Making Extra- and Intra-Disciplinary Collaboration Work

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Introduction

Cognitive science is inherently interdisciplinary. It brings together methodologies, tools, concepts, and data from philosophy, linguistics, anthropology, machine learning, psychology, neuroscience, and education to understand the nature of the human mind. *Collaborative* interdisciplinary research is becoming increasingly attractive (and perhaps unavoidable) as the questions being tackled become more complex. Moreover, there is a growing recognition of the value of multidisciplinary collaboration on the part of both federal and private funding agencies and, consequently, an escalating emphasis on supporting truly collaborative research. Despite all of this, scientists vary greatly in their experience with collaborations and opportunities are rare to discuss how to make the most of collaborations, what factors make collaborations work or not work, and how to measure the success or failure of collaborations.

This symposium will examine successful models in which a number of scientists have bridged the extradisciplinary gap across disciplines and the intradisciplinary gap across methods and concepts within a discipline. We will turn an analytic lens on the value of collaborative networks and teams of researchers and will report on the logistic, social, and scientific processes that drive intellectual growth and research. We will also discuss how to measure collaboration and interdisciplinarity at both small and large scales. In a unique combination, the history of one collaborative group will be related from both the perspectives of the scientists and their funding agency.

As such, this symposium examines collaborations as entities worthy of scientific study by cognitive scientists in and of themselves, collaborations as engines for novel interdisciplinary research in cognitive science, and measures of collaborative activities in cognitive science as data to be modeled and analyzed.

One practical outcome of this symposium will be disseminating information of use to those interested in developing interdisciplinary collaborative grant proposals and in conducting productive interdisciplinary collaborative research in cognitive science.

Thomas Palmeri will moderate this symposium.

Avoiding Fault Lines in Interdisciplinary Collaboration

Christian Schunn - LRDC, University of Pittsburgh

The members of research groups can vary on many dimensions (e.g., discipline, location, gender, age, ethnicity). This diversity, when harnessed through good group processes (e.g., not the typical brainstorming protocol), can lead to increases in creativity. But when these dimensions correlate (e.g., female biologists at one university working with male engineers at another university), the potential for small problems turning quickly into large problems (often in the form of fault lines) is increased. Bringing together laboratory and field research from cognitive and social psychology of group collaboration in general and scientific collaboration in particular, I will discuss factors that are predictive of continuation and success in intra and interdisciplinary scientific research groups, including meeting frequency and meeting type, work allocation, mentoring structure, and other tasks processes.

The Benefits of Interdisciplinarity: A Case Study

James L. McClelland – Stanford University

This talk will address the benefits of interdisciplinary engagement, drawing on examples from my own collaborations linking computational and experimental approaches to understanding human cognition and on others linking cognitive and neural levels of analysis. I will focus particularly on the process that led to the Complementary Learning Systems theory of memory, developed jointly with Bruce McNaughton and Randy O'Reilly. This interdisciplinary connection between my psychological and connectionist perspective and McNaughton's experimental neuroscience perspective provided the opportunity not only

for substantive research, but also provided me with a lasting basis for interdisciplinary engagement across approaches and levels of analysis. This basis then allowed me to go on to build the interdisciplinary bridges necessary for the creation of the Center for the Neural Basis of Cognition. In my talk I will discuss some of the challenges as well as the benefits of interdisciplinarity and suggest possible ways in which institutions and funding agencies can facilitate the creation of such connections.

Exploring Perceptual Expertise Through Collaborative Science

Isabel Gauthier – Vanderbilt University

True progress in science requires the integration of knowledge at different scales and converging results from multiple techniques. Cognitive neuroscientists often collaborate to meet such challenges. Collaborations are often less than optimal, when they arise as a result of physical proximity or to plug holes in a specific project. In the age of electronic communication, it is now possible to collaborate more widely, facilitating a much more multidisciplinary approach to research. In 2000, with the support of the James S. McDonnell Foundation, a group of scientists with common interests in the study of skilled object perception formed the Perceptual Expertise Network (PEN) to explore new avenues for collaboration. PEN is an example of how science benefits from a question motivated framework rather than one motivated by techniques. The particular organizational and scientific challenges that have been encountered by our group will be discussed, as well as those structures we have created that have been most helpful in facilitating collaboration. Future steps in our collaborative model will be discussed, including the participation of PEN in a new NSF-funded Science of Learning Center - a more extensive "network of networks" focused on the temporal dynamics of learning (web site: tdlc.calit2.net).

PEN: An Exemplar of Collaborative Activity

John Bruer – James S. McDonnell Foundation

The James S. McDonnell Foundation's 21st Century Science Initiative offers two type of grant support: individual research awards and collaborative activity awards. At the program's inception it was our intent to apportion 75% percent of our research funding to individual grants and the balance to collaborative activity awards. PEN was one of the first collaborative awards. Its success has prompted us to change our priorities and devote 75% of our funding to collaborative awards. I will address the Foundation's interest and commitment to collaborative awards and what we have learned about this mode of funding from PEN, as well as other projects. These projects have also prompted the Foundation to exploit scientometric and bibliometric techniques to assess the impact of our grant making and to measure the extent of the collaboration these grants generate. PEN provides a case study.

Measures and Models of Connections in Science

Robert Goldstone – Indiana University
Katy Börner – Indiana University

While several of the other presentations in this symposium describe valuable case studies of scientific collaboration, our interest has been in modeling the macroscopic consequences of individual scientists' decisions to collaborate and forge connections beyond their own field. We have applied the tools of scientometrics to study the structure and evolution of scientific knowledge and collaborations. In one project (Börner, Maru, & Goldstone, 2004) we have developed an agent-based model of the pattern of co-authorships and co-citations in a large journal data set. Systematic deviations from a power law distribution of citations are well fit by a model that partitions authors into topics, includes a bias for authors to cite recent papers, and has agents recursively cite papers cited within papers that they read. More recent extensions of this model incorporate self-organized topics and social networks of collaboration. In a second project (Goldstone & Leydesdorff, 2006), we consider the journal Cognitive Science as a case study for assessing interdisciplinarity in science. One measure we advocate is "Betweenness centrality," defined for Journal X as the number of shortest citation paths connecting other journals that includes X. Informed by our measures and models, we discuss the field of cognitive science, and scientific fields more generally, in terms of cross-fertilization, export and import of knowledge, and growth.

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