

Motivations and Goals in Developing Integrative Models of Human Cognition

Glenn Gunzelmann (glenn.gunzelmann@us.af.mil)

Cognitive Models & Agents Branch, Air Force Research Laboratory
711 HPW/RHAC, 2620 Q St., Building 852
Wright Patterson Air Force Base, OH 85212-6061 USA

Abstract

There has been tremendous growth recently in theories that attempt to provide more comprehensive accounts of the foundational mechanisms of human cognition. Such theories have taken a variety of forms, and have focused on different levels of analysis. The diversity is important and necessary, but can serve as a barrier to interaction, comparison, and integration, even at venues like the Annual Meeting of the Cognitive Science Society that should foster such dialogue. This workshop is intended to bring together individuals working on integrative models of human cognition, to emphasize shared motivations and goals. Ultimately, building scientific communities that bridge levels of analysis, methodologies, and theoretical approaches to work toward more comprehensive theories will be critical to the addressing the central goal of the Cognitive Science Society – understanding the nature of the human mind.

Keywords: Integrated Models; Unified Theories of Cognition; Cognitive Models; Cognitive Architectures; Neural Architectures.

Introduction

The motivations for integrative models of human cognition have their roots in the origins of cognitive science as a scientific discipline. Even before cognitive psychology emerged, ideas about unifying principles to explain cognition were expressed in the scientific literature (e.g., Newell, Shaw, & Simon, 1958; Rosenblatt, 1961), including so-called grand psychological theories proposed during the first half of the 20th century. The call for more comprehensive theories was explicitly made by Newell (1973), who expressed concern about the prospect that traditional, phenomenon-driven cognitive psychology would, by itself, lead to the kind of integrative understanding of the human mind that is the goal of cognitive science.

In the decades since, integrative theories of human cognition have become increasingly prevalent in cognitive science. These theories now represent an exciting diversity of theoretical approaches and levels of analysis, better reflecting the diversity of the cognitive science community as a whole. As noted by McClelland (2009), this growth has been tied in important ways to sustained increases in computing power that enable cognitive modeling at a scale and resolution that was unimaginable half a century ago.

The participants in the workshop have been selected to capture much of this theoretical diversity. The current state of the art in this area makes this workshop a timely and important contribution to the Annual Meeting of the Cognitive Science Society and the broader cognitive science community.

Goals and Scope

The need to bring together this community of researchers was expressed by Newell (1990). Newell explicitly and deliberately referred to *Unified Theories of Cognition* in the plural, noting that multiple implementations are important for progress in the science. More recently, McClelland (2009) emphasized that “different simplifications are required to explore different issues.” (p. 12). Interactions among cognitive scientists from different methodological and theoretical backgrounds are crucial to identifying common foundations and interconnections among levels of analysis and theoretical perspectives.

To reinforce and further develop the identity of this scientific community, this workshop will create an important opportunity for interaction and discussion amongst researchers working toward more integrative theories of cognition. It will not focus on a debate about the merits of developing integrative models of human cognition. The participants share, in general, an appreciation of the value of developing such theories, which provides the unifying theme for the event.

In addition, the workshop will not focus on the claims of particular integrative models. That is an important scientific activity, but the goal here is to build broader appreciation of shared motivations and goals, despite sometimes very different approaches and theories. All of the presenters seek unifying mechanisms that cut through the complexity of human cognition and enhance our understanding. Complementary perspectives and opportunities for integration will be highlighted to emphasize connections. In addition, contemporary challenges in this pursuit will be discussed, which will facilitate future scientific debates regarding particular claims and mechanisms.

Workshop Organization

The workshop will be organized around a set of presentations and opportunities for discussion. The focus will not be on theoretical overviews. Instead, contributors will comment on the role of integrative models in cognitive science, including understanding the fundamental principles of human cognition broadly, and integrating across components of cognition to perform complex tasks. Presenters will highlight links to alternative approaches and methodologies, and discuss current challenges in developing integrative models of the human mind.

Speakers will be given approximately 25 minutes, with no more than 15 minutes of presentation material. This will allow significant opportunity for questions, comments, and discussion. In addition, the closing session of the workshop will consist of a panel discussion with the goal of

identifying and highlighting common themes and perspectives that have emerged across the day.

Workshop Organizer

Dr. Glenn Gunzelmann is the Science and Technology Advisor for the United States Air Force Research Laboratory's Cognitive Models and Agents Branch. His research attempts to expand the explanatory breadth of integrative theories, including theories of human spatial competence (e.g., Gunzelmann & Lyon, 2011) and fatigue (e.g., Gunzelmann, Gross, Gluck, & Dinges, 2009).

Target Audience

This workshop targets the central purpose of the Cognitive Science Society – it “brings together researchers from many fields who hold a common goal: understanding the nature of the human mind” (CSS Website). The presenters represent a range of disciplines in cognitive science, who will focus on important challenges associated with creating more comprehensive theories. Because this steps back from the theoretical and technical details of the theories, this workshop should be approachable and of interest to a broad audience at CogSci2013, and will make an important contribution to the event.

Participants

Presenters

Joscha Bach

Berlin School of Mind and Brain
Humboldt University

Jerome Busemeyer

Cognitive Science Program
Department of Psychological and Brain Sciences
Indiana University

Chris Eliasmith

Canada Research Chair in Theoretical Neuroscience
Departments of Philosophy & Systems Design Engineering
University of Waterloo

Noah Goodman

Department of Psychology
Stanford University

Rick Granger

Psychological and Brain Sciences Department
Dartmouth University

Andrew Howes

School of Computer Science
University of Birmingham, UK

Rick Lewis

Departments of Psychology and Linguistics
University of Michigan

Randy O'Reilly

Department of Psychology and Neuroscience
University of Colorado Boulder

Ron Sun

Cognitive Science Department
Rensselaer Polytechnic University

Niels Taatgen

Department of Artificial Intelligence
University of Groningen

Josh Tenenbaum

Department of Brain and Cognitive Sciences
Massachusetts Institute of Technology

Discussion Panel

Wayne D. Gray

Cognitive Science & Computer Science Departments
Rensselaer Polytechnic Institute

Jay McClelland

Department of Psychology
Stanford University

Frank E. Ritter

College of Information Sciences and Technology
The Pennsylvania State University

Archiving

In conjunction with the workshop, a proposal is being submitted to *Topics in Cognitive Science*. Presenters at the workshop will be invited to submit brief papers to complement the presentations at the workshop. Discussants will be encouraged to submit commentaries to the Topic on Integrative Models of Human Cognition, based on both the papers and workshop presentations. All workshop attendees, and others in the cognitive science community, will also be invited to contribute to the discussion in the journal.

References

- Gunzelmann, G., Gross, J. B., Gluck, K. A., & Dinges, D. F. (2009). Sleep deprivation and sustained attention performance: Integrating mathematical and cognitive modeling. *Cognitive Science*, 33(5), 880-910.
- Gunzelmann, G., & Lyon, D. R. (2011). Representations and processes of human spatial competence. *Topics in Cognitive Science*, 3(4), 741-759.
- McClelland, J.L. (2009). The place of modeling in cognitive science. *Topics in Cognitive Science*, 1(1), 11-38.
- Newell, A. (1990). *Unified Theories of Cognition*. Cambridge, MA: Harvard University Press.
- Newell, A. (1973). You can't play 20 questions with nature and win: Projective comments on the papers of this symposium. In W. G. Chase (Ed.), *Visual information processing* (pp. 283-308). New York: Academic Press.
- Newell, A., Shaw, J. C., & Simon, H. A. (1958). Elements of a theory of human problem solving. *Psychological Review*, 65(3), 151-166.
- Rosenblatt, F. (1961). *Principles of neurodynamics*. Washington, DC: Spartan Books.