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The Value of Diversity in Cognitive Science

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Abstract

A recent article (Núñez et al., 2019) claims that cognitive science, while starting off as a multidisciplinary enterprise, has "failed to transition to a mature inter-disciplinary coherent field." Two indicators reported in support of this claim target one of the two journals of the Cognitive Science Society, *Cognitive Science*, depicting cognitive science as an increasingly monodisciplinary subfield which is dominated by psychology. With a focus on the society's other journal, *Topics in Cognitive Science*, the present commentary reveals a greater degree of interdisciplinarity and discusses the relative values of diversity and integration for the field.

Keywords: Cognitive science; Anthropology; Inter- and multidisciplinarity; Diversity; History of science; Emergence

1. Introduction

Launched during the cognitive revolution, cognitive science started off as a multidisciplinary investigation of the mind. Key to the inception of this enterprise was the aim to

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combine perspectives and research paradigms from its founding disciplines and turn them into one coherent, well-integrated "science of the mind" (Gardner, 1985). More than half a century later, Núñez et al. (2019) set out to assess whether cognitive science has reached this goal. To this end, they analyzed two socio-institutional indicators (i.e., cognitive science curricula and the doctoral training of current cognitive science's faculty) and two bibliometric indicators (author affiliations and citation patterns for *Cognitive Science*, the first journal of the Cognitive Science Society). The former attest to a lack of coherence in the field, the latter to a lack of diversity. Núñez and colleagues therefore concluded that "the devised multi-disciplinary program failed to transition to a mature interdisciplinary coherent field" (2019, p. 782).

By and large, the data speaks for itself. Given how important institutionalized training is for the future of a field, the two socio-institutional indicators in particular are clearly not going to raise the spirits of those among us who are committed to the cognitive science enterprise. The two bibliometric indicators, although being coarse proxies only (a point to which I will return in Section 2.2.; and see Cooper, 2019), jointly reflect the unquestionable overrepresentation of psychology in the journal. Yet, while there is a lot to deplore, and ideally to remedy, the state of the field is not as desolate as suggested. To support this view, I will take a closer look at the society's second journal, *Topics in Cognitive Science*, analyzing the content of what is regarded as topical in the field—both in general and with a focus on anthropology—before discussing the relative values of integration and diversity.[1]

2. *Topics in Cognitive Science*

The journal *Topics in Cognitive Science* (*topiCS* for short) is the second flagship journal of the Cognitive Science Society, launched in 2009. In its first ten years, it served as outlet for 495 scientific publications. Approximately 10% of these are "Best of" papers from the society's annual conference (CogSci) and, more recently, the *International Conference on Cognitive Modeling* (ICCM). The lion's share of publications, however, belongs to the specific topics that are characteristic of the journal.

2.1. *Topics in* topiCS

Topics that are proposed to the journal's editorial board for review come from within, and on occasion outside of, the cognitive science community. Typically, they consist of one or several of the following article types: an introduction to the topic, original research articles, reviews and syntheses, or debate contributions such as commentaries and replies.

From 2009 to 2018, a total of 42 topics were published. The bulk of these revolved around specific research subjects, both classic (like language or learning) and novel (like music cognition or miscommunication), or around specific approaches (like the potential of action games or quantum theory for cognitive science). Five topics adopted a meta-

perspective on cognitive science itself, among them one on the role of philosophy and one on the role of anthropology for cognitive science, the latter with the largest number of contributions among all of the topics.

Feeding the titles and keywords of all topic contributions into a word cloud program produces the picture in Fig. 1a. It renders "cognitive" as the most frequent word, followed by "language," "modeling," "science," and "learning."

Word clouds, however, are imprecise in many regards. For instance, they may collapse words with divergent meanings (like *modeling* and *model*), while segregating words indicative of the same concept (like *language* and *linguistic*). In a second step, therefore, a more in-depth analysis was conducted, this time also comparing the topic contributions with the "Best of" papers from both CogSci and ICCM. For each publication category, the 10 most frequently mentioned concepts were identified, and the frequencies were calculated for the combined set of concepts (depicted in Fig. 1b).

There are several noteworthy aspects. First, "cogn-" remains the most or second most frequent term in all three categories. Interestingly, though, only in the topic contributions is a substantial proportion of this (18%) allotted to the composite label "cognitive science" (rendering this the fourth most frequent term), while it is functionally absent in the other two categories. One reason for this is that contributions to topics more often take a meta-perspective on the discipline (such as "The original sin of cognitive science," Levinson, 2012).[2]

Second, the contributions to the publication categories do share a concern with a set of subjects, even if to varying degrees, but this set is relatively restricted. Only four concepts are among the 10 most frequent in all three categories alike: Besides "cognitive,"

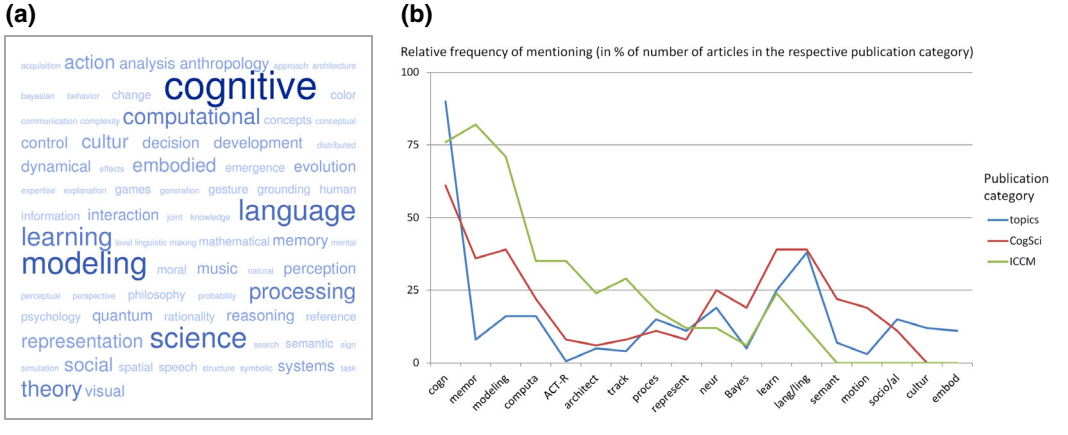

Fig. 1. Content frequency in all topic contributions (titles and keywords combined). (a) The 75 most frequent content words (graph produced with *TagCrowd*). (b) Relative frequency of those concepts that were among the 10 most frequently mentioned content words in at least one of the three publication categories: topics contributions (topics), "Best of" papers from CogSci (CogSci), and "Best of" papers from ICCM (ICCM). Content words on the *x*-axis are roughly ordered so as to maximize clarity; values on the *y*-axis show the relative frequency of mentioning in % of number of articles in the respective publication category (n = 442 for topics, 36 for CogSci, and 17 for ICCM).

these are "modeling," "computational," and "learning." Even if comparing only the CogSci and ICCM papers, the number of subjects of common interest increases by just one (i.e., "memory"). This pattern seems to indicate an ongoing commitment to computational modeling, arguably the signature approach of cognitive science, but also substantial diversity—or lack of integration in the words of Núñez and colleagues—with regard to concrete subjects.

Third, both the ICCM and CogSci papers seem to be somewhat more homogeneous in terms of content, the former, unsurprisingly, with a relatively strong focus on computational modeling and cognitive architecture applied to memory and learning, the latter with somewhat more concern also with neuroscience concepts, Bayesian modeling, and language. Contributions to topics, by contrast, exhibit much greater diversity, which is reflected in the overall lower proportions of single concepts (besides "cognitive," only "language" and "learning" are represented with more than 20%). The topic contributions also stand out through their concern with novel subjects that are entirely absent in one of the other two categories (e.g., "socio/social," "action," or "development") or in both of them (e.g., "embod," "quantum," "cultur," and "anthropology"). In fact, three of these subjects ("socio/social," "cultur," and "embod") are among the 10 most frequent subjects in topic contributions.

2.2. Anthropology in topiCS

In order to gain a more accurate picture of the diversity in the topic contributions, the following analysis will zoom in on content. This will be undertaken with a specific focus on anthropology, not only because of my own background, but also because it features as a case in point in Núñez et al. (2019). In fact, once a pioneer and founding member in the cognitive science endeavor, anthropology has become its "missing discipline" (Boden, 2006; and see Fig. 1 in Núñez et al., 2019) and is hence arguably the one discipline for which it is not so much integration that is at stake, but rather rapprochement in the first instance (Beller, Bender, & Medin, 2012).

This estrangement is underlined by recent data showing that doctoral training in cognitive science completely lacks faculty members with a background in anthropology and does not include a single obligatory course in this discipline (Núñez et al., 2019). When it comes to publications in *Cognitive Science*, a functional absence of anthropology is reflected both in the author affiliations in all 1,020 articles published since 2000 and in the journal's citation environment for the years 2000, 2007, and 2014. As someone with a strong commitment to reconnecting anthropology with cognitive science (e.g., Beller et al., 2012; Bender, Hutchins, & Medin, 2010), I cannot but agree with this depiction. And yet, I am more optimistic than the authors appear to be. But before laying out my main arguments, a few qualifications may be in order.

First, while author affiliation is a useful proxy for a scholar's background, it is not always indicative or accurate (as in my own case); especially anthropologists who are concerned with cognition frequently end up in non-anthropological institutions.

Add to this the demographics involved: Contributions to conferences and journals reflect the proportions of the respective 'populations.' The base rate of potential contributions from psychology is one or two orders of magnitude greater than that for anthropology.[3] In the case of conference contributions, proportions further depend on the opportunities for attending, with CogSci being infeasible for most anthropologists both in terms of timing and expense (cf. Beller et al., 2012).

And finally, bibliometric indicators based on a journal's citation environment ignore the specifics of publication traditions in different disciplines. Anthropologists (but not only anthropologists) have a much stronger preference than, say, psychologists for monographs and edited volumes. Furthermore, cognitive research lies solidly outside of mainstream anthropology and hence frequently ends up in interdisciplinary journals or more content-specific journals from neighboring disciplines. To illustrate this, take the article by Astuti and Harris (2008) in *Cognitive Science*, which can be regarded as a role model for interdisciplinary work involving anthropology. While over half of the 51 sources cited in this article are anthropological references, only two of them appeared in anthropological journals. In other words: Even if many more such papers were published in *Cognitive Science*, the bibliometric indicator would still detect only a marginal increase in anthropological references.

Importantly, none of these caveats substantially changes the overall picture of a prevailing imbalance, in which anthropology is substantially less clearly represented than most other disciplines. So whence my optimism? The first indication that anthropological contributions may be less marginalized in cognitive science than assumed is furnished by Fig. 1a, which reflects that subjects clustering around "culture" are among the 10 most frequent ones in the topic contributions in *topiCS*, and subjects clustering around "anthropology" are among the 25 most frequent (Fig. 2 depicts frequencies separately for titles and keywords to highlight the partly disjunct distribution of the two terms).

To identify publications bearing an anthropological mark, a search for relevant terms was conducted over the titles and keywords of all topic contributions. These terms included "anthropol," "ethno," "arch[a]e," "ecology" (subsequently narrowed to usage in Hutchins's (2010) sense of cognitive ecology), "cultur," "folk," "indig," and "cross" (subsequently narrowed to usage in cross-cultural or cross-linguistic comparisons). Further correcting for instances in which more than one search term was associated with a single article resulted in 37 contributions that explicitly targeted *anthropology* (including *archaeology*) and another 18 contributions that dealt with *culture* (including *enculturation* and *cultural evolution*) or employed anthropological methods (such as *ethnomethodology* or *comparisons*)—hence amounting to 12% of all topic contributions. One of these, Hutchins's (2010) *Cognitive Ecology* is even ranked as number 7 in the top 10 most frequently cited *topiCS* papers ever.

When scrutinizing the topics themselves, the results are even more encouraging. Almost one third (13 out of 42) of them include anthropological considerations: Besides the two that explicitly focus on anthropology, eleven more contain contributions that are (co-)authored by anthropologists, adopt anthropological methods, or develop anthropological ideas.

While I could have included topics that tackle questions with a long tradition in anthropology such as those involved in *collective behavior*, *embodied cognition*, or

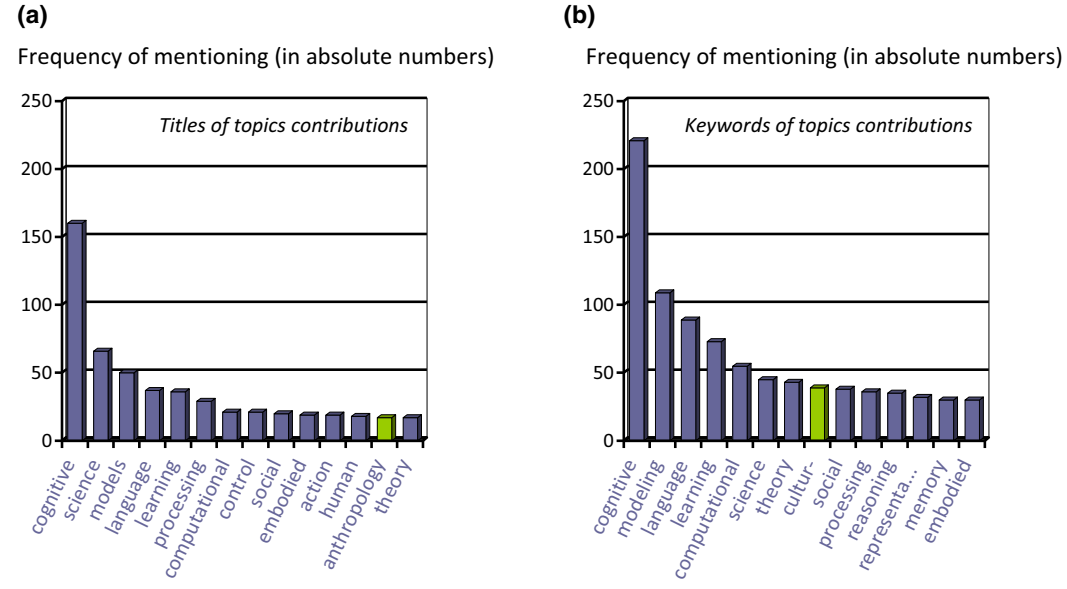

Fig. 2. The 14 most frequent content words in all topic contributions: (a) titles (n = 442) and (b) keywords (n = 420). In the former, "anthropology" ranks as 13th (together with "theory"); in the latter, "cultur-" (aggregating across "culture," "cultural," and "enculturation") ranks as 8th.

mathematical practice and cognition, I would rather take the lack of (apparent) anthropological involvement here as an opportunity to note that it is not always easy to recruit anthropologists to such topics.

Finally, disciplines also exert an influence by way of the ideas they propagate. When firmly establishing appealing ideas in new fields, the watermark of the discipline in which they originated may be so blurred that future generations become more and more oblivious of their provenance, perceiving the contribution as just one variant of cognitive science (Bender et al., 2015, p. 685). Some of the arguably most productive ideas in cognitive science originated from anthropology, broadly conceived, or were inspired by an anthropological perspective: from theoretical concepts such as *distributed* and *embodied cognition* (Hutchins, 1995; Ingold, 2000), through methods like cross-cultural studies (Murdock & White, 1969; Tylor, 1889), to entire research topics like cultural evolution (Boyd & Richerson, 1985; Gray et al., 2007). While the absorption of these ideas would be regarded a mark of successful integration, it certainly renders it more difficult for abstract indicators to detect and trace the impact of the respective discipline.

2.3. *The integrative potential of* topiCS

If nothing else, the data presented here at least show that the picture obtained depends on the data considered. But I see the data as more informative and as encouraging insofar

as they attest to the willingness and ability of the field to tackle challenges and open up opportunities for minority perspectives and fields.

Akin to cultures, scientific fields are emergent phenomena, organized by attractors (Sperber, 1996) and subject to diverse degrees of consensus (Gatewood, 2012; Romney, Weller, & Batchelder, 1986). Submissions to conferences and journals largely pattern a research field in a bottom-up manner by both reflecting and stabilizing mainstream tendencies. It was presumably for this reason that Núñez and colleagues picked *Cognitive Science* for their bibliometric analyses. Being a more classic type of journal, it is representative of the manuscripts submitted. While the journal website stresses its focus "on the multidisciplinary study of minds and other intelligent systems" and emphasizes that manuscripts "which are specifically written for a multidisciplinary audience are given the highest priority" (https://onlinelibrary.wiley.com/page/journal/15516709/homepage/ForAuthors.html, retrieved September 6, 2019), the editors can only choose from what they receive. And even if papers which are "accessible to only a narrow or discipline-specific audience" tend to be returned without formal review, publications largely reflect the proportions of research topics and researcher populations.

Partly to compensate for this, *topiCS* also invites proposals from outside of the mainstream. The editorial board is charged with proactively recruiting "exciting, under reported work, across the full-range of cognitive science topics." Specifically welcome are great debates; integrative and reflective contributions, for which established researchers are encouraged to examine broader issues and trends in cognitive science; and new or emerging work, either on established areas that are experiencing an upsurge of interest or a major paradigm shift, or from scholars who do not consider themselves cognitive scientists and yet are still doing cognitive science work (http://csjarchive.cogsci.rpi.edu/topiCS/FAQs.html, retrieved September 6, 2019). Finally, all acting editors for prospective topics are asked to ensure that their selection of contributions represents a multiplicity of perspectives.

That the publications in *topiCS* do not reflect the demographics in cognitive science at large is substantiated when comparing the content of the topic contributions to the individual papers as reported in Section 2.1. While the "Best of" papers focus more strongly on classic subjects of cognitive science (revolving around computational models, representations, and processing), *topiCS* is keener on picking up cutting-edge topics and engaging in critical self-reflection. For this very reason, *topiCS* may prove to be a remedy for some of the issues diagnosed by Núñez and colleagues.

3. Diversity in cognitive science

Núñez et al. (2019) raise two distinct, yet related concerns: They diagnose a lack of *diversity* and a lack of *integration* in cognitive science. Both have their roots in the overrepresentation of psychology, which clearly comes at the cost of diversity (in terms of the involvement of other disciplines) and arguably, though less clearly, at the cost of integration (in terms of theoretical, conceptual, and methodological identity across disciplines). The analysis presented here shows that this is less of an issue for *topiCS*, the

society's second flagship journal, where we find less psychology, more diversity of topics and perspectives, and many instances of successful cross- and interdisciplinary collaborations (Bender, Beller, & Nersessian, 2015) than is claimed by Núñez and colleagues for the field at large.

Based on their approach, diversity is valuable only in the early stages of an emerging research field, especially when it comes in the form of diversity in the sources feeding into the field. Maturation into a well-integrated cohesive science then requires a decrease in diversity, namely to the extent that consensus is established on the "hard core" of a research program. In this sense, cognitive science is portrayed as "a textbook case of failed interdisciplinarity," especially when compared to "mature fields" like the natural sciences or psychology (Núñez et al., 2019, p. 788). It may well be an empirical question whether a random sample of, say, biologists from across the subfields would reach greater consensus on research questions, paradigms, and methods; and when extending this thought experiment to social scientists (including psychologists), not even major theories (Beller & Bender, 2017; Mischel, 2009) or the core subject of the very discipline (Brumann, 1999; de Munck & Bennardo, 2019) is consensual anymore.

But even if we assume that cognitive science is exceptional in this regard, integration of diverse approaches would not be easy to detect when successful. For instance, many of the authors in our topic on cognitive diversity engage in interdisciplinary collaboration and defy assignment to any single discipline (Bender et al., 2015). As discussed earlier, concepts and approaches can traverse disciplinary boundaries and become absorbed in neighboring fields.

According to Núñez et al. (2019), this kind of integration is far from standard in cognitive science. However, the homogeneity in research questions, methods, and theoretical developments, which follows from integration, raises the question of whether more of this is unconditionally preferable (see also Cooper, 2019; Gentner, 2019). To tackle the complex and diverse dimensions of the mind, a *family resemblance* model of cognitive science may be better suited than a *prototype* model, that is, a cluster of related assumptions, theories, and methods that can be developed and related to one another more flexibly, rather than consensus on a core set of assumptions, theories, and methods. With an elusive target like the mind, into which valid and reliable insights are so hard to obtain, wouldn't it be wise to diversify our means for obtaining such insights?

Plurality in research strategies and paradigms may indeed prove to be vital to the field's prospering, and we should take pains to capitalize on it (Unsworth, 2012). Some of the early paradigms in cognitive science (like the often criticized *cognitivism*) may be limited in the scope of their applicability, and more recent approaches like *distributed* or *embodied cognition* open up exciting new opportunities. But are these approaches truly incompatible, and do the newer ones really vitiate the older ones? Newton's laws still hold, almost everywhere and in all everyday contexts, even after the advent of relativity theory, and so too are representational accounts still instructive for a vast number of research questions. Many subjects can be investigated, in equally conducive ways, on a variety of levels and with complementary approaches—and most conducively so, in fact, when combining these approaches across levels. Finger counting, for instance, involves a representational, distributed, and embodied dimension (as well as several others), all of

which need to be addressed when aiming for a comprehensive account of its development and implications (Bender & Beller, 2012).

Combining diverse approaches and the insights they yield allows us to target different components of cognition, to take different levels of analysis into account, and to broaden our perspective by considering different points of view. Besides illuminating a phenomenon, diversity in perspectives also increases affordances for "thinking outside the box," hence creating the conditions for cross-fertilization with new ideas, like quantum theory (Wang et al., 2013) or the complex systems approach (van Orden & Stephen, 2012) and even raising novel research questions that will advance the field (Barrett, Stich, & Laurence, 2012; Bender et al., 2015).

4. Conclusion

Given the complexities linked to the "multiple and diverse dimensions of the mind" (Núñez et al., 2019, p. 789), a multitude of approaches to its investigation seems to be the most sensible strategy. This is naturally jeopardized if single disciplines dominate. Therefore, some precautions should be taken to increase the visibility of sidelined disciplines and hence the diversity of perspectives. While the bottom-up patterning of conference and journal topics will always reflect the predominant research paradigms, we could try to do something about the current categorization of our journals as "experimental or cognitive psychology"; we could be more proactive in recruiting submissions from minority disciplines; we might even consider designing some recommendations for what should be included in cognitive science curricula; and if—as Núñez and colleagues state—"exciting and successful cross-disciplinary mind-related work" really is produced outside of cognitive science (2019, p. 782), we might wish to ensure that this work is recognized as cognitive science. Providing a platform for a range of different perspectives and establishing affordances and incentives for grasping this opportunity should remain an enduring goal.

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Notes

1. A somewhat similar, yet more fine-grained analysis of the content of submissions to *Cognitive Science* can be found in Cooper (2019).

2. By contrast, the virtual key term of the "science of the mind" occurs with a frequency of less than 5% in the topic contributions and ICCM papers (with about half of these referring to *Theory of Mind/ mindreading*), and it is completely absent in the CogSci papers.
3. Just by way of comparison: While the *American Psychological Association* has over 118,000 members, the *American Anthropological Association* has 10,000 members, the latter including not only cultural anthropologists, but also biological (or physical), linguistic, and medical anthropologists as well as archaeologists and linguists. In addition, while cognitive psychology is a strong and arguably expanding subfield within psychology, cognitive anthropology has never had a major impact on anthropology proper.

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