

Synopsis: CDTLI Workshop Brain, Behavior and Mind (Summer 2011).

Participants: Rebecca Hanrahan, Wally Herbranson, Doug Hundley, Leena Knight, Tom Knight, Matthew Prull, Ginger Withers and Chris Wallace (Coordinator).

Philosophy, mathematical modeling, psychology and biology all have a stake in understanding the operation of the human mind, but come at the problem from different theoretical contexts, examine the features of mind at different levels with different goals and, accordingly, may appear to our students as representing alternate intellectual universes. The new fields of neuroscience and cognitive sciences have emerged, however, through vigorous cross-pollination between a somewhat unexpected set of academic disciplines. This workshop grew out of informal conversations various combinations of us were having that suggested that a) a liberal arts curriculum could be ideal for cross-training in brain, behavior and mind and b) there was sufficient shared interest in brain and mind across the 3 divisions that new opportunities for student engagement could be created just by opening new channels of communication between the participants in this workshop.

The workshop was divided into 6 sessions about 3 hours long that occurred at intervals dictated by the summer travel schedules of the participants. The sessions were organized into following 3 parts:

- 1) **Disciplinary Tours.** Each participant presented a compact overview of how their home discipline would approach analysis of the brain, what they were looking for and how they would know when they found it. The goal was that this orientation would help break down barriers between our perspectives and help establish a common vocabulary and awareness of each other's key interests as they relate to neuroscience.
- 2) **Group Hunt.** To stimulate critical debate and promote convergence, we read and discussed a recent book that purported to find a new coherence between the cellular organization of the human brain and cognitive properties of the human mind. Although we differed on our identification with the aim of the book and with our satisfaction with the author's arguments in support of his case, the exercise seemed to naturally generate common ground as we identified our specific concerns in scholarly efforts to define the mind, and to relate analyses of brain function to mind.
- 3) **Simply Connect.** The goal of this final session was to brainstorm about ways we could create new links for students between the courses that we are already teaching. These links could be a shared case study that threads through multiple courses or simply time to consider alternative viewpoints. We also considered opening new avenues for cross-disciplinary interaction.

The first 5 sessions were held at the Glover Alston, which turned out to be a wonderful venue. It gave a quiet retreat with convenient spaces for presentations and discussion a few steps from dining areas for breaks and lunch.

Outline of the sessions

I. Sessions 1-4 Disciplinary tours

Session 1) The promise of an integrative biology of the human brain: Cellular Perspective

June 6, 2011 9:30AM-12:30PM

Withers: Cellular basis of brain development

Readings: Le Doux, J (2002) "Building the brain," Chapter 4 of *Synaptic Self: How our brains become who we are*. New York: Viking.

Wallace: Cellular basis of brain information storage

Readings: Holloway, M. (2003) The Mutable Brain. *Scientific American* September 2003:54-61; Fields, R.D. (2008) White matter matters. *Scientific American* March 2008.

Session 2) The promise of an integrative biology of the human brain: Systems Perspective

June 8, 2011 10:00AM-12:00PM & 1:00 PM-3:00 PM

T. Knight: Object recognition & sensory-motor integration in neural systems

Readings: "Movement" and "Sensation and Perception" from Society for Neuroscience's *Brain Facts: A primer on the brain and nervous system* (<http://www.sfn.org>); Rizzolatti, G. & Sinigaglia, C (2010) The functional role of the parieto-frontal mirror circuit: interpretations and misinterpretations. *Nature Reviews Neuroscience* 11:264-274; Munoz, D.P. and Everling, S. (2004). Look away: The anti-saccade task and the voluntary control of eye movement. *Nature Reviews Neuroscience* 5:218-228.

L. Knight: Neurobiology of psychiatric and neurodegenerative disorders

Readings: "Neural Disorders Advances and Challenges" and "Glossary" from Society for Neuroscience's *Brain Facts: A primer on the brain and nervous system* (<http://www.sfn.org>); Talks by Ed Boyden at MIT (http://www.ted.com/talks/ed_boyden.html) and V. S. Ramachandran (http://www.ted.com/talks/vilayanur_ramachandran_on_your_mind.html)

Session 3) The challenge of integrating brain and cognitive science

July 5, 2011: 9:00AM-1PM

Herbranson: Split Brain Syndrome & Comparative Analysis of Memory

Readings: Gazzaniga, M. (2008) Spheres of influence. *Scientific American Mind* June/July 2008; Clayton, N.S., Bussey, T.J. & Dickinson, A. (2003). Can animals recall the past and plan for the future? *Nature Reviews Neuroscience* 4:685-691. Avian Brain Nomenclature Consortium (2005) Avian brains and a new understanding of vertebrate brain evolution. *Nature Reviews Neuroscience* 6:151-159.

Prull: Defining cognitive processing in the human brain

Readings: Colheart, M (2001) Assumptions and methods in cognitive neuropsychology in B. Rapp (Ed.), *Handbook of cognitive neuropsychology: what deficits reveal about the human mind* (pp. 3-21). Philadelphia: Psychology Press.

Session 4) Do we really need to know the brain to understand the mind?

July 7, 2011: 8:30AM-12:30PM

Hundley: Modeling the mind mathematically and machine learning

Readings: Video demonstrations: Brain computer interface, machine learning (self-balancing pendulum, Stanford's Junior autonomous vehicle) and demonstration of Lorenz attractor.

Hanrahan: Analysis of brain begs questions of philosophy of mind

Readings: Searle, J.R. (1983) Can computers think? From *Minds, Brains and Science* pp 28-41. Cambridge: Harvard University Press; Block, N. (1978) Troubles with Functionalism. Excerpted from Savage, C.W. ed. *Perception and cognition* pp 261-325. Minneapolis: University of Minnesota University Press; Jackson, F. (1982) Epiphenomenal Qualia. *Philosophical Quarterly* 32:127-136; Jackson, F. (1986). *Journal of Philosophy* 83:291-95.

II. Group Hunt (Session 5): To what extent can (and should) accounts based on biological vs. cognitive analysis be integrated in the study of the human mind?

August 16, 2011 9:30AM-11:30AM & 12:30PM-1:30PM.

After reading of Ramachandran's book (see below) each participant submitted 3 questions to stimulate group discussion. These questions offered a broad critical scaffold on which to explore Ramachandran's synthesis of cognitive psychology and clinical neurology as well as identified points of convergence and divergence between the perspectives of our native disciplines .

Readings: Ramachandran, V.S. (2011) *The tell-tale brain: a neuroscientist's quest for what makes us human*. New York: W. W. Norton & Company, Inc.

III. Simply Connect Session 6): What can we do to promote student opportunities for developing cross-disciplinary literacy and critical competence.

August 18, 2011 2:30-5:30PM

We gathered with our syllabi to discuss possibilities for interaction between our existing classes. This discussion evolved into a consideration of a course that we might be able to design and teach as a cross-disciplinary team with the goal of engaging students in the kind of cross-talk and debate the workshop generated for us. The consensus of the group was there is sufficient interest amongst both faculty and students, and existing relevant courses, to merit consideration of developing a minor program or concentration that combines biology and cognitive science in a broad, synthetic manner.

Outcomes:

Anticipated outcomes. Overall, individual assessments suggest that we were successful in achieving our anticipated outcomes: we established a mechanism for this group to communicate and discuss our common interest for the first time; we concretely identified commonalities and divergences in perspectives about approaching studies of mind and brain; and we learned how to communicate with one another more effectively.

Additional benefits. In addition to the anticipated gains from our disciplinary tours, we also planned 2 sessions that would allow for brainstorming, with the hope that they would yield

additional, and potentially unanticipated outcomes. In that regard, our workshop was also successful. We found that we had enthusiasm for continued interactions and for developing new opportunities to maintain these interactions. Potential ideas included building a reading/reference collection that we all could use in courses and scholarship, working together to bring visiting educators to campus, and establishing a journal club for faculty and students. We considered how we might develop a team-taught course in cognitive neuroscience, and outlined in broad terms how such a course might be organized. We also discussed, albeit only briefly, how we might take advantage of other internal sources of funding (e.g. Innovation in teaching fund) to further develop interactions and opportunities for students.

By sharing syllabi, and discussing our courses, it became apparent that we have a core of courses largely already in place that could support a new minor or concentration in Brain, Behavior and Mind. It also became apparent that such a program has the potential to eliminate the tailoring of a personalized set of courses, senior capstones and assessments associated with the numerous individually planned majors that we all have worked with, and thus reduce the invisible load of supervising these IPMs. These students could now work within the framework of established major programs (e.g. Biology, Psychology, Philosophy, Math), and would be able to engage neural and cognitive science in new ways through the coherently cross-referencing collection of neuro/cognitive themed courses the proposed minor program would provide.

Finally, we continue to realize longer-term benefits from the workshop that help support sustainable interactions, as members of the group continue to circulate emails alerting everyone to current science that might be of interest to some, or all, of us. In addition, we have had further electronic discussions on how to move forward on plans for a minor program.

(Assessments by individual participants appended below)

Participant Assessment of Brain, Behavior and Mind

Ginger Withers (Biology)

- 1. the workshop's success (or lack thereof) in meeting the goal of encouraging creative inquiry into the possibilities of cross-disciplinary teaching and learning;*

I would rate this workshop as extremely valuable. First, it brought together a set of faculty across 3 divisions who all have a common interests in what properties of the nervous system make us human, and in understanding how the brain generates complex behavior. The disciplinary tours were useful both in helping familiarize each of us with the lingo and current debates of each of our disciplines, and in providing entrée into discussions/debates about what we, as card-carrying members within a discipline, can learn from the work that is going on in other disciplines. I, for example, directly benefitted from discussions about machine learning (if machines can do it, can we put a more fine point on why we think that our capacity for learning is special?), and from discussions about the mind as an emergent property of the nervous system.

From a practical standpoint:

- A) As a group, participants in the workshop have begun to identify what would be involved in offering an interdisciplinary minor in Brain, Behavior and Mind.**
- B) We talked about the structure of a new course that would be team taught by some, or all, or the group, and in our final meeting, began to plan a tentative syllabus.**

The discussed minor would have minimal staffing and resource implications, as the workshop participants appear to already offer a critical mass of courses that would be necessary for success of the program. The team-taught course was an exciting idea for me, and the rest of the group seemed to be equally enthusiastic. The challenge there would be to figure out ways to accommodate such a course in our respective loads.

- 2. and an indication of how each member anticipates incorporating the results of the workshop into his or her instruction*

In our Neurobiology class, Chris and I are working to include debates between those firmly rooted in the reductionist perspective (i.e. we can only understand the mind by studying the elemental components of the nervous system) vs. those cognitive scientists and philosophers who maintain that the mind cannot be understood at that level.

During the workshop, we brainstormed about other ways to strengthen the nature of cross-disciplinary interactions by sharing equipment and resources, and came up with some suggested readings.

Thomas Knight, Biology

Our workshop was a success in that we explored each other's academic perspectives on "the mind" and openly discussed ways in which we could work together to generate new instructional materials, new interdisciplinary courses, and possibly a neuroscience minor. Neurobiology and behavioral neuroscience are my areas of interest, and it was very exciting to be examining these topics with invested colleagues for the first time in my tenure at Whitman; in this regard alone, I consider this a successful project. Based on our discussions, there seems to be interest in working to integrate existing neuroscience courses and forging new offerings. I am very interested in this possibility for at least two reasons: 1. It might allow me the opportunity to teach a course directly related to my interests; 2. I believe that a formal neuroscience concentration, minor or even major would benefit Whitman and its students. This workshop demonstrated that we do have a critical mass of interest and ability for moving in this direction.

I currently do not teach a course that is directly focused on neuroscience, except where I advise thesis research students working on my own research projects — this makes incorporation of workshop results into my course offerings difficult. Based on Biology department curricular needs — my courses are major-required courses — I will not be able to alter the content of my introductory biology course or physiology course substantially to allow exploration of neuroscience. This does not preclude, however, an enriched experience for students, since I will likely find a way to introduce readings, examples, definitions, references, etc. into these courses for those students interested in supplemental, interdisciplinary, neuroscience-focused information. Certainly this workshop has provided me with more information for advising. What is more exciting is the prospect of working with this group to develop new course offerings. Our departmental curriculum may shift slightly in the next few years, and Leena and I may be free to develop a course in neurophysiology or behavioral neuroscience. If we were able to offer a new neuroscience course such as this, Whitman would have sufficient offerings for a neuro-related minor; at a minimum, a course like this could be cross-listed for Biology, Psychology and Neuroscience. Indeed, as a start, our workshop group has already begun developing an interdisciplinary seminar course for neuro-interested students of any major.

Finally, this workshop showed that we have the breadth of interest and ability to connect as colleagues to design a minor of study in neuroscience. Most of us in the workshop have served as advisors for several Independently-Planned Majors (IPMs) focused on neuroscience and such a minor would be sure to attract several students every year. Given the interdisciplinary nature of neuroscience, most agree that it is feasible for us to develop a minor that complements and serves currently existing major programs and our own research programs.

Leena Knight, Biology

I was excited to be a part of this workshop exploring “brain, behavior, and mind” given that neurophysiology and neuropathology are my areas of interest and expertise and because I don’t currently have the opportunity to teach in these areas. This workshop was a success from the beginning if for no other reason than I was able to discuss neuroscience with enthusiastic colleagues. We, of course, went beyond this, exploring each other’s academic perspectives on the mind and openly discussing ways to incorporate our various ways of thinking into new instructional materials and courses. We also considered the possibility of a neuroscience minor to help streamline the student interest in this area and make our collective areas of brain study readily available to our students. Based on our discussions, there seems to be a general interest in working to integrate existing neuroscience courses and developing new offerings. I am very interested in this possibility because it might allow me the opportunity to teach a course directly related to my interests, and because I believe that a formal neuroscience minor or even major would benefit Whitman and its students.

I currently do not teach a course that is directly focused on neuroscience, except where I advise thesis research students working on my own research projects — this makes incorporation of workshop results into my course offerings difficult. Given the Biology department curricular needs — my courses are major-required courses — I will not be able to alter the content of my courses substantially to allow exploration of neuroscience. However, the workshop has introduced me to readings, examples, literature resources, etc. in the broader discipline of brain and mind that make me better equipped to advise students needing supplemental or interdisciplinary neuroscience-focused information. I am more excited at the prospect of working with this group to develop new course offerings, perhaps an offering that spans two or more departments and is truly cross-disciplinary. Our workshop group has already begun developing an interdisciplinary seminar course for neuro-interested students of any major, which would be incredibly appealing to many Whitman students. Given the interdisciplinary nature of neuroscience, I think it is feasible for us to develop a minor with an upper level, cross disciplinary seminar course that complements and serves currently existing major programs and our own research interests.

Wally Herbranson, Psychology

My primary hope entering this CDTLI workshop was that I would gain a better understanding of the methods and theories that various individuals with different backgrounds (the participants) used to approach common topics of interest (brains and minds). I believe that goal was accomplished. Our initial meetings were each led by one or two group members, who provided a general tutorial on their area of specialization. Those tutorials covered an impressive amount of territory, and spanned several levels of organization, ranging from the detailed cellular mechanisms of brain function to abstract philosophical concepts (and many points in-between). I was pleasantly surprised by how much material was covered without much redundancy. While I'm not sure we always got the essence of everyone's presented material (perhaps we are weak students?), I do think we acquired a sense of where we all are on the academic landscape. Later, we read a recently published book by V.S. Ramachandran, a prominent figure in the world of neurology. While we had the standard criticisms that academics will level against any book that is written for a non-specialized audience, our discussion provided a rewarding opportunity to talk about a common work from each of our varying perspectives. We finished by brainstorming about some ways to remain in contact, and possibly expand our conversations to include students and/or other individuals.

In hindsight, I perceive our various views as being largely consistent (or at least compatible). This observation is not terribly surprising, but is nevertheless comforting. As reflected in my primary goal, I think it is useful to know where in the curriculum each of us leaves off and others pick up. It would be impossible for any one individual to maintain expertise in all of the levels we visited during the workshop. As a group, however, we seem to cover the spectrum with enough overlap to maintain effective lines of communication. Coming out of the workshop, I'm planning to subtly modify some of my classes (most notably, Psych 360: Physiology of Behavior) to make reference to other courses where appropriate, and to more closely tailor the content to my niche. That should allow me to bulk up areas that are unique to my field, and perhaps whittle away at elements that are covered elsewhere (as well as to point students toward the relevant resources if they want to explore those different approaches).

Moving forward, I am especially motivated by two additional but more tentative possibilities. One is an interdisciplinary course or reading group. This possibility is compelling because the field of neurobiology progresses rapidly, and in many different directions simultaneously. Continuation of the workshop in one form or another would enable us all to stay current on new developments, even if they are not closely related to the literature we actively monitor. A second possible extension is the establishment of a minor that crosses departmental boundaries. While the details may not be easy to coordinate, I think we do have the interest necessary on the part of both students and faculty.

Matthew Prull, Psychology

The focus of this workshop was to address how behavior and mental life can be studied and understood from the perspectives of biology, philosophy, psychology, and mathematics. The workshop began with “institutional tours,” each of which was led by different faculty members. The biological perspective, represented by Leena Knight, Tom Knight, Chris Wallace, and Ginger Withers, focused on understanding normal and abnormal behavior and mental functions in terms of the structure and functioning of the central nervous system. The philosophical perspective, represented by Rebecca Hanrahan, focused on the various perspectives from Descartes to the present that were developed through logic, analysis, and argument. The psychological perspective, represented by Wally Herbranson and Matthew Prull, focused on assumptions and methods for studying cognitive processes and included discussions of the potential adaptive functions of mental processes and the utility of cross-species comparisons of behavior. Last but certainly not least, Doug Hundley represented the mathematical perspective by focusing on the degree to which behavior can be mathematically modeled, as well as a consideration of whether behavior and cognitive functions can be simulated by computers. One or two workshop members presented their perspective as part of an informal 2-3 hour meeting; one or two such meetings occurred on a particular day.

The second part of the workshop brought all the members and perspectives together in a common discussion about V. S. Ramachandran’s book *The Tell-Tale Brain*, which we all read; this meeting was designed to continue the exchange of different perspectives, this time oriented around a common work. Finally, the culmination of our workshop consisted of an informal meeting in which group members were afforded opportunities to share course resources, software, and literature with each other. Moreover, we had a lively discussion about what a team-taught course in cognitive neuroscience might look like, and we briefly discussed the possibility of initiating a cognitive neuroscience minor at Whitman.

On the whole, what I took away from this workshop is a richer and deeper understanding of the ways in which behavior and mental life are studied from some of psychology’s nearest intellectual neighbors. This understanding of some of the major principles, ideas, and methods of study across the disciplines will undoubtedly provide immediate and tangible benefits in terms of teaching. The notes and handouts provided by the presenters will be particularly useful — indeed, I have referred to several of them already as resources in my teaching of the biological side of psychology in *Introductory Psychology*, and I believe I will refer to these same resources again in *Cognitive Psychology* and perhaps also *Seminar in Human Memory*. Thus, the handouts and notes will assist in altering the content of my existing courses, primarily by providing me with resources to elaborate more fully on course topics that are already a part of those courses. Finally, although perhaps not directly related to teaching, I believe it is worth mentioning that I developed a much deeper appreciation for the work that my colleagues do. This workshop not only provided an opportunity to learn from each other about a topic of common interest, but also contributed to an enhanced level of camaraderie and mutual respect.

Doug Hundley, Mathematics

The goal of the workshop was to build connections between very disparate disciplines (Mathematics, Biology, Psychology and Philosophy) using the brain, behavior and mind as the underlying model. In support of this goal, our group undertook six sessions over the summer, each lasting about 3 hours. Each of the first 4 sessions were organized about the discipline of the speaker, and the last two sessions were to investigate more specific connections between the disciplines.

From my perspective, the sessions were all very well organized, and all the symposia (except my own of course) brought in topics that I had not considered before- In fact, very often points that were completely unexpected would become major topics of discussion- I thought this was an excellent way for us to become better acquainted with each other's discipline and to see what threads ended up being common throughout.

Even though the biologists outnumbered the mathematicians and philosophers by a ratio of 4 to 1, one thread became very clear as we progressed- That was a question of "scale"; One thread using scale was somewhat obvious since Professors Withers and Wallace are cellular biologists and the Professors Knight are more systems biologists, but there seems to be a point, what was called a transition point, where there is a huge leap in what the neural model can accomplish. Exploring this transition point in various contexts was very helpful.

Personally, I think I probably benefited the most from interactions with our resident Philosopher, Prof. Hanrahan, since the issues she raised were probably the farthest away from things I usually consider in my work. Although I should mention that I found all of the presentations to be exceptional and well encapsulated the heavy bio background and highlighted current issues.

Finally, the choice of text was very good- V.S. Ramachandran is both eloquent and rather controversial, so there was no lack of material in his book from which to draw us out during our 5th open session.

The ideas we discussed will be very helpful in my teaching as we transition from the old modeling course to a new statistics based modeling in the mathematics department- I am in the process of creating a new course in machine learning, and will be able to assist the other departments in fashioning a "brain, behavior and mind" minor.

A big "thanks" to Chris Wallace for his willingness to be the primary organizer and doing all the work that went with it!!

Rebecca Hanrahan, Philosophy

Across campus, there are a variety of faculty members from a variety of very different disciplines all of whom explore questions concerning the nature of the mind. The purpose of this workshop was to bring us together so that we could breach the disciplinary boundaries that divide us by developing a shared vocabulary and a shared set of questions.

We met six times during the course of the semester; each meeting lasted about three hours. The first two sessions were devoted to neurobiology, the third session was devoted to psychology, and the fourth session was split between mathematics and the philosophy of mind. In the fifth session, we discussed V.S. Ramachandran's *The Tell-Tale Brain* (which I loathed***) and in the final session, we discussed our classes and how we might construct a cognitive science minor.

I must admit that I was the least prepared for this seminar. One of my areas of research is the philosophy of mind but yet I know little about the brain and how it works. This, though, is the primary area of expertise for four of my colleagues and the two in psychology have command of the basics of neurobiology. While I was as a consequence handicapped in my ability to follow the conversation at certain points, what was fascinating to me were the moments when the conversation veered (sometimes accidentally) into the philosophical. One of the issues for me became how the participants in this seminar were conceiving of the relationship between the mind and the brain. At times, they leaned towards identifying the one with the other. At other times, they seemed to reject this identification. And then at yet other times, they seemed to reject the need to answer the question as to whether the brain is the mind.

The other issue that arose for me concerned whether or not the participants were using metaphors in their descriptions of the brain. In what sense do cells communicate or is this "communication" merely metaphorical? When there is a synaptic misfire, should this misfire be understood as a "misrepresentation?" When there is no misfire, is "information" being passed? This is an issue I would like to explore further. I do believe there are metaphors at work here and in future iterations of Philosophy of Mind I would like to consider what these metaphors illuminate and what they obscure.

I firmly believe that this session marked the beginning of a conversation and that lots of work needs to be done for us to see within each other's disciplines. One way we might move forward with this task is if we continued this workshop but narrowed its focus to, for example, perception. Each of our disciplines speak to this topic in ways that might interestingly overlap. Also, all the participants in the group are enthusiastic about the possible creation of a cognitive science minor. I think the process of creating such a minor will push the conversation between us further in such a way that might bare real intellectual fruit for us as scholars and teachers.

**** *Ramachandran is a neurobiologist and in this book he treated other disciplines within cognitive science as mere handmaidens to his discipline. Oh yeah, he also presented a thought experiment as his, when it wasn't. In my world, that counts as plagiarism.*