

A Study of Research Collaborations at a Teaching University with a Focus on Diversity

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ABSTRACT

Providing equitable opportunities for all faculty enhances success and retention which in turn benefits all students. In 2011 Cal Poly San Luis Obispo (a teaching focused university) formally adopted the Teacher-Scholar model which increased the discussion and consideration of scholarly activities in the tenure and promotion process. In this paper we present preliminary results on how this changed the pattern of research collaboration in the ensuing decade. We particularly focus on the impact on diverse communities. We compare these collaboration patterns with a neighboring research focused university (UC Santa Barbara).

Introduction

Faculty retention is an important consideration for any university. The retention of diverse faculty is a particular concern as a diverse faculty benefits not only the university but also the success of all students. In an academic environment, one of the things that helps retention is providing more opportunities and resources for conducting research. However, it is important that these resources and opportunity are provided on an equitable basis. In this paper we look at a teaching university (Cal Poly San Luis Obispo), which over time increased its emphasis on research activities as an integral part of tenured and tenure track faculty responsibilities. This change was formalized by the adoption of the Teacher-Scholar model in 2011. We examine data from 1991 to 2021 and note how the number of publications per person and the number of collaborators per person changed over that period. We also look at statistics for the same period for a neighboring university (UC Santa Barbara) to get a baseline for comparison. We further break out these statistics by gender.

Data Collection

For context, UCSB currently serves ~26,000 students with approximately 1,208 instructional faculty, while Cal Poly San Luis Obispo serves ~22,000 students with approximately 1,400 instructional faculty. (See Table 1) We consider two similar and nearby universities (100 miles apart) to better contextualize the change in publications and collaborations for computing researchers over time for a university that consistently had a research focus, versus a university enhancing the role of scholarship and research for newer faculty.

School	Students	Instructional faculty
UCSB	~26,000	1,208
Cal Poly	~22,000	1,400

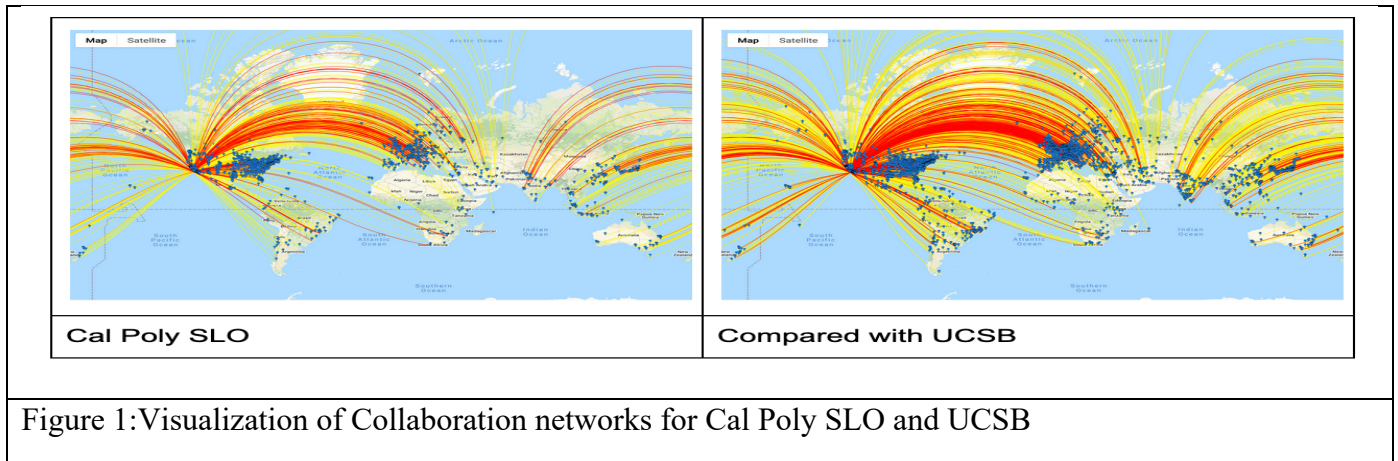
Table 1: Demographic comparison of UCSB and Cal Poly

We use bibliometric data for collaboration and publication data is from the SCOPUS database and via the ICSR Databricks team. We examine the change over time in 5-year increments from 1991-2021 for the research population publishing in fields related to computing at these institutions. Gender inference is made using NamSor (only for researchers with probability of accurate inference > 60%). The dataset was generated by querying SCOPUS:

Central California data: SCOPUS open due to COVID19 (30,000 seed researchers and 473,854 collaborators) - large portion of the Cal Poly and UCSB STEM researchers (tangential fields to computing) 1970-2021

Visualization

To build and analyze the collaboration networks, we create graphs for researchers (faculty, students, and staff) who have a published paper as the seeds for each institution. Using these seed vertices we built a graph, with an edge between vertices meaning the two authors have published a paper together. Professors and students that have not published anything in a five-year window but have published in the past are not considered in that period.



In Figure 1 we see a visualization of the collaboration networks for Cal Poly SLO and UCSB over the entire period. As expected UCSB has noticeably more collaborations than Cal Poly SLO. We can also see that UCSB has collaborations with more Asian institutions.

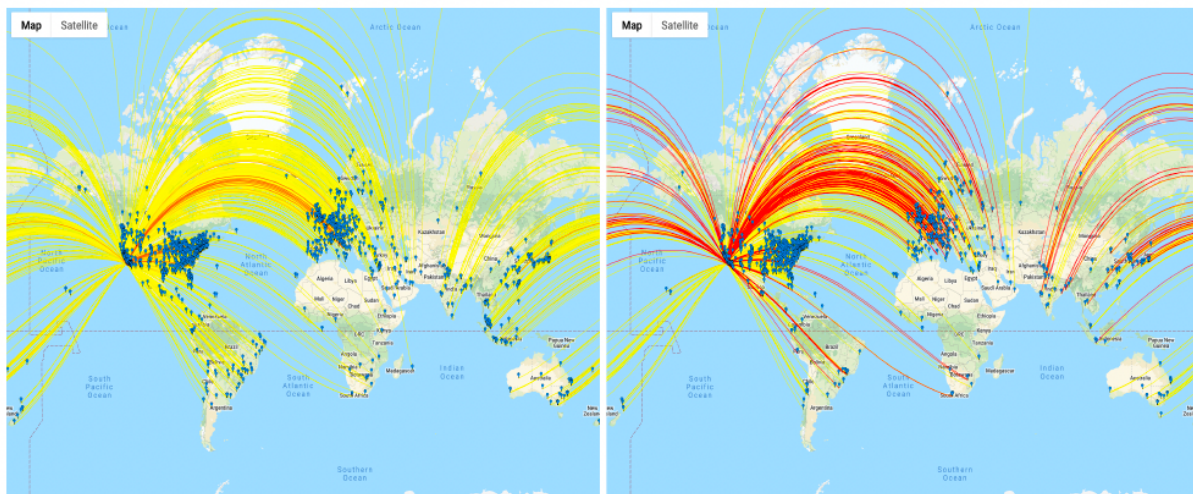


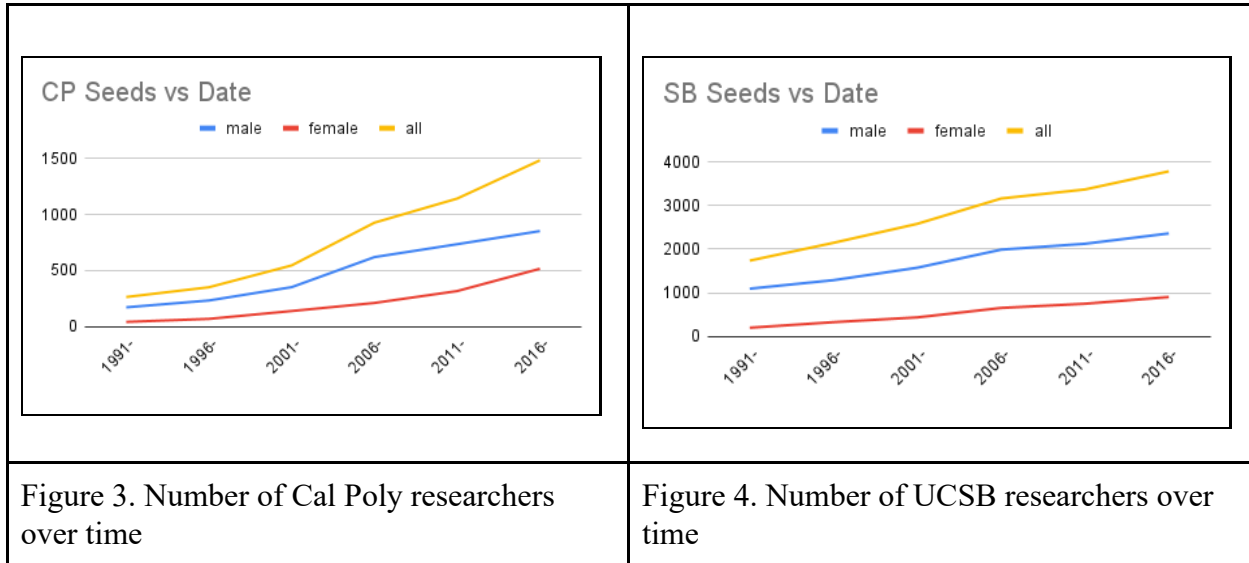
Fig. 2: Visualization of two subnetworks for the Cal Poly Collaboration network based on inferred gender of the seed author. Lines represent a shared publication and line coloring denotes the strength of the collaboration with red indicating a stronger collaboration (greater than 100 publications).

In Figure 2 we break down the collaboration networks by inferred gender. An interesting observation is that a greater number of the female collaborations are red indicating stronger collaboration. This agrees with results from [1] that women collaborate more with the same co-authors.

Results

Figures 3 and 4 show the number of researchers at each university. During the period studied, the number of seed researchers at Cal Poly increased by an average of 8.45% per year while UCSB's researchers increased by 3.41% per year.

(This occurs from an increase in total counts of ~41 per year for Cal Poly and ~68 per year for UCSB)



To understand the changing research landscape, we also consider the average number of collaborations per seed researcher. For example a researcher publishing a paper with two other people counts as two collaborations (size is capped at 20). Considering the percentage increase, again Cal Poly had a larger increase with the average researcher increasing their collaborations by 3.2% each year and the average UCSB researcher increasing their collaborations by about 1.5% per year during the same period. (Cal Poly had an increase of 0.14 collaborations per researcher per year whereas UCSB's increased by 0.25 collaborations, again with a larger overall research community of ~4x as many collaborations per researcher). As shown in Figure 3 and 4, we see that gains in both publications and collaborations are similar for both inferred male and female researchers with stronger similarity/equity in collaboration patterns for inferred female and male researchers for Cal Poly seed researchers versus UCSB researchers).

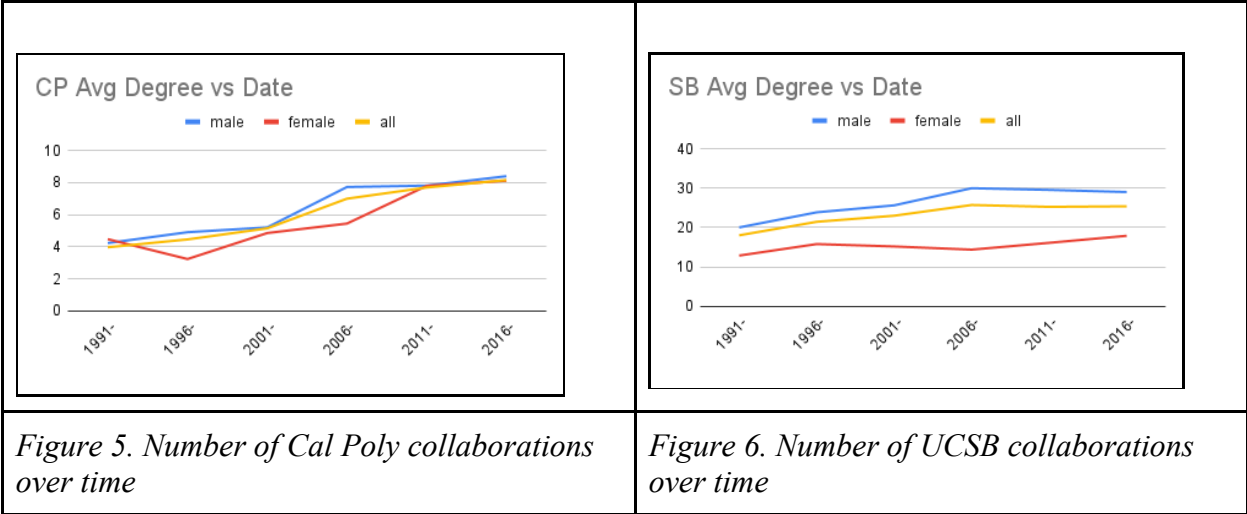


Figure 5. Number of Cal Poly collaborations over time

Figure 6. Number of UCSB collaborations over time

Analysis

The preliminary results seem to indicate there was more gender equity in the collaborations at Cal Poly compared to UCSB. Of course this will require more research to confirm. Also as summarized in Table 2, our examination shows that during this 30-year period, Cal Poly has seen relatively more growth in researchers and their corresponding collaborations each year than UCSB. This appears to show that the teacher-scholar model positively impacted the overall research and collaboration community within Cal Poly while still maintaining equity with respect to gender.

Table 2: Summary of institutions and academic collaboration changes over time

	Cal Poly	UC Santa Barbara
Number of Students	22,000	26,000
Number of Instructional Faculty	1,400	1,208
Average Annual Increase in Researchers from 1991 to 2021	8.45%	3.41%
Average Annual Increase in Collaborators from 1991 to 2021	3.2%	1.5%

Future Work

This work is ongoing and is part of a larger project to visualize and understand the nature of academic collaborations. Future work will consider additional fields of study beyond computing, race and ethnicity demographics of researchers and comparison with a broader set of institutions in order to better understand our institution's successes and challenges.

References

- [1] L. Ductor, S. Goyal, and A. Prummer, “Gender & collaboration,” in *Cambridge working papers in economics*, Faculty of Economics, University of Cambridge, 2018.
- [2] E. Araújo, N. Araújo, A. Moreira, H. Herrmann, J. Andrade, Jr., “Gender differences in scientific collaborations: Women are more egalitarian than men”, *PLOS ONE*, 12(5):1–10, 05 2017.
- [3] L. Holman, C. Morandin, “Researchers collaborate with same-gendered colleagues more often than expected across the life sciences”, *PLOS ONE*, 14(4):1–19, 04 2019.
- [4] C. Carroll, N. Garg, T. Migler, B. Walker, Z. Wood, “Mapping and visualization of publication networks of public university faculty in computer science and electrical engineering” In *CATA*, 2020.
- [5] L. McNichols, S. Pineda, E. Sauerborn, B. Tat, K. Yoo, J. Lehr, Z. Wood, T. Migler, “Mavac: Mapping and visualization of academic collaborations with a focus on diversity”, in *Complex Networks XII*, pages 86–97, Cham, 2021. Springer International Publishing.
- [6] L. Nakamichi, T. Migler, Z. Wood, “An analysis of four academic department collaboration networks with respect to gender”, in *Complex Networks & Their Applications IX*, pages 262–272, Cham, 2021. Springer International Publishing.