

Teaching Introductory Cognitive Science at Lehigh University: Two Approaches

Ideally, given the interdisciplinary nature of cognitive science, any introduction at the undergraduate level should be team-taught. Such was the practice at Lehigh for several years following the inception of our program (see earlier pieces by Malt & Melchert, 1988, and Kay, 1992, in *CogSci News*). As increased budgetary consciousness came to weigh against such collaborations, however, it has become usual to assign the course to a single instructor. Each instructor must now contend not only with his or her own disciplinary limitations, but with the task of presenting a unified survey of cognitive science without other-disciplinary colleagues to lean on. Most recently, this Herculean task has been assumed by Mark Bickhard and Alex Levine who here report on their distinct *historical* and *thematic* approaches to the problem of being all of Cognitive Science to novices.

A Historical Approach to Teaching Introductory Cognitive Science

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Introductory Cognitive Science at Lehigh generally has a broad mix of students, both with respect to their majors and their years in school. But the course is

intended to attract first year students in particular, and this has produced a problem in teaching. Specifically, available textbooks for Cognitive Science seem to be inappropriate for one or both of two reasons: 1) they are not genuinely interdisciplinary cognitive science texts, but, instead, focus primarily on one of the affiliated disciplines, usually artificial intelligence, or 2) they are too advanced for most first year college students.

I have found two books that offer an interdisciplinary introduction: Stillings, Weisler and Chase's (1995) *Cognitive Science: An Introduction* and Ó Nualláin's (1995) *The Search for Mind*. Stillings et al. provides a powerful overview that is truly interdisciplinary, but it moves too strongly into advanced discussions that first year students find unacceptably difficult. It is also difficult to isolate the advanced passages and to focus on the more introductory discussions because they are thoroughly mixed. Stillings et al is a book with a grand sweep that would fit extremely well in an introductory course for more advanced students.

Ó Nualláin is a shorter book, but it too moves too fast and assumes too much for use in an introductory course. Ó Nualláin is also a polemical book, and so would serve well in an advanced course, both for filling out narrower horizons and for stimulating discussion: there is something to outrage everyone, and it will surely keep interesting controversy going (Bickhard, 1997).

In response to this difficulty in finding a single interdisciplinary text, I have adopted a historical approach to introducing Cognitive Science, with several texts selected to fill out this history, and no privileged core text. The course begins with Gardner (1985). Gardner is powerfully interdisciplinary, and explicitly historical in its approach. He slights, in my judgment, the influence of Piaget early in the history of cognitive science, and, like all authors, has his own definite axes to grind, but the book is overall a good beginning. Students like it, and it provides a broad background for the contributions and relevance of all of the major disciplines associated with cognitive science. There are two related problems with Gardner: 1) it only follows the history up to the middle 1980s, and, correspondingly, 2) in light of more recent developments, some of the discussions of the issues at the time of publication now have a slightly dated air. Nevertheless, it has worked well over several years of using this historical approach.

For several years, I then turned to Crevier (1993) for a history of Artificial Intelligence, and to selections from Bechtel & Abrahamsen (1991) for connectionism. Crevier worked adequately, but was too light and in any case is now out of print. Bechtel & Abrahamsen served well, but as connectionism has waned in its frontier importance, the detail

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of coverage began to become a little inappropriate, and it could not address the most recent developments in the field. Both books, of course—through no fault of their own—violated the basic interdisciplinary character of Cognitive Science.

This year I have replaced both Crevier and Bechtel & Abrahamsen with Franklin's (1995) *Artificial Minds*. Franklin offers an explicitly historical discussion, and in this sense is highly tuned to the overall design of the course. He organizes the book around three major phases of cognitive science history, individuated by the dominant and frontier approaches to representation and mind. This is strongly parallel to my own view, and so, obviously is congenial. The first phase was the classic computational or symbol manipulation phase; the second revolved around connectionism; and the third is identified by Franklin as being constituted by situated and autonomous agent approaches. I would put more emphasis on the agents than on situatedness per se, but otherwise concur with Franklin's organization. Franklin's book is partly interdisciplinary, but makes no special point of covering the range of cognitive science disciplines. The discussions, however, often turned out to be on the light side.

In the past, I have followed Crevier and Bechtel & Abrahamsen with some of my own work. In Spring 2000, I followed Franklin with Bickhard (1996), selections from Bickhard & Terveen's (1995) *Foundational Issues in Artificial Intelligence and Cognitive Science: Impasse and Solution*, and some newer papers of mine (Bickhard, in press-a, in press-b). This served both to give some substance to the ranting that I had been doing up to that time in the semester, and to give at least one sample of fully contemporary work.

These readings also transition naturally into the robotics and autonomous agent focus of the last book in the class, Clark's (1997) *Being There*. Clark's book is primarily philosophical, and so does not fully carry forward the interdisciplinary theme. But Clark is sensitive to the fact that the agentive approach itself borrows from multiple disciplines, and so the book retains an awareness of the underlying interdisciplinary nature of the field. Clark also has his own focus on these issues, one that I don't fully agree with, but the book is a good read, and makes for a successful close to the class discussions, which tend

to range far beyond the explicit contents of the readings. A recent book that might also serve for this most recent historical phase is Pfeifer and Scheier's (1999) *Understanding Intelligence*, but Pfeifer & Scheier is 1) massive, and 2) focused much more on design principles than is appropriate for a strictly introductory course. Nonetheless, the next time I teach the class, I will consider using excerpts from Pfeifer & Scheier.

The historical approach has been the only way I have so far found to capture the interdisciplinary character of cognitive science while also maintaining the first year introductory character of our course. It has allowed me the flexibility to put together the necessary coverage, and to replace some of that coverage as necessary and as desirable over time.

The historical approach, however, is not just a resort of necessity but has distinct advantages. Without a sense of the history of the field, it is much more difficult to understand how and why the field, and its various parts, have arrived at their current positions. Without knowing what the historical failures of computationalism were, for example, students are left to uncover for themselves the fundamental underlying issues—and such individual level historical recapitulation is seldom a successful strategy. Without understanding the previous errors that historical shifts were motivated to solve, it can be impossible to understand why those shifts occurred at all, and that includes the shift to the most recent phase.

Science is a historical process, building on previous attempts and their successes and failures. Robotics, autonomous agents, dynamic systems, and related approaches are now at the frontiers of the field not just because of historical whims, but because computationalism and connectionism were not adequate to problems that were accepted as central to the field. That, of course, is not to claim that computationalism and connectionism have been or should be abandoned, or their study curtailed. In fact, computational and connectionist contributions have been incorporated into robots and autonomous agents. However, this is a much more subtle process than merely persisting with computational and connectionist models per se, and it is that kind of subtlety that needs to be understood by students. In my view, such understanding is not an advanced deeper level that follows on lengthy study of computationalism and connectionism per se, but is essential and

extremely useful to real understanding of computationalism, connectionism, and autonomous agents, even at a rudimentary, introductory, level.

Historical approaches to scientific fields are rare outside of history courses, but they offer strong advantages nevertheless. If education is more than just filling the empty buckets on top of students' shoulders with facts (Popper, 1965), but has instead to do with understanding and skill at thinking, understanding the history of a field, including its errors, offers a much deeper understanding of the field per se.

Cognitive Science Dressage: Teaching Interdisciplinarity to the Undisciplined

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Francis Bacon is credited with having called philosophy the "Queen of the Sciences." Since this dictum gives my home discipline pride of place, I've always found it appealing. But in the Spring 1999 semester, while teaching our Introduction to Cognitive Science for the first time, I came to appreciate the true meaning of the Baconian slogan. Philosophy is indeed a queen of the sciences: a drag queen, a beautiful, seductive impostor. For a philosopher, the trick to introducing neophytes to cognitive science consists in harnessing the seductive imposture of philosophy in the service of an interdisciplinary ideal.

I opted to structure my course thematically, as opposed to historically. Two prized philosophical chestnuts, the mind-body problem and the problem of other minds, are gripping enough to furnish some sort of thematic unity even in a course whose primary thrust is not philosophical. It is possible, with some artifice, to represent much of the work done within the various contributing disciplines of cognitive science as addressed toward one or the other of these problems. Toward this end, I found Paul Churchland's dated, but eminently accessible *Matter and Consciousness* (1988) a useful introduction, which I followed with readings from John Haugeland's (1997) *Mind Design II* anthology and a collection of contemporary

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readings selected to counter Haugeland's engineering bias. I originally assigned Barbara von Eckhardt's *What is Cognitive Science* (1995), but to my chagrin the students could not follow it, and the text had to be abandoned.

The thematic option has advantages and disadvantages. One advantage is that the choice of unifying themes allowed me to play to my own strengths. In my experience, students know when one is trying to pretend to be what one is not. I could not pretend to be something other than a philosopher of mind with some knowledge of how my field contributes, along with other disciplines, to the grander project called cognitive science. One obvious disadvantage of my approach was that some of the contributing disciplines of cognitive science received rather cursory treatment. Philosophy, psychology, and computer science were well represented, neuroscience and linguistics less so, and anthropology hardly at all. In cognitive science, any choice of unifying themes, my own included, inevitably imposes an illusory coherence on what, in reality, is a collection of very loosely connected research projects. Something gets lost in the process.

And so, a philosopher in drag as a cognitive scientist, I presented what I thought would be a seductive sampling of relevant work. I was aware of the masquerade, though, and honesty demanded I let my students in on it too. What consoled me was my certainty that the illusion of cohesiveness was a necessary compromise. Though I could only regret the limited scope of my own disciplinary training and experience, no doubt any psychologist or neuroscientist faced with my task would labor under corresponding limitations. More important, the very idea of teaching an introduction to cognitive science for first- and second-year students is fraught with contradiction. In order to have a successful major program, we must recruit students early. Toward this end, some entry-level course is called for. However, most members of our target audience are obviously too new to their studies to have any firm disciplinary grounding. We must teach interdisciplinarity to the undisciplined.

I suspect that this predicament remains regardless of who teaches the course, or what thematic or historical unifying

framework is selected. There are various ways of addressing it, but perhaps the only way to make it disappear entirely would be to return to team-teaching the course, making it a collaborative effort by experts in several different cognitive science disciplines. As pedagogically attractive as this option seems, resource limitations prevent it from being put into practice, at least at Lehigh in 2001.

So as I look forward to teaching the introduction to cognitive science again in the Spring of 2001, my thoughts have turned to improving my drag. A true team-taught course remains an impossibility, but five colleagues in other disciplines have agreed to give guest lectures. They had better not even think about backing out. Readings are also being tweaked. The new anthology edited by Rob and Denise Cummins is promising (*Minds, Brains, and Computers—The Foundations of Cognitive Science*, 1999), and I am also considering making up for my neuroscience deficit with Gazzaniga's new *Cognitive Neuroscience: A Reader* (2000). *Mind Design II* will remain, and though I'd really like to find a more up-to-date replacement for *Matter and Consciousness*, so far none of the candidates seems appropriate.

I end with a note regarding assigned work, from which, if it's well conceived, students tend to learn more than they ever could from readings alone. Whatever misgivings I may have had regarding my choice of themes and readings, I was pleased with student reaction to my assignments, two short discursive papers and a slightly longer one. Most achieved good results on their final papers, for which I required what, for first- or second-year undergraduates, must have seemed like a lot of research. To ease the burden, I prepared an extensive bibliography and a file of key source readings, to which I referred in individual student conferences about three weeks before the due date. But I also required that all students come up with at least three sources on their own. In the end, I received a surprising number of carefully researched, well thought-out essays, whose authors had achieved a gratifying appreciation for the complexities of cognitive science research. So I conclude that successful dressage should be evaluated in terms not only of the disciplinarity, but of the scholarly discipline imbibed by the subject. That, after all, is much of what undergraduate education is about.

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