Welcome to Cognitive Science: The Once and Future Multidisciplinary Society

Wayne D. Gray

Cognitive Science Department, Rensselaer Polytechnic Institute

1. Introduction

Colleagues, friends, and readers. I read/heard the news about *the Núñez paper* on the morning of June 14th 2019. It was there in my emails, all over the CogSci twitter feeds, and in the considerable consternation expressed by many members of the Cognitive Science Society Governing Board (GB). I wondered at the time, why the gnashing of teeth? After all, have not the words, "A Multidisciplinary Journal" been the subtitle of our flagship journal, "Cognitive Science," since its founding? Why would we adopt that title and why would we keep it on the cover page of our journal all of these years if we did not believe this description helped to clarify our intentions? And why would someone accuse us of failure for being something that, each month with each issue of the *Cognitive Science* journal, we boldly declare that we are? In any case, occasional self-examinations and self-reassessments are as important to professional societies as they are to individuals. With that goal in mind, this topic was born with a ruthless deadline; namely, to recruit a small number of short papers written by those in our field who found some aspect of the challenge posed by Núñez *et al.* (2019) to be engaging, and to write, edit, and publish those short papers in the next (i.e., the October 2019) issue of this journal.

2. Overview of the papers

2.1. Schunn (1)

Christian D. Schunn (Learning Research and Development Center, University of Pittsburgh) is noteworthy in our field for turning his attention to bibliometric techniques decades

before Núñez (Schunn *et al.*, 1998) (also in the list of bibliometric analyses, see Rothe *et al.*, paper in our 2018 proceedings). I was trained to mistrust conclusions drawn from data in the absence of evidence that a data manipulation actually varied what the authors claimed it varied, or absent evidence that the analyses performed actually supported the conclusions the authors drew. As bibliometric analyses have their own techniques and methods, I asked Chris to take a critical look at the data Núñez presents and the analyses performed in that paper. Chris (this issue: *What Should Cognitive Science Look Like? Neither a Tree Nor Physics*) does an excellent job of explaining to our community what Núñez did, what he should have done, and the distance between the conclusions which Núñez published versus the conclusions that might be supported by the data and analyses performed. (Note that as Schunn's paper was "commissioned by the Editor" I place it first in this collection. The rest of our papers are listed alphabetically by the author.)

2.2. Bender (2)

Andrea Bender (Psychosocial Science & SFF Centre for Early Sapiens Behaviour, University of Bergen, Norway) discusses the Núñez complaints through the lens provided by her many contributions to this journal, *Topics in Cognitive Science (topiCS)*. These contributions include her strong role as a member of the Senior Editorial Board of *topiCS* as well as the several collections of papers which she and her late husband, Sieghard Beller, recruited, organized, and edited for this journal.

Andrea proposes this journal (i.e., *Topics in Cognitive Science*) as a model for the field and also points to the vast differences in the size of the community of Psychological researchers (118,000 members in the American Psychological Association) versus Anthropology (10,000 members in the American Anthropological Association). In addition to the shear differences in number of anthropologists and psychologists, Andrea discusses vast differences between Psychology and Anthropology in publication traditions which are not reflected in Núñez' analyses. She then provides her own analyses which compare the presence of anthropological terms in the keywords and titles of papers published by this journal. Indeed, she argues that some of the most transformative ideas in cognitive science, ideas embodied by terms such as "distributed and embodied cognition," methods like cross-cultural studies, and research topics such as cultural evolution have been absorbed into the Cognitive Science mainstream from Anthropology. Hers is a wide-ranging but exceedingly interesting paper which I strongly recommend to all interested in this debate.

2.3. Broude et al. (3)

Led by Gwen J. Broude, in "Rumors of Our Death . . .," the entire Cognitive Science Department of Vassar College (which also includes Kenneth R. Livingston, Joshua R. de Leeuw, Janet K. Andrews, and John H. Long, Jr.) weighs in with the Monty Pythonesque message of "not dead yet." Theirs is a story of academic realities and a long view of the evolution of other fields including Physics, Chemistry, and Biology. As a field that touches on many disciplines, it seems inevitable that many core researchers will inhabit

departments in those "other" disciplines and, as they will see their work as important to multiple disciplines, will publish in journals of those disciplines as well as journals tagged as "cognitive science." Their paper provides an interesting argument and we thank the entire department of Cognitive Science at Vasser for being the first department to publish a joint paper in *topiCS*; this, at least, bodes well for the future of our field.

2.4. Cooper (4)

As the current Executive Editor of the *Cognitive Science* journal, Richard (Rick) Cooper (Psychological Sciences, Centre for Cognition, Computation, and Modeling, Birkbeck, University of London) knows something about the breadth and depth of current Cognitive Science. His calm perspective on what makes a successful "interdisciplinary" versus "multi-disciplinary" program is reassuring as it seems to enshrine a "bridge too far" caution for integrating more than two disciplines at any given time. Likewise, his discussion of Lakatos versus Popper helps to clarify some of the confusion introduced by Núñez. After soaring with the philosophers of science, Cooper chides Núñez for first prioritizing the contributions of Psychology and Computer Science in the emergence of Cognitive Science and then complaining that those disciplines are more central than the other four hexagonal disciplines (i.e., the disciplines shown on the cover of the Cognitive Science journal and discussed in the original Mac Arthur Foundation report). Cooper then goes on to provide some original analyses of the data for papers submitted to the *Cognitive Science* journal. These analyses are interesting as they highlight long-term trends not captured by Núñez' approach and raise issues that should concern most cognitive scientists.

2.5. French (5)

Robert M. French (LEAD-CNRS, University of Burgundy, France) tells us that "it is true that cognitive science, as a unified, fully integrated science, doesn't really exist and, truth be told, never really did." And "It seems to me that cognitive science has become, if not the unified discipline that was hoped for in the late 1970s, an on-going and productive process of collaboration, largely, but not exclusively, between computational modeling/computational tools, neuroscience, and experimental psychology."

Bob tells us that economics "with its current emphasis on agent-based modeling and emergent decision-making, has become a full-fledged member of the cognitive-science community." And sees the field of evolution as filling the gap left by anthropology.

His bottom line is that cognitive scientists are people who want to better understand the mechanisms of cognition and are willing to make use of input from diverse domains to achieve that end. In other words, there is no need to define cognitive science as the confluence of computer science, philosophy, psychology, anthropology, neuroscience, and linguistics. Not only are we multidisciplinary but contrary to what is suggested by the seven disciplines on our cover, we are neither limited to those seven and, as our field evolves, nor should we consider the original six or current seven to be eternal components of our multidisciplinary mix.

2.6. Gentner (6)

Dedre Gentner (Psychology Department, Northwestern University) argues several points, none of which favor the view of Núñez and colleagues. It is not so much that she views the comments of Núñez as wrong as they are, but that she sees them as inconsequential for the development and progress of cognitive science. Cognitive Science's pluralism is a sign of its low walls – its openness to research and to researchers from a variety of disciplines; that is, it is not only multidisciplinary but (in common to the points raised by French) it is continually open to new disciplines, not bound to the original hexagon. In contrast to some of our other commentators, perhaps most notably Goldstone and French, she agrees with Núñez that Cognitive Psychology is too dominant.

A very interesting part of Gentner's argument is her recent (August 2019) exchanges with two of the principle founders of our field. Don Norman tells us, "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." Going further, Norman says, "no discipline has a single coherent view." As Cognitive Science, "by its very nature" extends from "basic neuroscience . . . up through human behavior, decision making, and belief systems," Norman concludes, "I cannot imagine a single coherent theoretical perspective that unites these very different levels of analysis."

The first editor of the *Cognitive Science* journal, Allan Collins, tells Gentner, "I didn't 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."

2.7. Goel (7)

Ashok Goel (Design & Intelligence Laboratory, School of Interactive Computing, Georgia Institute of Technology) has written a very thoughtful and unabashedly pro-Nunez paper. In contrast to many other of our "Response to Núñez" papers, he sees Núñez' reports as red-flagging a current crisis and seeks a forward path for Cognitive Science that would lessen the dominion of Cognitive Psychology. He also accuses the executive editors of our two society journals as being, "Cognitive Psychologists." His is an interesting, well-written, but very polemical paper, and we look forward to seeing whether or how his proposals are received.

2.8. Goldstone (8)

Long-time Senior Editorial Board member of *topiCS* Robert L. Goldstone (Psychological and Brain Sciences Department, Program in Cognitive Science, Indiana University) turns our attention from "Inter-disciplinary" and "Multi-disciplinary" approaches to the

"relatively uncommon class of 'integrative sciences'." He tells us that Integrative Sciences are a small class which includes "Anthropology," "Artificial Life," and the study of "Complex Systems." Citing Maturana and Varela (1973/1980), he tells us that "adaptation is a theme for all three of these integrative sciences." Goldstone's is a wide-ranging discussion that covers many aspects of the debate. This makes it difficult to summarize or to give its essence in a short paragraph. He defines our core questions as follows: " How can an agent make decisions and perform actions that increase its likelihood of flourishing? How do agents aptly perceive and use patterns in the environment? How do agents create and modify organizations through social learning, communication, cooperation and competition?" He avoids using concrete terms such as "human" as he sees "agents" as encompassing humans, brains, bee hives, companies, artificial intelligences, and more. I find the agent perspective an interesting addition to the discussion of the issues raised by others in this issue of *topiCS* as it captures commonalities among the various examples of what could all be termed "cognitive agents" that I had not previously considered.

2.9. McShane (9)

Recusing yourself from the activities of many of your colleagues in a small department is an interesting experience. However, my joy and surprise with what they have written is almost worth the exclusion from that process. Led by the strong pen of Marjorie McShane, she and our colleagues (Selmer Bringsjord, James Hendler, Sergei Nirenburg, and Ron Sun) weigh in on this debate. The paper leads with a discussion that could be summarized as "what the heck is so unified about any other discipline" and a short listing of subareas of modern linguistics including recording dying languages, engaging with infants, brain activity in fMRIs, and studies of ancient texts, as well as a short discussion on the lack of common ground between, say, the Chomskians and the neo-Whorfians. As an inevitably biased bystander, let me draw your attention to the next-to-last paragraph which is a very Rensselaerian take on Cognitive Science and serves to emphasize the diversity of our field and, also, to the last paragraph which is a heart-felt statement with which I suspect most readers of this special section of *topiCS* will concur.

2.10. Rosenbloom and Forbus (10)

Paul Rosenbloom, Computer Science Department & Institute for Creative Technologies (USC) and Kenneth D. Forbus (Computer Science Department, Northwestern University).

Rosenbloom and Forbus begin by repositioning the Núñez critique from one of failure to achieve the founders' goals to one of the dominance of Cognitive Psychology across all aspects of Cognitive Science. As many of the founders (e.g., Don Norman, Allan Collins, Jim Greeno, Alan Lesgold, David Rumelhart, Jay McClelland) would now be classified as Cognitive Psychologists and others, such as the ever ecumenical Herb Simon, did much research in the cognitive psychology tradition (and, indeed, given the number of department affiliations Simon amassed while at CMU it may be notable in this regard that his office was in the Psychology Department), it might be the case that cognitive

psychology is truly baked into the soul of modern cognitive science. They conclude, "cognitive science today is thus largely aligned with cognitive psychology due to how their goals align. However, it remains an interdisciplinary field that goes beyond simple cooperation among the constituent disciplines in both its educational structure and the language it uses."

They conclude that the most important omission from the fields which grace the cover of the *Cognitive Science* journal is "Computation" and that "the notion of computation should be considered as definitional for the field of cognitive science." They rightly (in my opinion) state that the approach to cognition taken by Cognitive Psychologists will not take the entire field of Cognitive Science to where we want to be. They also hold up the notable, ongoing, effort of (dare I say) the multidisciplinary team of Stocco, Laird, Lebiere, and Rosenbloom presented at the 2018 meeting of our society (Stocco, Laird, Lebiere, & Rosenbloom, 2018) to come up with a "standard model of the mind," specifications which anything which we would call a mind must have.

3. Editor's conclusion

I would add to these discussions that at the beginning of time (i.e., "time" as the discipline of Cognitive Science measures it), Allen Newell warned an assemblage of largely Cognitive Psychologists that, "you can't play 20 questions with nature and win" (Newell, 1973). In order to "win", even those cognitive psychologists who are interested only in human intelligence (i.e., those not interested in machine intelligence or those not interested in approaches to general intelligence as per Stocco *et al.* 2018) must adopt approaches beyond the "binary" 20 questions approach. However, I also cannot resist adding a corrigendum of my own; namely, that in addition to witnessing giant advances in computational power and computational models, ours is also the age of Big Data. Despite pleads from staunch cognitive psychologists such as Griffiths (2015) and Goldstone and Lupyan (2016), few cognitive researchers (whether psychologists, computer scientists, or others in the Cognitive Science community) have turned to such sources (for a creative and interesting example, see the groundbreaking work, published in this journal, by Ramscar *et al.*, 2014). It strikes me that a combination of Computation and Big Data may well define the next 40 years of research in Cognitive Science.

References

Goldstone, R. L., & Lupyan, G. (2016). Discovering psychological principles by mining naturally occurring data sets. *Topics in Cognitive Science*, *8*(3), 548–568.

Griffiths, T. L. (2015). Manifesto for a new (computational) cognitive revolution. *Cognition*, *135*(SI), 21–23.

Maturana, H. R., & Varela, F. J. (1973/1980). *Autopoiesis and cognition: The realization of the living*. Dordrecht, Holland: D. Reidel.

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.

Núñez, R., Allen, M., Gao, R., Rigoli, C. M., Relaford-Doyle, J., & Semenuks, A. (2019). What happened to cognitive science? *Nature Human Behaviour*, *3*, 782–791.

Ramscar, M., Hendrix, P., Shaoul, C., Milin, P., & Baayen, H. (2014). The myth of cognitive decline: Nonlinear dynamics of lifelong learning. *Topics in Cognitive Science*, *6*(1), 5–42.

Rothe, A., Rich, A. S., & Li, Z.-W. (2018). Topics and trends in cognitive science (2000–2017). In C. Kalish, M. Rau, J. Zhu, & T. T. Rogers (Eds.), *Proceedings of the 40th Annual Conference of the Cognitive Science Society* (pp. 1175–1180). Austin, TX. Cognitive Science Society.

Schunn, C., Crowley, K., & Okada, T. (1998). The growth of multidisciplinarity in the cognitive science society. *Cognitive Science*, *22*(1), 107–130.

Stocco, A., Laird, J., Lebiere, C., & Rosenbloom, P. S. (2018). Empirical evidence from neuroimaging data for a standard model of the mind. In C. Kalish, M. Rau, J. Zhu, & T. T. Rogers (Eds.), *Proceedings of the 40th Annual Conference of the Cognitive Science Society* (pp. 1094–1099). Austin, TX: Cognitive Science Society.