Exploring Gaps, Trends and Applications of Research on Computational Models of Memory and Learning

A Bibliometric Analysis on the Top 100 Cited Articles on Computational Models of Memory and learning

Ethan Nguyen, Tammy Do, Devin Chau, Shishir Tallada, Vianca Lopez, Aanya Shenoi, Gabriella Seiglie, Jersey Rucker, Zeenia Charania, Cleo Chantel Alexa, Edwin Joshy, Vrishti Misra, Dhruva Bhat, Fatima Khan Lookmanji, Edmundo Leong

Introduction

Computational models are used to compactly describe large amounts of data through algorithms. Used to map brain activity, these models can obtain causal claims about the relation between neural properties and behavior (NIH). In our research, we conducted a comprehensive analysis of studies exploring the application of computational memory and learning on cognitive processes.

Objectives

Our primary objective is to discover relevant patterns and trends in the research of computational models of memory and learning. We aim to discover the overall direction and potential gaps in this field of study, and more specifically which geographic regions lack current research in the discipline.

Results

These studies were published between 1993-2021, with the United States contributing the largest amount of published articles, authors, and citations. After a steep drop off in contribution, several other first-world countries follow.

To observe common themes in the studies, the larger preliminary search (n=10,453) was used. Looking at a larger dataset from the preliminary search, the several prevalent topics were "Neuroscanning", "Artificial Intelligence & Machine Learning", and "Education & Educational Research."

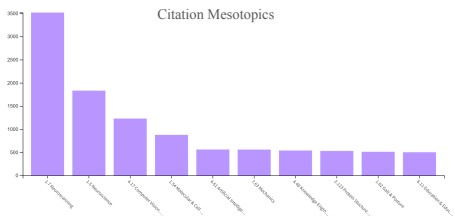

Figure 3: Distribution of citation mesotopics in the preliminary dataset. Common mesotopics include neuroscanning, artificial intelligence & machine learning, and education & educational research.

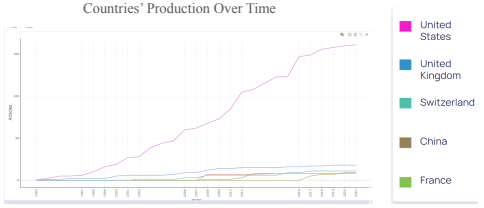

Figure 4: Top 5 countries producing articles in the top 100-cited articles dataset (1993-2021). Overall trend is increase in article production over time. United States leads article production with >100 article gap with other competitors.

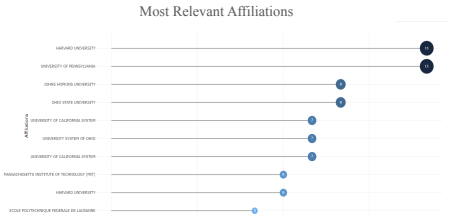

Figure 5: Top 10 affiliations in the top 100-cited articles dataset. 9 of the 10 affiliations are based within the United States.

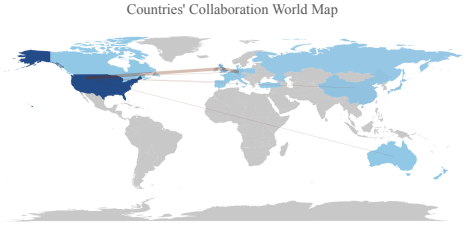

Figure 6: World map showcasing frequency of collaboration between countries. No collaboration in South America, Africa, South Asia, and Southeast Asia.

Methods

Using the Web of Sciences database, our preliminary search of "computational models of memory and learning" used keywords "computational models", "memory development", and "learning development" resulted in 10,453 relevant studies. Sorting by most cited articles, the top 100 studies were selected for a bibliometric analysis study.

Figure 1: Flow chart of data extraction

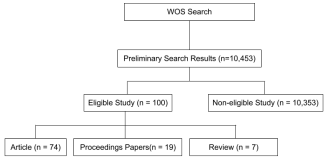

Figure 2: Mapping analysis of dataset extracted from Web of Sciences.

Conclusions

Using computational models of memory and learning, understanding of these cognitive processes will continue to advance. Our results have shown this research has found uses in the fields of AI/ML and education, as this research will fuel the development of new technologies in these fields. With this research, education systems can be reformed to implement new practices that maximize memory and learning efficiency while AI/ML can be enhanced with improvements to its problem-solving and large-scale data analysis abilities. Our research also shows that we can improve the accessibility of research opportunities to developing countries.