



Cognitive Science 46 (2022) e13199
© 2022 Cognitive Science Society LLC.
ISSN: 1551-6709 online
DOI: 10.1111/cogs.13199

This article is part of the “Progress & Puzzles of Cognitive Science” letter series.

An Impoverished Epistemology Holds Back Cognitive Science Research

Matthew Goldrick^{a,b,c} 

^a*Department of Linguistics, Northwestern University*

^b*Department of Psychology, Northwestern University*

^c*Cognitive Science Program, Northwestern University*

Received 26 May 2022; received in revised form 3 August 2022; accepted 23 August 2022

Keywords: Formalization; Empiricism; Quantitative methods; Qualitative methods

1. Introduction

Since the foundation of our discipline, there has been skepticism about the ability of cognitive science to achieve interdisciplinarity (see Nuñez et al., 2019, for a recent review). Since the turn of the 21st century, there has been increasing concern that cognitive psychology has come to overwhelmingly dominate cognitive science (e.g., papers in Cognitive Science Society journals tend to be on cognitive psychological topics and are submitted by researchers affiliated with psychology departments; Cooper, 2019; Gentner, 2010; Leydesdorff & Goldstone, 2014; Nuñez et al., 2019; Schunn, Crowley, & Okada, 1998). Based on these results, reform proposals have often focused on the need to increase representation by researchers in multiple disciplines (e.g., Goel, 2019).

I believe that such interventions will address the symptoms without treating the underlying issue. An overly narrow epistemology—beliefs about how we should come to understand the nature of the mind and brain—holds back our field. Specifically, current cognitive science research is held back by two biases:

Correspondence should be sent to Matthew Goldrick, Department of Linguistics, Northwestern University, 2016 Sheridan Rd., Evanston, IL 60208, USA. E-mail: matt-goldrick@northwestern.edu

- *Data over theory*: Research focused on empirical data is viewed as more revealing of the nature of the mind/brain relative to research developing explanations of cognitive capacities.
- *Quantitative over qualitative*: Quantitative data and methods are viewed as central to understanding the nature of the mind and brain; qualitative approaches are seen as peripheral, if relevant at all.

To overcome these biases, our field must cultivate a broader range of perspectives to enable the development of theories that can address both quantitative and qualitative data.

2. Data over theory

The bias towards expanding the empirical base of cognitive science, rather than developing theories, can be seen clearly within cognitive psychology itself (as noted by Guest & Martin, 2021; van Rooij & Baggio, 2021; among others). But this bias is not discipline specific. In linguistics, the rapid adoption of new methods in recent years has generated enormous amounts of quantitative data. However, there has been far less attention to the development of theories that explain the full range of empirical results (Goldrick & Cole, 2021; van Oostendorp, 2013). Incentives in the field of neuroscience have been argued to “maximize breadth in published findings as opposed to depth of understanding” (Rajtmajer et al., 2021, p. 7). While less pronounced in the early years of cognitive science (Schunn et al., 1998), in the past two decades this bias has been reflected by a reduced representation of theoretically oriented disciplines. This includes disciplines like artificial intelligence (Forbus, 2010; Rosenbloom & Forbus, 2019) that are constructed around highly formalized, quantified theories as well as disciplines like the philosophy of mind (Bechtel, 2010; Thagard, 2009) which are based on qualitative, verbally articulated accounts.

Why is the bias against theory a problem? If the goal of our field is to *explain* the capacities of the mind/brain (Cummins, 2000), it is not sufficient to simply document empirical regularities. Data by itself do not provide explanations, no matter how rigorous our empirical methods are (Bechtel, 2010; Thagard, 2009; van Rooij & Baggio, 2021). Advancing our understanding of the mind and brain clearly requires investment in developing theories. While formal models will be a critical part of this endeavor (Guest & Martin, 2021; van Rooij & Baggio, 2021), we will also require strong, clear verbal theories. Verbal accounts play an important role in articulating the assumptions and conceptual foundations of our models of cognition (Bringmann, Elmer, & Eronen, 2022). They also play a key role in articulating the assumptions underlying our empirical methods (Oude Maatman, 2021) and the principles and practices underlying inquiry and explanation in cognitive science (Bechtel, 2010)—issues that cognitive scientists must approach critically and reflectively (Thagard, 2009).

3. Quantitative over qualitative

The dispreference for research focused on developing verbal theories is related to another bias that pervades our field. Mainstream cognitive science research is almost exclusively

grounded in quantitative methods (i.e., data that represent phenomena numerically; theories that are implemented mathematically, formally, and/or computationally). Qualitative traditions (i.e., data and theories expressed verbally) are avoided in both theoretical and empirical research. The shunning of qualitative research is particularly visible in work examining social structure. Cognitive scientists have dispreferred the qualitative, field-based (as opposed to experimental) discipline of anthropology, contributing to its near absence in cognitive science venues (Beller, Bender, & Medin, 2012). Similar patterns are seen within disciplines; many areas of linguistics (Charity Hudley, Mallinson, & Bucholtz, 2020) and cognitive psychology (Brady, Fryberg, & Shoda, 2018) have long resisted theoretical concepts derived from qualitative ethnographic methods. More broadly, quantitative data and theories are frequently seen as definitional for characterizing a rigorous science of cognition (see, e.g., Tafreshi, Slaney, & Neufeld, 2016, for a historically informed discussion of this issue in the context of psychology).

The bias against qualitative theory and methods is clearly problematic. It limits the range of intellectual traditions that can participate in the field, leaving behind disciplines that were initially seen as core, foundational contributors to cognitive science (i.e., philosophy, anthropology; Miller, 2003). Critically, it prevents cognitive science from truly engaging with human diversity. Qualitative methods (e.g., ethnographies, conversation analysis) have been critical for understanding the full richness of cross-cultural variation in human experience and human cognition (Majid, 2021). Much of the cutting-edge theoretical work on race comes from qualitative research traditions (Charity Hudley et al., 2020). The failure to engage theoretically with such issues likely contributes to the persistent lack of diversity in the participants and topics studied by much of current cognitive science research (for recent discussions, see Kidd & Garcia, *in press*; Roberts, Bareket-Shavit, Dollins, Goldie, & Mortenson, 2020). An empirically and theoretically adequate cognitive science clearly requires us to engage with qualitative as well as quantitative data sources.

4. Moving forward

While editors, conference organizers, granting agencies, and other academic gatekeepers can help counteract these biases by encouraging participation by researchers from diverse disciplinary, theoretical, and methodological traditions (e.g., Bender, 2019), we must build up a less impoverished epistemology in cognitive science trainees. It is essential that cognitive scientists learn to avoid conflating statistical models and cognitive theories; the former does not provide explanations of behavior (Fried, 2020; van Rooij & Baggio, 2020; but see Yarkoni, 2020). This conflation likely contributes to both of the biases discussed above: Theory development is reduced to data analysis; and scientific reasoning is restricted to quantitative analyses (Tafreshi et al., 2016). Recognizing the poverty of this “statisticism” perspective must be accompanied by positive support for qualitative research methods and theory development (quantitative as well as qualitative). While it is impossible for every cognitive scientist to be equally facile in all methods and approaches, training programs must provide future cognitive scientists with the “conceptual competence”

(Aftab & Waterman, 2021) needed to enable a richer cognitive science. Trainees need to have an understanding of the assumptions underlying different theoretical and empirical frameworks, the ability to critically assess such assumptions and discuss alternative frameworks, and the intellectual humility needed to facilitate respectful interactions across different research traditions. These changes will provide fertile ground for the emergence of new syntheses of the quantitative and qualitative, empirically driven, and theoretically oriented cognitive science.

Acknowledgments

Thanks to Virginia de Sa, Asifa Majid, Iris van Rooij, and participants in the *Cognitive Science in Practice and in Theory* lecture series at Northwestern University (April 2022) for helpful discussions.

References

- Aftab, A., & Waterman, G. S. (2021). Conceptual competence in psychiatry: Recommendations for education and training. *Academic Psychiatry, 45*, 203–209.
- Bechtel, W. (2010). How can philosophy be a true cognitive science discipline? *Topics in Cognitive Science, 2*(3), 357–366.
- Beller, S., Bender, A., & Medin, D. L. (2012). Should anthropology be part of cognitive science? *Topics in Cognitive Science, 4*, 342–353.
- Bender, A. (2019). The value of diversity in cognitive science. *Topics in Cognitive Science, 11*, 853–863.
- Brady, L. M., Fryberg, S. A., & Shoda, Y. (2018). Expanding the interpretive power of psychological science by attending to culture. *Proceedings of the National Academy of Sciences, 115*, 11406–11413.
- Bringmann, L. F., Elmer, T., & Eronen, M. I. (2022). Back to basics: The importance of conceptual clarification in psychological science. *Current Directions in Psychological Science, 31*(4), 340–346.
- Charity Hudley, H. A., Mallinson, C., & Bucholtz, M. (2020). Toward racial justice in linguistics: Interdisciplinary insights into theorizing race in the discipline and diversifying the profession. *Language, 96*(4), e200–e235.
- Cooper, R. P. (2019). The multidisciplinary flux of cognitive science. *Topics in Cognitive Science, 11*, 869–879.
- Cummins, R. (2000). “How does it work?” vs. “What are the laws?” Two conceptions of psychological explanation. In F. Keil & R. Wilson (Eds.), *Explanation and cognition* (pp. 117–145). Cambridge, MA: MIT Press.
- Forbus, K. D. (2010). AI and cognitive science: The past and next 30 years. *Topics in Cognitive Science, 2*, 345–356.
- Fried, E. I. (2020). Lack of theory building and testing impedes progress in the factor and network literature. *Psychological Inquiry, 31*, 271–288.
- Gentner, D. (2010). Psychology in cognitive science: 1978 to 2038. *Topics in Cognitive Science, 2*, 328–344.
- Goel, A. (2019). A cognitive reformation. *Topics in Cognitive Science, 11*(4), 892–901.
- Goldrick, M., & Cole, J. (2021). *Advancement of phonetics in the 21st century: Exemplar models of speech production* [Manuscript submitted for publication]. Department of Linguistics, Northwestern University.
- Guest, O., & Martin, A. E. (2021). How computational modeling can force theory building in psychological science. *Perspectives on Psychological Science, 16*, 789–802.
- Kidd, E., & Garcia, R. (in press). How diverse is child language acquisition research? *First Language*. <https://doi.org/10.1177/014272372111066405>
- Leydesdorff, L., & Goldstone, R. L. (2014). Interdisciplinarity at the journal and specialty level: The changing knowledge bases of the journal *Cognitive Science*. *Journal of the Association for Information Science and Technology, 65*, 164–177.

- Majid, A. (2021). Olfactory language requires an integrative and interdisciplinary approach. *Trends in Cognitive Sciences*, 25, 421–422.
- Miller, G. A. (2003). The cognitive revolution: A historical perspective. *Trends in Cognitive Sciences*, 7, 141–144.
- 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.
- Oude Maatman, F. O. (2021). *Psychology's theory crisis, and why formal modelling cannot solve it*. PsyArXiv. <https://doi.org/10.31234/osf.io/puqvs>
- Rajtmajer, S. M., Errington, T. M., & Hillary, F. G. (2021). *How failure to falsify contributes to the replication crisis in the clinical neurosciences*. PsyArXiv. <https://doi.org/10.31234/osf.io/5fb7h>
- Roberts, S. O., Bareket-Shavit, C., Dollins, F. A., Goldie, P. D., & Mortenson, E. (2020). Racial inequality in psychological research: Trends of the past and recommendations for the future. *Perspectives on Psychological Science*, 15, 1295–1309.
- Rosenbloom, P. S., & Forbus, K. D. (2019). Expanding and repositioning cognitive science. *Topics in Cognitive Science*, 11, 918–927.
- Schunn, C. D., Crowley, K., & Okada, T. (1998). The growth of multidisciplinary in the Cognitive Science Society. *Cognitive Science*, 22, 107–130.
- Tafreshi, D., Slaney, K. L., & Neufeld, S. D. (2016). Quantification in psychology: Critical analysis of an unreflective practice. *Journal of Theoretical and Philosophical Psychology*, 36, 233–249.
- Thagard, P. (2009). Why cognitive science needs philosophy and vice versa. *Topics in Cognitive Science*, 1, 237–254.
- van Oostendorp, M. (2013). Phonology between theory and data. In S. R. Anderson, J. Moeschler, & F. Reboul (Eds.), *The language-cognition interface* (pp. 289–306). Geneva: Librairie Droz.
- van Rooij, I., & Baggio, G. (2020). Theory development requires an epistemological sea change. *Psychological Inquiry*, 31, 321–325.
- van Rooij, I., & Baggio, G. (2021). Theory before the test: How to build high-verisimilitude explanatory theories in psychological science. *Perspectives on Psychological Science*, 16, 682–697.
- Yarkoni, T. (2020). Implicit realism impedes progress in psychology: Comment on Fried (2020). *Psychological Inquiry*, 31, 326–333.