in the infants' mind toward frequent, short or unambiguous strings because these aspects can be shown to ease the task computationally.

- **The Role of Evidentiality in Argumentation in Turkish within a Bayesian Reasoning Framework: Arguments from ignorance**

Hatice Karaaslan, Annette Hohenberger, METU, Hilmi Demir, Bilkent

To what extent arguments are acceptable or fallacious is an important topic of research (Oaksford & Hahn, 2004). In the face of uncertainty in our everyday lives, the rules of logic do not seem to suffice to define acceptable or bad reasoning (Hahn et al., 2009). Thus, complementary theories are required to compensate for the missing focus on content-related elements in argumentation, especially in seemingly fallacious arguments such as arguments from ignorance. Bayesian probability appears to be a good candidate offering epistemic norms for argumentation (Oaksford & Chater, 2004). Within the Bayesian framework, argument strength is determined by the interactions

between three factors including prior belief, polarity and source reliability. Bayes' theorem considers prior beliefs and provides an update rule for the degree of belief associated with the conclusion in light of the evidence (Hahn et al., 2005). A specific type of arguments from ignorance and evidentiality, a feature in Turkish, are investigated in this study. The hypothesis is that argument acceptance is expected to vary depending on the presence of and the kind of evidentiality, marked with overt morpho-syntactic markers (-DI or -mİş) (Aksu-Koç, 1988; Aikhenvald, 2004). The dialogues manipulating evidentiality along with prior belief, polarity and reliability were presented in booklets to 114 university students. As the data shows, arguments with stronger prior beliefs and arguments with higher reliability of source are considered more convincing. Both -mİş and -DI as markers of evidentiality affect people's acceptance ratings of the arguments, neutral case leading to significantly lower scored arguments.

- **Theory of Mind in 4 and 6-year-old Children Studied through the Shape-Bias**

Tuğba Dursun, Kerem Alp Usal, METU (Study Advisor: Annette Hohenberger)

Two groups of children have been studied with cards that had colored (red, yellow, blue) geometric shapes (triangle, circle, square) on them. The first group consisted of 7 children who were 4 years old and the second group of 8 children who were 6 years old. In the first phase the shape-bias was tested: the participant was shown an example card and then two question cards. One of the question cards matched the example card in shape and the other in color. Participants were asked which of the two question cards matched the example card. This set-up was repeated 7 times with different triplets, and when it was over the

participant was verbally informed whether he/she preferred shapes or colors. The results showed a significant shape-bias in children: average preferences for shapes were 6.714 for the 4-year-olds and 6.125 for the 6-year-olds. In the second phase, theory of mind (ToM) was tested. The first triplet of the set-up in the first phase was administered to a third-party in front of the child who always chose the opposite of the child's preference, i.e., color. After that, the participant was given a verbal clue that the third-party preferred the opposite. Then, for the other 6 triplets, the participant was asked to guess the choice of the third-party. Results showed that 4-year-olds gave an average of 2.3 correct answers out of 6, whereas 6-year-olds gave 5.5 correct answers ($p=.013$). The results are in line with the literature and suggest that the current task can be used as an alternative test of ToM development.

- **Recall differences of humorous and metaphoric sentences**

Deniz Zengin, METU

Humor is one of the cognitive abilities which all healthy human beings have. According to incongruity theory of humor, without incongruity humor cannot be perceived and discriminated from other stimuli. Metaphors can also be explained via incongruity theory. According to the definition of metaphors there should be an incongruity between the first and the second parts of the metaphoric stimulus. Based on these similarities, the main aim of this study is to analyze the recall rate differences of these two kinds of stimuli. 12 adults participated in the experiment. The experiment was designed in SuperLab 4.0. There were nine stories (3 humorous, 3 metaphoric, 3 control) in the experiment. The number of immediately recalled words was counted for each story and for each participant, and percentages of recalled words were calculated. The result of a dependent t-test shows that humorous

stories ($M=61.48$, $SE=3.77$) were recalled more than metaphoric stories ($M=44.26$, $SE=4.73$), $t(35) = 3.43$, $p < .05$ and control stories ($M=27.30$, $SE=3.15$), $t(35) = 7.80$, $p < .05$. According to Schmidt's study (1994), humorous stimuli are better recalled than non-humorous stimuli. In the present study, it is found that humorous stimuli are recalled better than the metaphoric stimuli. The underlying mechanisms could be the strong incongruity which humorous stories have. Also, the incongruity and unexpectedness of the humorous stories may have attracted participants' attention more. Furthermore, it is shown that metaphoric stories have the ability to attract participants' attention compared to the control group stories.

- **Investigating the Effect of Experience on Concrete and Abstract Word Processing**

Selgün Yüceil, METU

As shown in previous studies, semantic processing of words is mainly effected by frequency, context and concreteness. In this study, concreteness effect was examined in a lexical decision task by using concrete words, abstract words in a control group and law concepts in expert and novice lawyer groups. It was intended to show the effect of expert knowledge in semantic processing. In the first part, 200 words (50 concrete, 50 abstract and 100 pseudo words) were presented, each for 3000ms. In the second part, the same procedure was used for 70 words (35 law concepts and 35 pseudo words). The first part was administered to both control and law groups, the second part was administered only to law groups. Reaction times and error rates were analyzed by repeated measures ANOVA. Control group consisted of 15 graduate students (mean age 25; 9F, 6M). Law groups were 17 expert lawyers (mean age 40; 8F, 9M) and 17 novice lawyers (mean age 24; 7F,

10M). For the control group, there was a significant word type effect $F(1.03, 14.53) = 15.8, p < 0.01$. Bonferroni corrected pairwise comparisons also yielded significant differences. Concrete words reaction times ($M=708, SD=131$) were significantly faster than abstract words ($M=728, SD=130$). Both concrete and abstract words were significantly faster than pseudo words ($M=859, SD=213$). Results replicated the concreteness effect prominently.

- **Brain-brain coupling: fNIRS hyperscanning of pairs in a sentence repetition task**

Erdoğan İşbilir, METU

Hyperscanning methods where brains of two or more subjects are simultaneously scanned during joint activity have recently emerged in response to the challenges involved with investigating neural correlates of social interaction with single-subject paradigms. Recent hyperscanning studies found inter-brain synchronizations at the pre-motor and motor cortices of two interacting subjects during perceptual/motor coordination tasks such as finger tapping or imitation tasks. Whether similar inter-brain synchronizations can be observed at other brain locations associated with higher-order cognitive tasks such as language processing is an active area of research in social neuroscience. This poster will present preliminary findings from a pilot study that aim to contribute to these efforts. The study investigates the level of neural synchronization at the left dorsolateral pre-frontal (left-DLPFC) cortices of two participants with functional near-infrared spectroscopy (fNIRS) while they perform a joint sentence reading task adapted from Cummins et al. (2013). The experimental protocol consists of matched and mismatched sentences in Turkish which are read aloud by the participants. The matched sentences are identical to each other

while the mismatched sentences differ only by one word towards the end of the sentence. The left-DLPFC activations of the participants were analyzed by wavelet transform coherence (WTC) to test whether stronger inter-brain coherence values are observed in the left-DLPFC when partners read matching sentences, whereas a significant decrease in coherence is expected to occur when their performance is disrupted by the presence of mismatching words.

- **Communication through Diagrams: Division of Labor between Gestures and Arrows**

Melda Coşkun, Cengiz Acartürk, METU

In this study, we aim at studying the relation between arrow production and gesture production in various multimedia teaching environments. Twenty-four participants, who were all experienced educators, were asked to teach a topic of their choice, as if he teaches to a learner audience. They taught the same topic in the same way in three experimental conditions: (i) Teaching on the board in a standing position, (ii) Paper-and-pencil teaching on the seat, (iii) Teaching by a tablet while sitting. All experiment sessions were videotaped. For the analysis, gestures and arrows were annotated. Arrows were classified into three groups: deictic arrows direct attention to the specific area, relational arrows connect two representations, and iconic arrows present motion, force, physical representations, and processes in a depiction. Gestures were also divided into three groups: deictic gestures point to entities, iconic gestures present picturable aspects of semantic content, and finally beat gestures are speech-related rhythmic hand movements. The results indicated that speakers produced more gestures and fewer arrows in the board session. This difference decreased in the paper session and reversed itself in the tablet session.

Similar trends were also found in the relation between deictic and iconic gestures together compared to all arrows, and iconic gestures compared to iconic arrows. These results support the hypothesis that there was a trade-off between arrow and gesture production. These results also suggest that arrows and gestures were used for the same communicative purposes in different modalities.

- **Prospective Time Estimation of Lower and Advanced Level Students of English**

Bengü Yurtseven, METU

In this poster presentation, I will present a research study whose aim is to show to what extent the difficulty level or cognitive demand of a task affects time estimation. Both lower and advanced level Turkish learners of English were involved in a dual task in which they had to perform a temporal and non-temporal language task simultaneously. In this prospective time estimation experiment, they were asked to do an English pronunciation task knowing that they will be asked to reproduce the duration of that task later. The pronunciation task had two difficulty levels, high (ambiguous task) and low (unambiguous task). According to the Attentional Gate Model of Zakay and Block (1996) people underestimate the duration of a difficult, cognitively challenging task more as opposed to a cognitively less demanding task. The more attention is consumed by the secondary non-temporal task, the less attention is available for the primary temporal task. In line with the Attentional Gate Model, the findings in this study revealed that the ambiguous condition was underestimated more than the unambiguous one. This main effect of difficulty was qualified by a significant learner level*difficulty interaction revealing that lower level learners underestimated the duration of both the high and low level task equally,

whereas advanced learners underestimated only the high level task. Thus, it can be concluded from our study that when attention is consumed in cognitively challenging language tasks, second language learners of English judge the duration of that task shorter, commensurate with their level of learning.

- **The effect of training on the dual *n*-back task on consecutive interpreting: a pilot study**

Asiye Öztürk, METU

It has been shown in the literature that training on a dual *n*-back task results in improvements in fluid intelligence and working memory (see Jaeggi et al., 2008; Jaeggi et al., 2010). Considering the results of such studies, the present study aims to investigate the effect of training on a dual *n*-back task on recall rates during consecutive interpreting and fluid intelligence, as measured by the Raven Advanced Matrices. Fourteen 3rd-year Translation and Interpretation students at Atılım University, Ankara were divided into two groups in a yoked design; one group was trained on a dual 1-back task, the other group was trained on dual *n*-back tasks ranging from 1-back to 4-back for six weeks. The results showed that while both training groups' consecutive interpreting from English into Turkish and recall scores as well as Raven Matrices Reasoning Test scores improved, crucially, the interpreting test scores of the subjects who underwent the *n*-back training increased significantly more than those of the subjects who underwent the 1-back training. From these initial results we can conclude that the *n*-back task can be regarded as a useful tool for interpreting training programs; however, further research is needed.



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