

Symposia

Rumelhart Prize Symposium:

On Counterfactuals and Cognitive Science: Rumelhart Prize Symposium in Honor of Judea Pearl

Friday 10:10-11:50 a.m. Imperial Ballroom

Counterfactuals are the building blocks of scientific thought and the oxygen of moral behavior. The ability to reflect back on one's past actions and envision alternative scenarios is the basis of free will, responsibility, and social adaptation. Recent progress in the algorithmization of counterfactuals has advanced our understanding of this mode of reasoning and has brought us a step closer toward equipping machines with similar capabilities. I hope this symposium will inspire cognitive scientists to empower themselves with these new tools, and to tackle some of the more difficult problems that counterfactuals present: why evolution has endowed humans with the illusion of free will and how it manages to keep that illusion so vivid in our brain.

Steven Slooman, Judea Pearl, Nick Chater, Lance Rips, Jim Joyce, Stefan Kaufmann

Governing Board Symposium:

The Biology of Language

Friday 4:45-6:45 Imperial Ballroom

Human language is considered by many scientists to be a biological system, analogous to other perceptual and cognitive systems that are highly specialized, emerge early in life under informal conditions of learning, and have a specific neural substrate. This symposium will include three distinguished speakers who come from quite different traditions in Cognitive Science, and who will discuss the sense in which language is a biological system, the challenges that this view holds, and the nature of research that can shed further light on this issue. Noam Chomsky will provide the perspective of a linguist who has long argued for the idea of language as a mental organ; David Poeppel will provide the perspective of a neurolinguist who focuses on the neural instantiation of language; and Patricia Churchland will provide the perspective of a philosopher who has long considered the relationship between human knowledge and its neural representation. Elissa Newport will serve as discussant.

Noam Chomsky, Patricia Churchland, David Poeppel, Elissa Newport

Invited Symposium I:

Finding your way: The cognitive science of navigation

Thursday 10:10-11:50 Imperial Ballroom

One overarching research question in cognitive science concerns how information from perception and memory is processed and integrated in order to achieve robust, efficient, and adaptive behavior in space, as is necessary in wayfinding. Examining this integration is quite complicated, entailing an understanding of learning strategies, spatial memory representations of static and dynamic relations, perceptual and attentional processes that direct the encoding and maintenance of select information, reasoning and planning processes, communication of spatial information via language or other representational media, the influence of background knowledge, and the development of navigation plans. Due to the complexity of the problem, research in navigation cuts across a diverse set of disciplines, including cognitive psychology, linguistics, computer science, robotics, environmental psychology, developmental psychology, and geography, and ranges from basic research questions to practical applications. Because of the diversity of the approaches, there are relatively few opportunities

for researchers to meet across disciplines, and provide a diversified overview of the range of issues involved. In this symposium speakers focus on navigation from a broad range of perspectives: animal models, neuronal models, spatial and temporal learning, robotics, and neuroscience.

Neil Burgess, Ben Kuipers, Russ Epstein, Verner Bingman, Francesca Pazzaglia

Invited Symposium II:

Everyday Cognitive Science: Using the methods of cognitive science to explore spatial thinking in related disciplines

Saturday 10:10-11:50 Imperial Ballroom

This symposium will address how the breadth of investigation within the cognitive sciences can be brought to bear on applied everyday common problems, such as difficulties with reading charts and maps, and difficulties in using an in-car navigation device. Research with a problem-based focus often requires a systems approach that requires assimilation of work from many different disciplines. Such problems thus constitute ideal domains for illustrating the benefits of such multi-discipline and multi-method approaches. Speakers focus on the use of spatial thinking in the context of examining these applied problems. This symposium will illustrate the giving away of cognitive science.

Ruth Conroy Dalton, Madeleine Kehner, Dan Montello, Sara Fabrikant, Eric Riggs

More than just logic tasks: New Approaches to understanding Reasoning

Thursday 12:00-1:20 Imperial Ballroom

Reasoning research has long been associated with paper and pencil tasks in which peoples' reasoning skills are judged against established normative conventions (e.g., Logic). In this way researchers have tried to assess the extent to which we can think rationally, and of course how we deviate from normative conventions. The 'fruit flies' of this domain has been the Wason selection task (Wason, 1966), and Syllogistic reasoning tasks (Johnson-Laird, 1984). The field has advanced in helping us to understanding the influence of context on the kinds of inferences we tend to make, and we have gained significant insights into the kinds of situations in which our biased thinking is aligned with normative thinking and the situations in which it conflicts with it.

Wim de Neys, Magda Osman, Taeko Tsujii, Simon Handley

The potential of Quantum Probability for Modeling Cognitive Processes

Friday 12:00-1:20 p.m. Imperial Ballroom

Quantum probability (QP) theory is a theory for how to assign probabilities to observables. In the context of physics, it has been successfully employed by researchers for over 100 years and has been the basis for some of the most impressive discoveries of the human mind (e.g., the transistor, and so the microchip, and the laser). But the applicability of QP theory is not limited to physical phenomena and, indeed, there has been growing interest in exploring the potential of QP theory in areas as diverse as economics (Baaquie, 2004), information theory (e.g., Grover, 1997), and psychology.

Emmanuel Pothos, Jerome Busemeyer, Richard Shiffrin, Jennifer Trueblood, Zheng Wang, Reinhard Blutner, Harald Atmanspacher

Computational, Neuroscientific, and Lifespan Perspectives on the Exploration-Exploitation Dilemma

Saturday 1:40-3:00 Imperial Ballroom

Consider the following real-life decisions that we make: deciding which route to take home to minimize time spent traveling, choosing amongst a set of known restaurants or a new restaurant when dining out, deciding between reading a new book by a consistently good author versus an author whose books vary widely in quality. All of these decisions involve balancing the conflicting demands of exploiting previous knowledge in order maximize payoffs versus exploring less-known options in order to gain information about the currently optimal course of action. Indeed, successfully balancing these competing demands is a non-trivial problem of interest to artificial intelligence and neural Reinforcement Learning (RL) research communities alike (Cohen, McClure, & Yu, 2007; Daw et al., 2006; Sutton & Barto, 1998). There are adverse consequences for failing to properly balance these demands in the above examples.

A. Ross, Bradley W. Knox, Bradley C., Sam Gershman, Yael Niv Darrell A. Worthy, W. Todd Maddox, Jared M. Hotelling, Jerome R. Busemeyer, and Richard M. Shiffrin

Executive Functioning in Children and Adolescents with Disabilities

Friday 1:40-3:00 Imperial Ballroom

Recent research has demonstrated the importance of executive functioning—a set of cognitive abilities necessary for regulation and control of goal-directed behavior—to academic skills in typically developing children. Executive functioning may be of particular consequence for students with disabilities who may already be at risk for academic and learning problems. One domain of executive functioning, working memory, may be especially crucial for academic performance. This symposium will present research that takes knowledge of cognitive science to the realm of educating children with disabilities. The projects include both the exploration of executive functioning skills and the development of strategies aimed at improving executive functioning in children with disabilities. They bring together researchers with various backgrounds (e.g., cognitive psychology, educational psychology, special education, neuroscience) and cut across different types of psychological and cognitive disabilities with impairments in executive functioning skills.

Amy L. Sussman, Martin Buschkuhl, Susanne M. Jaeggi, John Jonides, Priti Shah, Lisa Daunhauer Deborah Fidler, Janine P. Stichter, Melissa J. Herzog, Karen V. O'Connor, Kristin Lierheimer, Jaime Kerpash, Jaclyn Benigno, Frances A. Connors

The Development of Spatial Cognition During Childhood: Extending Understanding of Perception, Memory, Language, Maps, and Gestures

Thursday 1:40-3:00 Plaza Ballroom

Understanding the development of spatial cognition during childhood is important for two reasons. First, because spatial cognition includes interactive processes such as perception, memory, language, and symbolic understanding, spatial cognition research extends our understanding in multiple domains. Second, paying close attention to development provides a lens through which to explore mechanisms that underlie stability and change over time. This symposium includes four talks that illustrate unity and diversity in the field, highlighting tight links between spatial perception and memory during early childhood explicated through dynamic systems theory, specifying the development of spatial language during early childhood by focusing on the role of scaffolding interactions, exploring links between spatial language, maps, and search strategies during early childhood, and explicating spatial thinking during childhood by integrating maps, words, and gestures.

Anne R. Schutte, Heidi Fleharty, Alycia M. Hund, David H. Uttal, Megan Sauter, Nina Simms, Dedre Gentner, David H. Uttal

Space (and Time) for Culture

Friday 12:00-1:20 Plaza

Space is a fundamental domain for cognition, and research on spatial perception, orientation, referencing, and reasoning addresses core questions in most of the disciplines that make up the cognitive sciences. Consequently, space represents one of those domains for which various disciplinary interests overlap to a substantial extent. For instance, the question of whether and how spatial cognition and language interact has been one of the core questions since early on (e.g., Clark, 1973; Miller & Johnson-Laird, 1976), and yet, consensus between psychologists and linguists is difficult to achieve (e.g., Li & Gleitman, 2002, vs. Levinson et al., 2002). Perhaps most controversial in this dispute is the extent to which spatial cognition is culturally variable (for linguistic variability, see also Evans & Levinson, 2009, and comments there-in).

Andrea Bender, Sieghard Beller, Giovanni Bennardo, Kirill V. Istomin, Niclas Burenhult, Olivier Le Guen, Lisa Huether, Thora Tenbrink

Fictional Worlds and Cognitive Science

Friday 1:40-3:00 Imperial Ballroom

Classical computationalism was committed to viewing cognition in terms of physical symbol systems, using representational formats akin to numbers, or language. Yet it is now becoming clear this is at best a very partial model that cannot account for and is in many cases incompatible with the emerging evidence from neuroscience. The study of how the human mind builds and inhabits intricate fictional worlds has proved to be indispensable to our understanding of representation, meaning construction, social cognition, and many other central issues in Cognitive Science. At the same time, there has been a cognitive revolution in the disciplines that were traditionally interested in fictional worlds, like literary studies or art theory. This symposium presents the latest work of six researchers studying the relation between fictionality and cognition.

Cristóbal Pagán Cánovas, Brian Boyd, Richard Gerrig, Thalia Goldstein, Francis Steen, Vera Tobin

Moving Beyond Where and What to *How*: Using Models and fMRI to Understand Brain-Behavior Relations

Saturday 12:00-1:20 Imperial Ballroom

One central goal of cognitive science is to understand how the brain supports cognition. Toward this end, a great deal of effort is devoted toward computational modeling and brain imaging. The former effort is well represented at the Annual Conference, whereas the latter effort is neglected. One common criticism of brain imaging research from the cognitive science community is that it is overly focused on the "where" of cognition, as opposed to the "how" (i.e., process-level questions linking brain and behavior). Model-based analysis of fMRI data links models to the interpretation of imaging data, allowing process-level questions to be asked. The basic approach involves fitting models to behavioral data and then using internal quantities from the models as regressors in the imaging analysis. In this symposium, a broad assortment of leading researchers demonstrate the value of this approach in several domains.

Nathaniel Daw, Bradley C. Love, John O'Doherty, John P. Spencer

Interactivity and Thought

Thursday 1:40-3:00 Imperial Ballroom

The idea for a symposium on interactivity arose at the last Cogsci conference in side bar conversations when people discussed, in rather animated form, what is meant by interactivity and how it figures in thought. A shared tenet of embodied, embedded, situated and distributed cognition is that people make sense of things interactively. They run a simulation, they exchange words, often taking turns to change and steer the flow of interaction; they gesture, they handle or manipulate things, they write, sketch or model. Because the concept of interaction seems intuitive, and the phenomena so pervasive, researchers tend to use the term to do more work than they have time to explain. A symposium offers a nice forum to spotlight the term and explore some of its applications.

David Kirsh, Herbert Clark, Susan Goldin-Meadow, Andy Clark

Explanation-based Mechanisms for Learning: An Interdisciplinary Approach

Saturday 3:10-4:30 Imperial Ballroom

The significant role of explanation in learning and generalization is ubiquitous and well documented: explanation promotes student learning in educational settings, drives conceptual development in young children, is accorded a central role in theories of conceptual representation, and has a long history in artificial intelligence. Despite this, relatively little is known about the precise mechanisms that underlie explanation's effects, and there is a paucity of discourse between the disciplines of cognitive science that study explanation. This interdisciplinary symposium brings together key researchers from education, development, cognitive psychology and computer science to synthesize the progress from these disciplines, forging connections between ongoing research programs to identify promising future directions.

Micheline Chi, Gerald DeJong, Cristine Legare, Tania Lombrozo, Joseph Jay Williams

New Approaches to the Problem of Conceptual Change in the Learning of Science and Math

Friday 3:10-4:30 Imperial Ballroom

Concepts are not static. They change in many ways from the most simple ñ as in cases where a new instance is added on to an existing concept ñ to the most radical ñ as in cases that involve belief revision, ontological category shifts and changes in causality. The purpose of the present symposium is to present some of the most recent attempts to describe and explain the more radical kinds of conceptual changes that take place when students are exposed to counter-intuitive concepts in science and mathematics.

Stella Vosniadou, Stellan Ohlsson, David D. Cosejo, Micheline T. H. Chi, David E. Brown, Nancy J. Nerserssian

Grow your own representations: Computational constructivism

Saturday 1:40-3:00 Plaza

From a cognitivist standpoint, one main interest of psychology is the study of representations of the human mind as they mediate how people react to stimuli in their environment (Palmer 1978). This can explain why two people that encounter the same stimulus can behave in very different ways (Chomsky 1959). For example, an art historian viewing a Jackson Pollock painting may exclaim "this is beautiful" due to her representation of his work as a rejection of

painting with a brush; however, a lay person may say "this is ugly" due to his representation of the painting as a cluttered mess of colors. Without knowledge of the representations of each person in this example, it would be nearly impossible to explain their behavior when interacting with the Jackson Pollock painting.

Joseph L. Austerweil, Robert L. Goldstone, Thomas L. Griffiths, Todd Gureckis, Kevin Canini, Matt Jones

Exploring Spaces to Make the Right Choice: The Cognitive Science of Search
Saturday 12:00-1:20 Imperial Ballroom

A central question in cognitive science is how humans explore different spaces to find useful resources, such as the right investment options, the perfect mate, or relevant information on the WWW. Understanding how cognition guides exploration across the wide range of information spaces is critical to our understanding of how humans learn about and make decisions in these environments. The goal of this symposium is to discuss the over-arching principles underlying the search process as humans explore in different environments. These principles include the adaptive nature of cognitive search processes (Wai-Tat Fu), the role of individual differences and executive processing (Thomas Hills), motivational and environmental factors (Art Markman), and the appropriate tradeoff between exploration and exploitation (Peter Todd). This diverse set of research results suggests that the cognitive processes underlying search are central to many areas of cognition.

Wai-Tat Fu, Thomas T. Hills, Arthur B. Markman, Peter M. Todd

What Should we Be Realist about in Cognitive Science?
Thursday 12:00-1:20 Plaza

What should we be a realist about in Cognitive Science? This fundamental question elicits answers that are not just philosophical in nature, but pertain to measurement of cognitive phenomena and interpretation of empirical results, as well as the daily practice and general philosophy of science. Four very different perspectives on this question will be provided by the speakers in this symposium: *Ecological Realism, Measurement Contextuality, Explanatory Pluralism* and *Structural Realism*. The participants address differences and similarities between these perspectives and examine whether unification or consensus perspectives can be achieved.

Fred Hasselman, Rick Dale, John Holden, Tony Chemero

Placeholder structure and numerical computation
Thursday 3:10-4:30 Imperial Ballroom

This symposium explores the role of placeholder structures—systems of words, non-linguistic symbols, or procedures—in the construction and manipulation of numerical concepts. The symposium will include four distinct talks, each touching on different systems of numerical representations. Each talk will discuss how placeholder structures guide and constrain learning, whether by facilitating the association of symbols with quantities, guiding inductive inferences, or facilitating operations that are unique to a particular structure.

David Barner, Neon Brooks, Michael C. Frank, Elizabet Spaepen