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# Cognitive Science Is and Should Be Pluralistic

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## Abstract

Núñez et al (2019) argue (1) that the field of Cognitive Science has failed, in that it has not arrived at a cohesive theory, and (2) that this is contrary to the intentions of the founders. Their survey of publication and citation patterns bears out the lack of a cohesive theory and also provides corroboration for (3) the concern that the field is becoming unbalanced, with psychology overweighted (Gentner, 2010). I will argue against points (1) and (2), but agree with point (3). My central claim is that cognitive science was never meant to have one unified theoretical framework, nor should it have.

*Keywords:* Cognitive science; Multidisciplinarity; History of cognitive science

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## 1. Introduction

Núñez and colleagues argue that cognitive science has failed. There are two key elements to their argument: first, that cognitive science “was meant to have a cohesive subject matter, complementary methods, and integrated theories” (Núñez et al., 2019, Abstract); and, second, that it has failed to arrive at a unified cohesive view. The central point of their paper is that this failure to converge on a single view means that the field has failed and calls into question its future.

Núñez et al. are right that the field has not converged on a single unified theory. If anyone doubted this, the impressive array of evidence surveyed by Núñez and colleagues would be hard to dispute. But they are wrong that this is a departure from the aims of the founders, as elaborated below. More important, Núñez et al. are wrong that this

pluralism constitutes a failure. On the contrary, I will argue that cognitive science's openness is integral to its purpose and critical to its success. However, Núñez et al. make one point with which I agree entirely: Psychology has become far too dominant in the journal and the conference, a point I also made in my review of the history (Gentner, 2010). Pluralism is not a threat to the future of the field, but dominance by one field is.

*What defines cognitive science?* The Sloan Foundation 1978 report on cognitive science stated: "What has brought the field into existence is a common research objective: to discover the representational and computational capacities of the mind and their structural and functional representation in the brain" (Miller et al., 1978, p. 6). The multidisciplinary nature of the field was depicted in a figure showing the six constituent disciplines: psychology, artificial intelligence, neuroscience, linguistics, philosophy, and anthropology with their strong and weak interactions (Fig. 1, adapted from the Sloan report [Miller, Keysar, & Walker, 1978, p. 37]; see also Miller's [2003] reproduction). This characterization has remained remarkably constant over the years. For example, the *Stanford Encyclopedia of Philosophy* defines cognitive science as follows:

Cognitive science is the interdisciplinary study of mind and intelligence, embracing philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology. . . The central hypothesis of cognitive science is that thinking can best be understood in terms of representational structures in the mind and computational procedures that operate on those structures. (Thagard, 2002; last update, 2010)

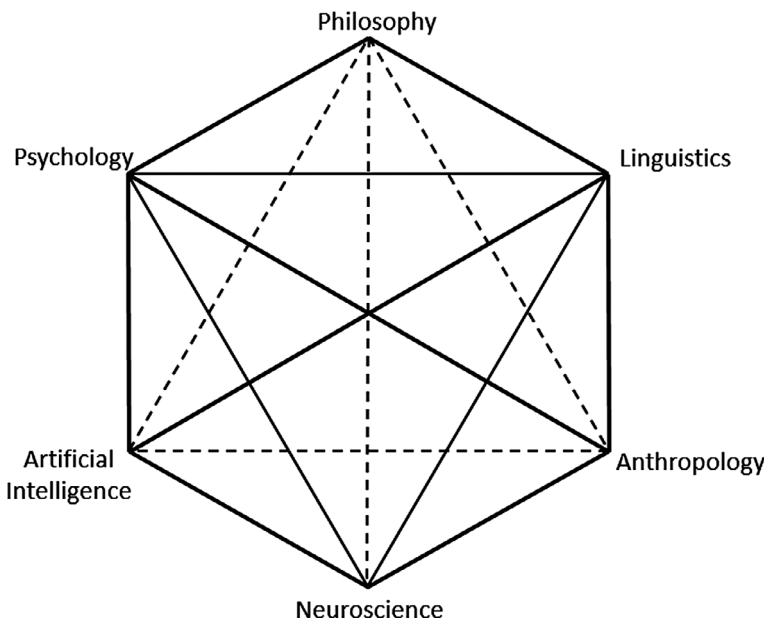


Fig. 1. Cognitive Science linkages (adapted from the Sloan Foundation's 1978 *State of the Art Report on Cognitive Science* [Miller et al., 1978]. See also Gardner's [1987] discussion.).

But although the central commitment has remained constant, the specific theories and research methods have changed enormously. This is only fitting. The constituent fields do not stand still, and neither should the interdisciplinary nexus called *Cognitive Science*. The rise of connectionism is a perfect illustration of the openness of the field. In the initial formulations of cognitive science, the representation level was taken to be symbolic. Despite this, when connectionist research and theory came on the scene in the 1980s, papers from this framework were published in the journal and presented at the conference. This was not a peaceful process; scathing dismissals were published on both sides, and fierce debates took place in print and at the meeting (e.g., Fodor & Pylyshyn, 1988 vs. Rumelhart & McClelland, 1987). But the outcome was a broader construal of possible types of representation. To again quote the *Stanford Encyclopedia*:

While there is much disagreement about the nature of the representations and computations that constitute thinking, the central hypothesis is general enough to encompass the current range of thinking in cognitive science, including connectionist theories which model thinking using artificial neural networks.

Likewise, situated cognition, distributed cognition, and embodied cognition—all of which ran counter to the idea of symbolic representations—were heard from at the meetings and in the journal. Not all of them caught on equally well. The extreme situated/distributed cognition view, that cognition is not in the head but in the environment, never became a mainline position. Embodied cognition—the idea that cognition is shaped by the body as well as the mind—has had greater impact. But no matter the outcome, the important thing is that debates around these ideas have made the field better—for example, by calling attention to the importance of context and physicality in shaping our representations. Had cognitive science congealed into a fixed framework early in its career, none of these would have happened. Further, the field would have missed the rise of comparative cognition and developmental cognition—two fields absent from the early discussions that have now taken their place at the table.

The point is that cognitive science cannot and should not aim for a crystalized theory. The component fields are constantly changing, and cognitive science needs to change too. Núñez et al. assume that the desired state of cognitive science is a single cohesive theory. I propose instead the metaphor of a multilingual set of people gathered to solve a common problem. It's unlikely that the six languages will evolve into a new combined language. Rather, each person does their best to become bi- or tri-lingual so that they can learn from others. The most productive interactions are likely to be dyadic or at most triadic, and which ones will take off cannot be predicted in advance. Every now and then, some group will hit on an arena in which enormous progress can be made, possibly leading to a new subfield. And apart from the big breakthroughs, little gems of insight will come floating along at more regular intervals. This includes disagreements—discovering that a neighboring field has made assumptions that contradict one's own can be quite enlightening.

*What did the founders intend?* According to Núñez et al. “this new science, explicitly named in the singular, was meant to have a cohesive subject matter, complementary methods and integrated theories.” I asked two of the founders, Don Norman and Allan Collins, this question.<sup>1</sup> Both replied and are willing to be quoted. Here is Don Norman’s reply (personal communication, August 2019):

When I helped start the formal discipline, the society, the journal, and the department at UCSD, I most definitely did NOT believe that there would ever be a single coherent view of cognition, not even in the definition of the term.

First, no discipline has a single coherent view. Every discipline covers so much territory, and so many different levels of analysis and different perspectives and goals, that coherence is not possible. I refer you to physics, chemistry, biology, computer science, psychology. . .

Second, Cognitive Science by its very nature extends from basic neuroscience (which in turn depends upon basic biology) up through human behavior, decision making, and belief systems. To take one simple example, both studies of the neurological basis of cognition and of the role of metaphor in thought and behavior are essential components of cognitive science. So too with the role of culture in language and behavior (and especially in the use of metaphor). I cannot imagine a single coherent theoretical perspective that unites these very different levels of analysis.

Allan Collins replied more briefly, but in the same vein (Collins, personal communication, August 2019)

I did not think about the issue of whether it was “meant to have a cohesive subject matter, complementary methods, and integrated theories” and I doubt that Roger or Don did as well. We just thought that AI and Psychology and Computational Linguistics were addressing related issues, and it would be good to have a journal that focused on the theoretical interactions between them.

Thus, it does not appear that cognitive science’s present pluralism is a fall from grace. From early on, the founders aimed for a fertile set of interactions, and not for a single theory to span them all.

### *1.1. The psychology takeover*

When the Cognitive Science Society officially began, in the late seventies, psychology was by no means the main player. The three disciplines that formed the core group were AI, psychology, and linguistics, with philosophy, neuroscience and anthropology playing

smaller roles. These priorities had grown up during the fifties and sixties, as Miller (2003) reviews in his essay on the cognitive revolution and the origin of cognitive science. As Miller describes, at Harvard's Center for Cognitive Studies, young psychologists met with brilliant and challenging senior scholars—including Jerry Bruner, Peter Wason, Nelson Goodman, and Noam Chomsky—to talk about the mind. They also met major European psychologists, whose tradition had never embraced behaviorism—notably Jean Piaget, Sir Frederick Bartlett, and A. R. Luria. And they encountered revolutionary work in computer science—Norbert Wiener's Cybernetics and Marvin Minsky and John McCarthy's Artificial Intelligence. The behaviorist grip on American cognitive psychology was ending and the ideas that would lead to cognitive science were invisibly taking root. By the mid-fifties, Alan Newell and Herb Simon were engaged in their seminal work at the intersection of AI and Psychology, using symbolic models to simulate human problem solving.

The Cognitive Science Society was incorporated in 1979 by Allan Collins, Roger Schank, and Don Norman. Schank came from AI, and Collins and Norman from psychology, with strong leanings toward AI. Two years earlier the same group, along with Eugene Charniak (AI) had founded the journal *Cognitive Science*. So of the four founding figures, two were in AI and two were psychologists with AI leanings. This balance of power reflected the feeling among those psychologists who embraced Cognitive Science that Psychology had a lot to learn from AI, as well as from other fields, including Linguistics and Philosophy (see Collins, 1977).

The balance of disciplines has changed radically over the ensuing decades. One way to look at this evolution is to consider the makeup of authors of papers in the journal *Cognitive Science* over the decades. Fig. 2 (adapted from Gentner, 2010) shows the proportions of authors from different disciplines in the first two issues of *Cognitive Science* in each decade from 1978 to 2008. The proportion of papers authored by psychologists increased steadily from about a quarter of the papers in 1978, to over half in 2008, leading me (in 2010) to make the gloomy prediction that by 2038, psychology would vanquish the other fields entirely and establish total dominion over cognitive science.

A recent analysis<sup>3</sup> by Cooper (in press) partly bears out this concern. He finds that already by 2002–2004, over 70% of the papers submitted and/or published in the journal *Cognitive Science* were from psychology—considerably more than the roughly 50% that I estimated. However, Cooper's data also show a slight downturn in psychology submissions (from 78.0% in 2002–2006 to 70.7% in 2015–2019)—possibly indicating an asymptote. Also, positive is an increase in linguistics submissions from 21.3% to 25.2%—though much of this gain is in psycholinguistics, which could count as psychology as well as, or instead of, linguistics. But on the negative side, philosophy and anthropology submissions have dropped from their already low levels. Of more concern, there has been a steep drop in submissions from AI and Computer Science, from 25.3% to 11.6%. As Cooper notes, without the perspective of computational methods, the potential of cognitive science will be limited (Cooper, in press, p. 7).

If psychology has indeed plateaued at around 70%–75% of cognitive science, perhaps a full takeover is not in the offing. But 70% is still a matter for concern. The mix of

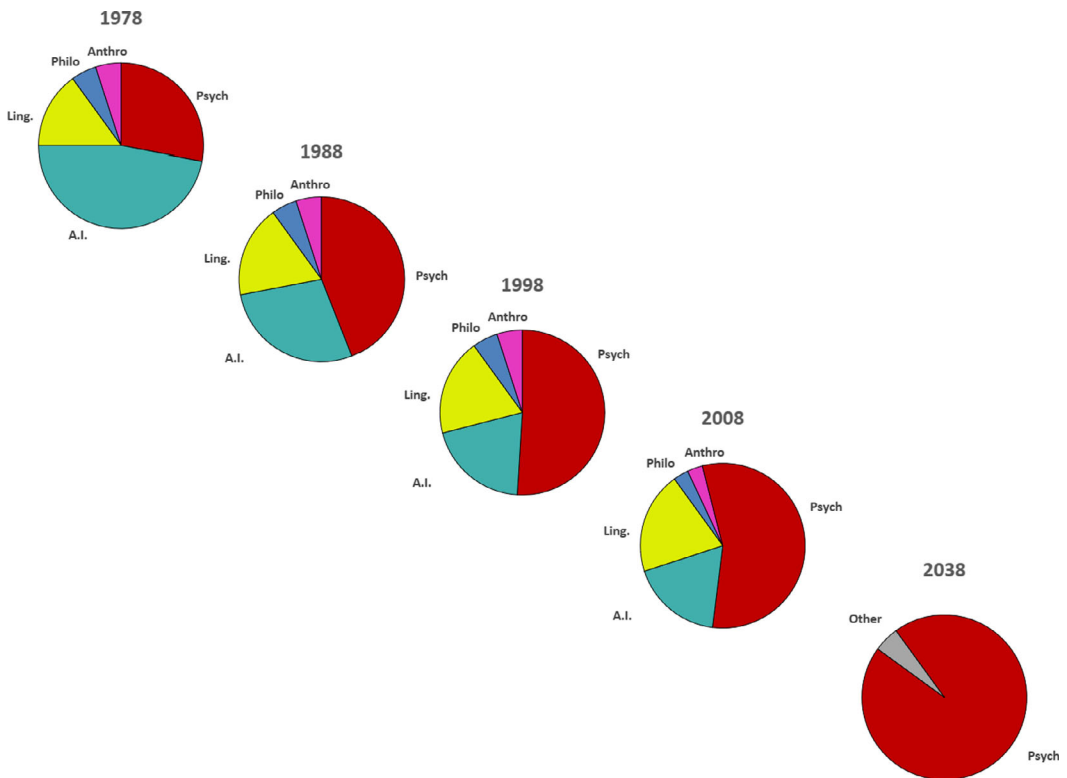


Fig. 2. Proportion of authors by discipline in the first two issues of *Cognitive Science* in each decade, beginning in 1978. If present trends continue, then by 2038, Psychology will have completed its conquest of *Cognitive Science* (Gentner, 2010).

disciplines and theoretical views in cognitive science has been the lifeblood of cognitive science. It has also enriched the contributing fields; indeed, psychology has been a major beneficiary. Psychology has been massively influenced by cognitive science, and it has thereby become a far more interesting field. It is now acceptable in cognitive psychology to articulate theories of internal mental structures and to develop intricate computational models. The current dominance of psychology in the journal and the conference risks cutting off the stream of interactions that breed this new knowledge.

What should be done? Some simple steps would help. First, reviewers for the journal and the conference should stop insisting that every paper involve experimentation with human subjects. A well-conceived computational simulation or corpus analysis should be considered publishable without new human experimentation (see Forbus, 2010). Second, the review boards of the journal and the conference should include members of all the constituent fields, and when possible, the major subfields. Third, conference organizers should strive for disciplinary breadth in the invited symposia. Fourth, Program Committee members when reviewing symposia for the Cognitive Science conference should give positive weight to disciplinary breadth. Finally, more generally, we must guard against a

“rich get richer” effect: It is easier to recognize excellent work in our own arena than in others, so unless we strive for disciplinary diversity, the preponderance of psychologists in the field will lead to more of the same.

Some of the disciplinary imbalance is out of our control. The number of philosophers interested in directly participating in cognitive science has always been limited. The same is true for cognitive anthropology, despite our continued interest in cultural factors that may influence cognition. Many AI researchers now work in industry on projects that do not require thinking about the nature of cognition. But that is all the more reason to remove barriers for people from these fields who do want to participate. On the positive side, some areas are far more prominent now than they were at the outset. Education, cognitive development, comparative cognition, and language and cognition are now part of the mix, having been essentially absent at the outset, and psycholinguistics is growing in its share. Neuroscience has grown from a trickle to a sizable contributor. Thus, there is still a rich mix of valuable intersections.

## 2. Conclusion

Cognitive science is doing fine. It retains its core commitment to the importance of representation and processing, albeit with greater flexibility as to the exact nature of these than in 1978. Cognitive science expressly does not have a single cohesive theory, nor should it. Its open character has allowed it to evolve as its constituent fields change, allowing the mix of disciplines to seed new ideas. Far from being a fault, this pluralism should be celebrated and preserved.

## Notes

1. In both cases, I sent the Núñez et al. article and asked, roughly “Is it true that when cog sci was founded, it was meant to have a cohesive subject matter, complementary methods, and integrated theories?”
2. This section is adapted and updated from my previous discussion of the history of psychology in cognitive science (Gentner, 2010).
3. Cooper (in press) traced which fields were listed by authors who submitted papers to Cognitive Science from August 2002 on.

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