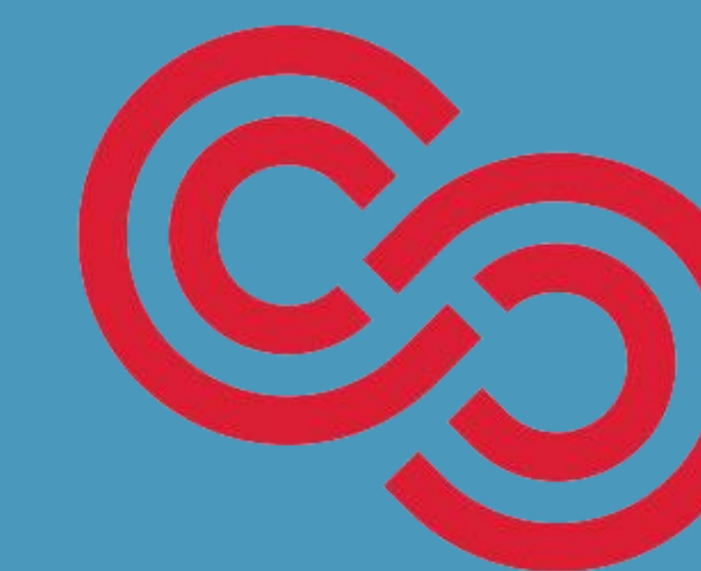


Charting the Evolution and Transformative Impact of the Pacific Symposium on Biocomputing Through a 30-Year Retrospective Analysis of Collaborative Networks and Themes Using Modern Computational Tools

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ABSTRACT

- PSB founded nearly 30 years ago to promote collaborative, **interdisciplinary research** in computational biology
 - Yearly themes to address emerging issues in biocomputing
- **30-year retrospective analysis of PSB proceedings** to reveal: 1) how interdisciplinary?, 2) impact of interdisciplinary research
- Analysis revealed:
 - 1) **evolving themes** reflecting adoption of advanced computational, multimodal methods;
 - 2) formation of **interdisciplinary ties**;
 - 3) interdisciplinary manuscripts were of **high impact/cited**
- Developed generative AI web app to explore past proceedings

BACKGROUND

- **Pacific Symposium on Biocomputing (PSB)** co-founded in 1996; originally from Biotechnology Computing Tracks at the Hawaiian International Conference on System Sciences
 - Platform for computation applied to molecular biology
- For the past thirty years, PSB has witnessed transformative changes in the field of biocomputing.
 - Yearly themes reflect **emerging areas** → e.g., AI in medicine
 - Crucial to understand academic impact of conference
 - **1996**: focus on foundational aspects of computational biology.
 - **2025**: multimodal & machine learning
- **Goal**: Retrospective analysis of PSB proceedings to appreciate **evolving themes & growth/impact of interdisciplinary collaboration**

METHODS

Inspired by a similar work analyzing conference themes and impact over 30 years, our analysis utilizes:

1. **Topic Modeling**: Latent Dirichlet Allocation (LDA), Dynamic Topic Models (DTM) and BERTopic to identify main themes of PSB, their prevalence, and evolution over time.
2. **Evolving Co-Authorship Networks**: Reflects participation in conference. Ties formed through co-authorship, characterized by: # prior collaborations, interdisciplinarity by comparing author's prior topic distributions for PSB works, author centrality
3. **Number of Citations**: The scientific impact of PSB themes broken down by topic and reported independently. Analysis of whether certain topics had gained or lost prominence over the years.
4. **Interactive Dashboard for Perusing Prior Proceedings**: A Retrieval Augmented Generation (RAG) tool as an interactive research tool for rapid access to past proceedings. Currently hosted on Streamlit at <https://psb-rag.streamlit.app>.

RESULTS

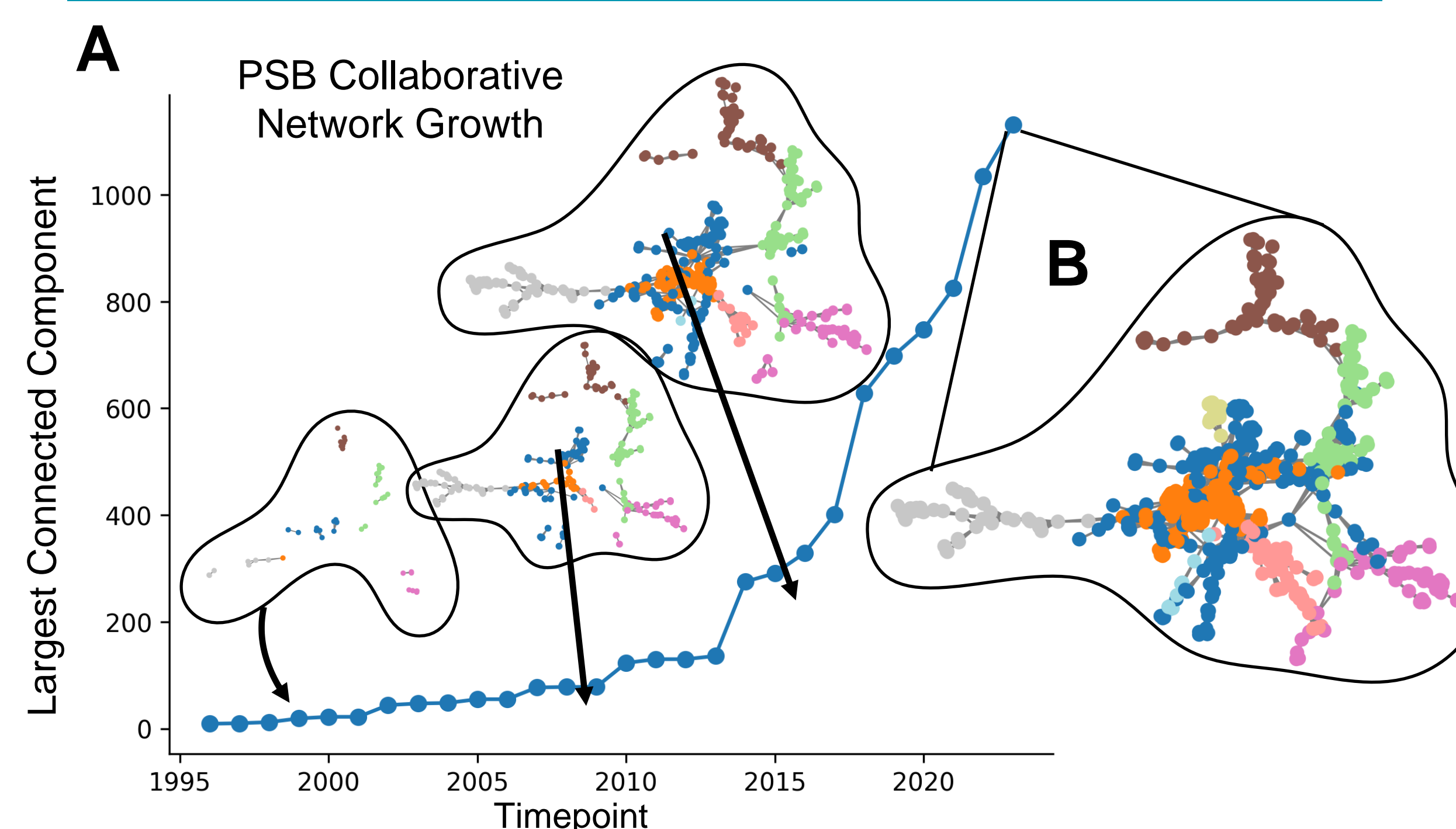


Figure 1: Co-Author Networks: A) Growth of the largest connected component within PSB, B) Visualization of the final 2024 collaborative network, labeled by assigned community via the Leiden algorithm

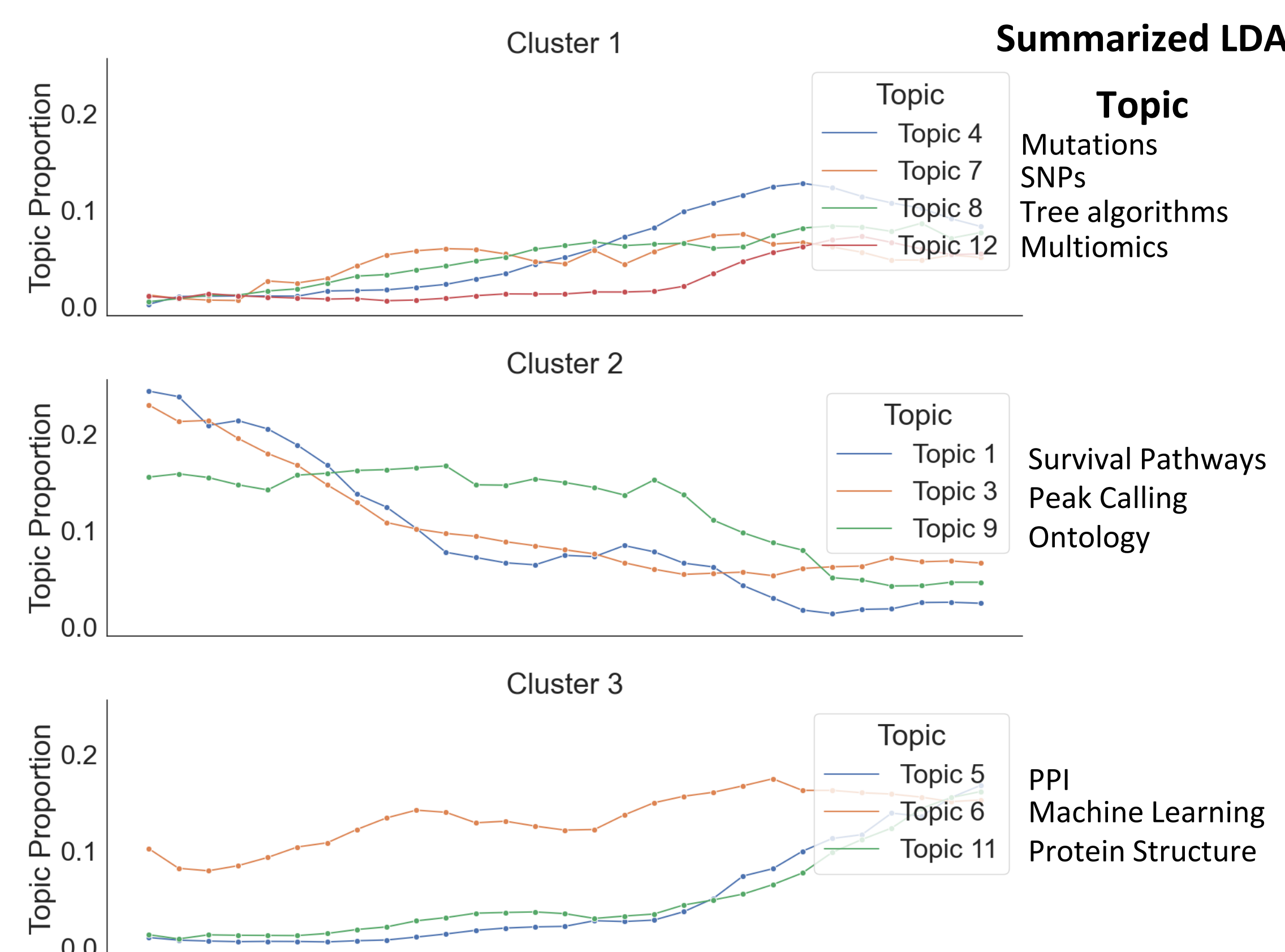


Figure 2: Prevalence of 14 LDA Topics Over Time

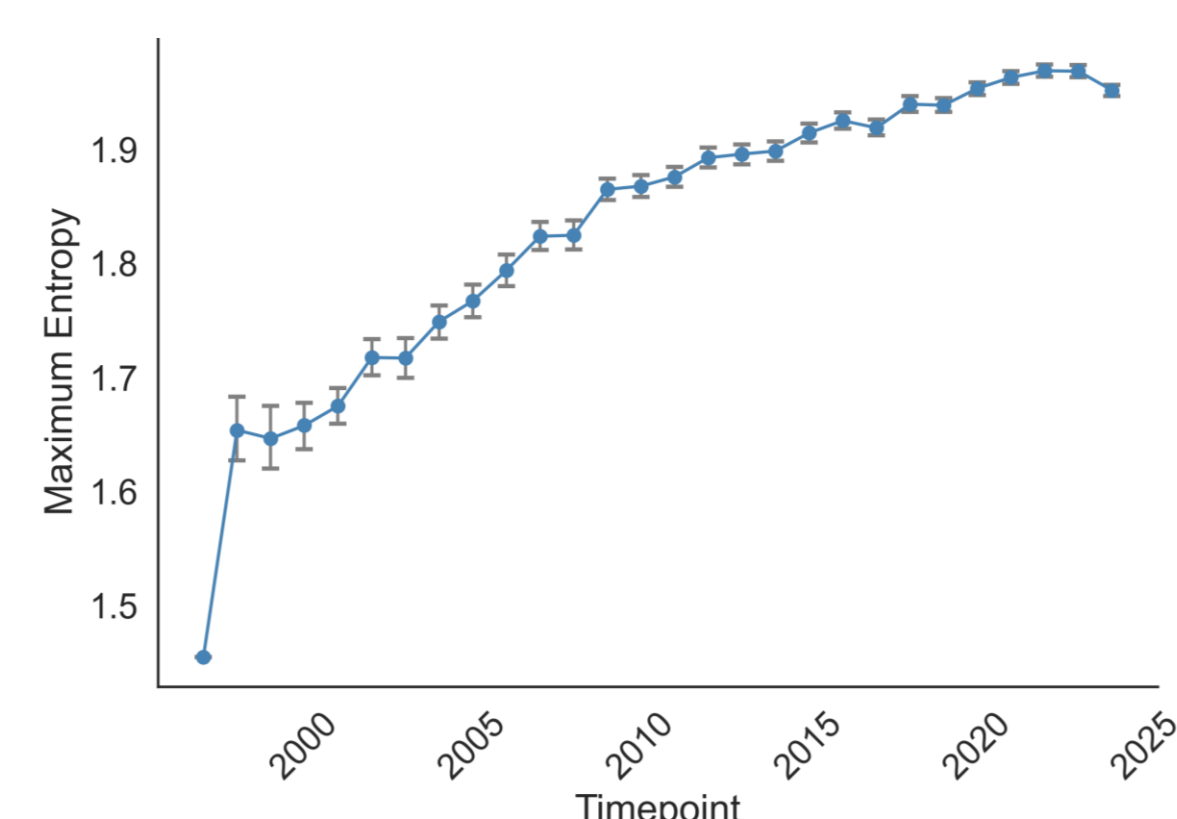


Figure 3: Topic diversity of manuscripts and interdisciplinarity of collaborations increases over time

Table 1: Statistical Findings: Demonstrate how interdisciplinarity /diversity of topics and collaborations increases over time based on increasing topic entropy and decreasing cosine similarity between author topic distributions; interdisciplinarity tied to higher citation count

Metric	Description	β	p-value
Topic Entropy	Gradual increase in diversity of topics over time	0.01	<0.001
Cosine Similarity Between Author's Topic Distribution Over Time	Gradual decrease in thematic alignment over time	-0.0028	<0.001
Formation of Tie Based on Topic Alignment at Prior Timepoints	Positively associated with likelihood of co-authorship	14.4	<0.001
Continued Collaborations	Co-authors who continue publishing maintain higher topic alignment	0.03	<0.001
Topic Diversity and Citation Count	Higher topic diversity (based on current manuscript topic entropy) associated with higher citation count	3.33	0.001
Interdisciplinarity /Lower Cosine Similarity and Citation Count	Higher interdisciplinarity (based on lower prior topic alignment, i.e., lower cosine similarity between prior topic distributions) associated with higher citation count	-3.06	0.002

Table 2: Key PSB Influencers identified through centrality analysis of cumulative co-authorship network

Timepoint	Eigenvector	Betweenness	Degree
1999	Toshihisa Takagi	Subramanian Subbiah	Satoru Kuhara
	Satoru Kuhara	A. Keith Dunker	Toshihisa Takagi
	Emiko Furuichi	Satoru Kuhara	Adam Godzik
2004	Satoru Miyano	Satoru Miyano	Satoru Miyano
	David C. Kulp	Philip E. Bourne	Satoru Kuhara
	Conrad C. Huang	Adam Godzik	William Stafford Noble
2009	Bart L.R. de Moor	Satoru Miyano	Russ B. Altman
	Conrad C. Huang	Russ B. Altman	Philip E. Bourne
	Thomas E. Ferrin	Philip E. Bourne	William Stafford Noble
2014	Russ B. Altman	Marylyn D. Ritchie	Adam Godzik
	Philip E. Bourne	Russ B. Altman	Russ B. Altman
	Zoubin Ghahramani	Satoru Miyano	Philip E. Bourne
2019	Marylyn D. Ritchie	Marylyn D. Ritchie	Russ B. Altman
	Sarah A. Pendergrass	Sarah A. Pendergrass	Atul Janardhan Butte
	Shafali Setia Verma	Russ B. Altman	Jason H. Moore
2024	Marylyn D. Ritchie	Marylyn D. Ritchie	Russ B. Altman
	Shafali Setia Verma	Russ B. Altman	Lawrence E. Hunter
	Sarah A. Pendergrass	Shafali Setia Verma	Joel T. Dudley

CONCLUSION & NEXT STEPS

Discussion

- Analyses demonstrate increasing diversity and interdisciplinarity of the research presented at PSB.
- Interdisciplinary collaborations → high impact work, adjusted for time
- Rising central role of key co-authors may reflect leadership roles and/or sustained collaboration

Limitation: Multimodal analysis not explicitly identified using BERTopic; further pretraining comparisons may reveal additional topic dynamics.

Future Directions and Implications

- Applying next-generation analytic methods may offer a deeper insight into the dynamics between topics, ties
- Citation networks: How PSB informed other high impact works?
- Associating community memberships/cliques with collaborative intent. Did formation of collaborations @ PSB spur high impact collaborations outside of PSB?
- Topic comparison between scholastic venues

References: <https://tinyurl.com/PSBWorksCited>

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