AI in the social sciences, a review based on trend analysis

Abstract:

With the rapid development of artificial intelligence in today's society, its intersection research with social sciences has gradually become a focus of attention in the field of interdisciplinary studies, this part of the study is based on 7011 literature records from 1970-2024 in the core database of Web of Science, using various visualization and analysis methods such as topic modeling, DataMapPlot, Voronoi Treemap and Parallel Tag Clouds and other visual analysis methods to explore the research trend of topics trend in the intersection of AI and social sciences, and to provide a data foundation for the subsequent literature review study.The study found that the interdisciplinary field shows obvious time evolution characteristics, especially after 2015, the research fever rises significantly and reaches the peak in 2022. This study identified seven core topics. which were identified through topic modeling ： Science Technology, Agents' Cognitive, Network information, Media and driving, Mental health, Information Recognition(detection), Development and Environment. This study provides a systematic visualization perspective for understanding the intersection of AI and social sciences, which has significant reference value.

Keywords: artificial intelligence; social sciences; visual analytics; topic modeling; LDA; bibliometrics

1. Introduction:

The rapid development of artificial intelligence has brought great convenience to many fields in social sciences, and many application scenarios under the intersection of social sciences and artificial intelligence have been realized nowadays, and the proliferation of application scenarios brings not only improved efficiency but also significant risks and potential pitfalls to which we need to pay special attention. In this paper, we would like to start from the perspective of time, explore the development trend over time in the intersection of social sciences and artificial intelligence, analyze the emerging topics with the development and predict the future research direction with the data to provide direction guidance for the subsequent intersection of interdisciplinary research.

In the past, most review articles focused broadly on applications and risks, covering wide areas but failing to analyze specific trends. This paper focuses on analyzing the evolution of topics to better understand this interdisciplinary field, examining development trends to predict potential future research directions, and exploring emerging topics to forecast their possible societal impact. This approach provides data-based, multi-dimensional guidance for future research.

2. Method:

While most of the past literature reviews have focused on integrating applications as well as

risks under the intersection of social sciences and AI, we conducted a study focusing on the development of trends, analyzing the literature both quantitatively and qualitatively, with the following specific research questions:

RQ1:What are the sub-topics that have evolved in research at the intersection of the social sciences and AI that have caused shifts in societal attention to the Detection sub-topic, and why have these shifts occurred? What are the sub-topics that show a high degree of similarity to Detection?

RQ2:How have developments in AI at the intersection of the social sciences and AI affected the content of the literature on social science research, and what are these shifts due to?

RQ3:In the development of the intersection of Social Science and Artificial Intelligence, how does the Science Technology topic and the Agents' Cognitive topic interact with each other, and why does the hotness of the Agents' Cognitive topic in 2017 begin to decline and begin to rebound in 2023? begins to decline and begins to rebound in 2023, and what factors are responsible for this trend?

In order to provide a systematic review of the intersection of social sciences and AI, we conducted a literature search for specific terms in the WOS core database, and the retrieved data contains literature from 1970-2024, during which the importance of AI under the intersection of artificial intelligence and social sciences has been increasing. After cleaning the acquired data，we chose several data visualization methods according to the research questions: DataMapPlot, Vorono Treemap and Parallel Tag Clouds.By visualizing the data we can find out more intuitively the influence of different fields at the intersection of Artificial Intelligence and social sciences as well as the evolution results of the topics over time.

2.1 LDA Topic Modeling

After cleaning the retrieved data, we first analyzed the research topics under the intersection of AI and social sciences using topic modeling. Topic modeling allows documents to be computationally classified into different topics[1] , the model we chose is LDA (Latent Dirichlet Distribution)[2] , LDA is a kind of unsupervised probabilistic topic model, which is capable of automatically discovering the structure of the potential topics from a large-scale collection of documents, this kind of topic model can group words based on co-occurrence, and each grouping corresponds to a topic, by analyzing the words under the grouping, the corresponding topic can be extracted, and then explore the topic. This topic model can group words based on co-occurrence, and each grouping corresponds to a topic. By analyzing the words under the grouping, the corresponding topic can be extracted, and then the patterns and trends under the topic can be explored. Our LDA topic modeling uses the following data: Web of Science based on the search terms TS=(Social Science) AND TS=(Artificial Intelligence) and Preprint Citation Index (Exclude Database) and Web of Science Core Collection (Exclude Database) and Web of Science Core Collection (Exclude Database). - Database) and Web of Science Core Collection (Database) exported from the 1970-2024 literature totaling 7011 articles, after data cleaning retained 6526 data, data processing process, the cleaned data for word splitting and vectorization to retain the textual features. LDA analysis and topic perplexity analysis were performed, and based on the results of the perplexity analysis (Fig. 1), the final number of topics was determined to be 7. After the topic

modeling, we named the topics based on the feature words obtained from the TF-IDF calculation.
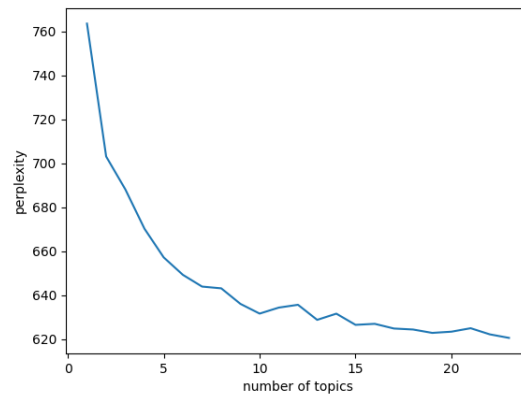

Figure 1: Perplexity analysis result curve

2.2 DataMapPlot Visualization

DataMapPlot is a density-based two-dimensional visualization method[3] , which can effectively demonstrate the clustering structure of high-dimensional data. In this study, we first use the UMAP algorithm to downsize the output of the VORONOI TREEMAP topic model to a two-dimensional space, and then use DataMapPlot to generate visualization charts. The advantage of this method is that it can intuitively display the influence size of different topics (indicated by the area of the color region) and the degree of correlation between topics (indicated by the degree of color overlap). We can visualize from DataMapPlot the influence of different fields and the association between different topics at the intersection of AI and social sciences. Based on the results of the visualization analysis, we found several popular topics: Human Agents Cognition , Healthcare , Ethical and Legal , Online Media, etc. From the perspective of topic intersection, the analysis can also be broadly classified into two major categories, namely: technology development and humanities and social sciences.
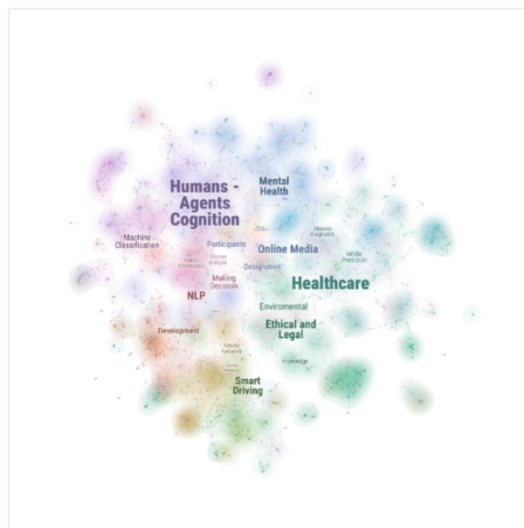

Figure 2: DataMapPlot visualization results

2.3 Voronoi Treemap Analysis

For the analysis of the distribution of research areas, this study used the Voronoi Treemap visualization method to retain the top 150 Research Areas in the Research Area list in the WOS database in accordance with the order of weights, and combined with the number of Research Areas and their duplicates, we finally retained the top 25 Research Areas (Fig. 3). Areas, and according to its weight allocation for Voronoi Treemap visualization analysis (Figure 3), Voronoi Treemap addresses the limitation of traditional Treemap in clearly visualizing small proportions of data. Voronoi Treemap visualization can be intuitively reflected in different areas under the cross-research of the degree of heat.
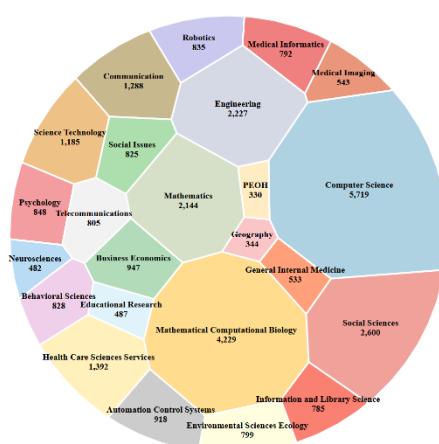

Figure 3: Distribution of Top 25 Research Areas (Voronoi Treemap)

2.4 Parallel Tag Clouds analysis

In order to analyze the development trend of topics and the evolution trend of topic sets, we need to choose an analysis method that can integrate time and topics, and the visualization analysis method we chose is Parallel Tag Clouds, which is a method that can visualize the weight of tags and the content of topic sets, and designing the horizontal axis to be time can better analyze the development trend of topics in the cross-cutting field over time.

After determining the research field, we narrowed down the scope of the search, performed data cleansing on the searched words and then carried out lexicon and Voronoi Treemap modeling, determined the modeling results and then processed and integrated the data again, assigned the corresponding year window to the data and based on the TF-IDF to assign weights to the words that appeared in each window, and appended the corresponding topic probability to each word, and then processed and analyzed the data for Parallel Tag Clouds visualization, and redesigned the deactivated word lexicon based on the analysis results to obtain the final visualization results (Figures 4 and 5). After the data processing, the Parallel Tag Clouds visualization analysis is carried out, and the final visualization results are obtained by redesigning the deactivation lexicon based on the results of the analysis (Figs. 4 and 5).

Figure 4 shows the visualization results of the topic sets according to the time trend, the color columns under the sub-topics represent the proximity of each topic, and the sub-topics will be grouped under the topic set with the highest similarity. Each topic set has several sub-topics, and

the topics under the same topic set have the same color, so we can analyze the evolution trend of the topic set according to the changes of the sub-topics under each topic set, and then make predictions about the possible future research trends.

Figure 5 shows the visualization results of the topic set sorted according to the weights under the TF-IDF analysis. The sub-topics under the year are sorted according to the TF-IDF analysis results, and the sub-topics on the top are the ones that have a higher influence under the year of the cross-axis, and the analysis of the overall trend under the cross-cutting domains can be achieved by observing the order of sub-topics under the different years as well as the changes in the positions of the sub-topics.
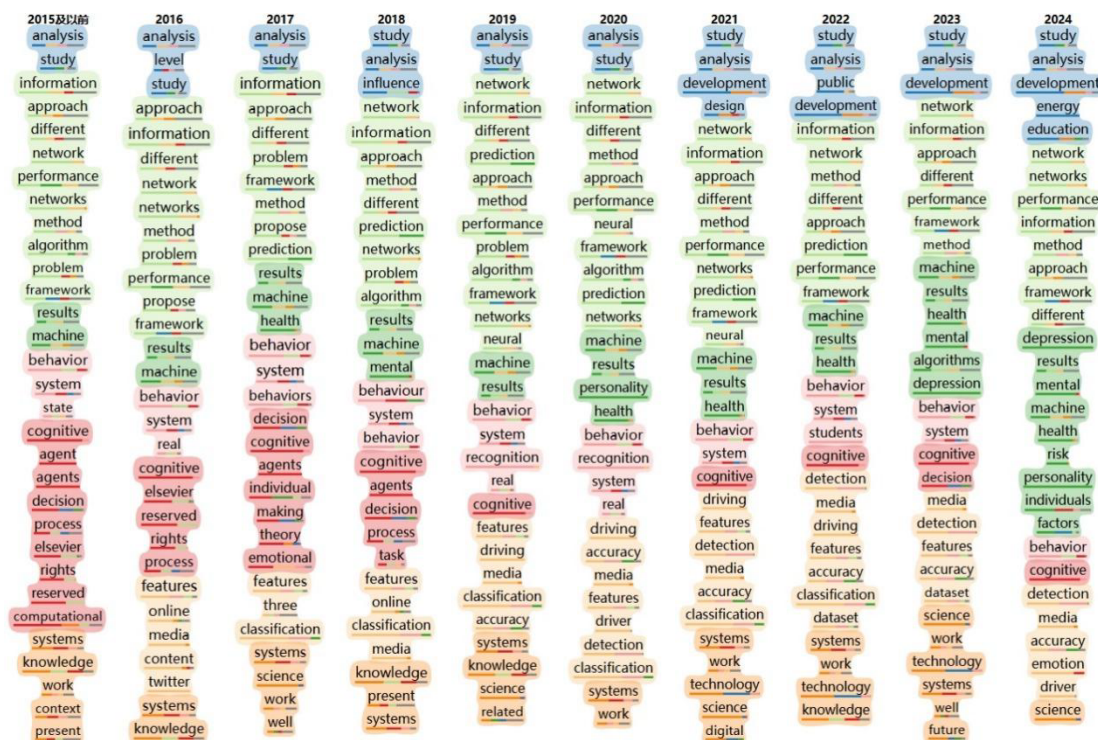

Figure 4: Year windows based Topic sorting

Figure 5: TF-IDF weight based sorting under year windows

3. Result.

The emergence of Artificial Intelligence has had a great impact on society in areas that include, but are not limited to, education, healthcare, and the economy. To understand how generative AI as an emerging technology affects our lives, we first need to consider the relationship between technology and society, the definition of technology has been defined differently at different times, Rudi Volti mentioned the definition of technology in the book he authored, "A system created by humans that uses knowledge and organization to produce objects and techniques for the attainment of specific goals[1] This definition explains the relationship between technology and humans very well. Technology is produced in response to human needs, technology is produced in response to human technological enthusiasm (technologi - cal enthusiasm) and application needs, and the development of technology in turn influences people's motivation levels, work styles, and modes of thinking[5] . People's quest for automation and curiosity about human-like intelligences drove the creation of today's AI boom. generative AI as a technological tool. Through Natural Language Processing (NLP) and Deep Learning, AI can carry out complex data analysis, language comprehension, and generative tasks, and there is a huge potential for research in the social sciences with these capabilities, which have given many fields in the social sciences the possibility of conducting more varied and efficient research.

In order to better explore the development trend under the intersection of AI and social sciences and to dig into new types of topics, we will discuss them with data.

3.1 Topic mining and analysis

In terms of topic mining and analysis, we first conducted a perplexity analysis where the number of topics we chose as a result of the perplexity analysis was 7. On the basis of the topic modeling, we combined an analysis for the time window in order to trace the changes generated by the data in the time dimension, and then explore the trends of the data over time.

Through a visual analysis of the literature at the intersection of social sciences and AI, we find that the number of publications of related studies grows significantly between 2015-2022 and peaks in 2022. The TF-IDF analysis reveals the continued high weight of the word "behavior," signaling that in-depth exploration and policy development of AI behavior may become a focus in the future. At the same time, the words "study", "detection", "mental" and "depression" have been gaining weight. The increasing weighting trend of terms such as "study", "detection", "mental" and "depression" reflects the increasing attention of academics to areas such as mental health and information regulation.

After performing LDA topic modeling, we named each of the seven topics at the intersection of social sciences and AI (Table 1), and the topics were defined in order of topic prominence as "Science Technology" "Agents ' Cognitive" "Network information" "Media and driving" " Mental health" "information Recognition(detection)" "Development and environment". Environment", by analyzing these topics, the rankings also symbolize the importance that the society attaches to the topic, we can find that in the field of social sciences and artificial intelligence there is a higher emphasis on the technical aspects and a higher alert to some crises, especially in the topic "Agents ' Cognitive", the topic of which is "Technology", "Agents ' Cognitive", "Network information", "Media and driving", "Mental health", "information Recognition (detection)", "Development and environment". Cognitive", which has a high percentage of articles in the cross-cutting field, and in addition to the technology-oriented topics and the ethics of intelligences, there are also the topic like "Mental health" focusing on clinical psychiatry, The emergence of AI has provided a new therapeutic aid for clinical psychiatry, providing a powerful tool for the treatment of "depression" and other mental illnesses. The emergence of AI has provided clinical psychiatry with new therapeutic aids for the treatment of "depression" and other psychological disorders. The emergence of AI has also had a significant impact on the media, and the problem of how to recognize false information generated by AI in social media has become an urgent issue.

Topic	Name	Key Words
Topic1	Science Technology	science, technologies, systems, future, development, ethical
Topic2	Agents' Cognitive	cognitive, agent, decision, interaction, behavior
Topic3	Network information	network, information, method, prediction, neural, algorithm
Topic4	Media and driving	media, driving, detection, classification, twitter, machine
Topic5	Mental health	health, mental, depression, personality, risk, medical, clinical
Topic6	Information Recognition(detection)	behavior, recognition, activity, crowd, analysis, accuracy, video
Topic7	Development and Environment	Development, public, economic, value, energy, impact, sustainable

Table 1: Topic naming after LDA topic modeling and keywords under the topic

3.2 Trend analysis of topic evolution

In order to better explore the evolution of the topics, we assigned the data under the time window and performed Parallel Tag Clouds visualization.

By analyzing the results of the Parallel Tag Clouds visualization by topic, we can identify some topic trends that vary by year. In the 1970-2024 timeframe, the Network information topic has remained stable and the influence of the topic has continued to grow. The "Media and driving" topic has remained relatively stable between 2016-2024, but its content has changed in some direction, with earlier topics consisting of "online media". In the early years, the main components of the topic were "online media", "classification", and from 2020 onwards, the components gradually changed to "detection" and "accuracy", which implies that the topic will evolve over time. This means that the focus of the topic "Media and driving" changes over time, as the output of AI itself may contain biased, discriminatory, toxic, and false information[6][7] , and AI may also suffer from distortion of information during multimodal transformations. information distortion, Newsguard found 614 AI-generated fake news information websites using AI Tracking Center markers at the end of 23, which proliferated false information about politics, religion, technology, etc[9] , similar problems make the society's concern about the media itself transformed into the concern about the authenticity of the information under media This trend reflects society's concern about the authenticity of information in the age of artificial intelligence, and is likely to be the focus of a large part of the "Media and driving" topic.

There are two topics that have evolved over the period 1970-2024, namely "Development and Environment" and "Mental health". The development of the topic of "Development and Environment" is in line with the topic of sustainability in today's world, and it can be predicted that under the future cross-cutting development, the words "sustainable" and "energy" will be used in the future. It can be predicted that in future cross-cutting developments, "sustainable" and "energy" will continue to be used as keywords around the topic "Development and Environment". The development of the topic "Mental health" is also in line with the psychological problems that are becoming more and more prominent in today's society, and the integration of AI into clinical psychiatry can make up for the inefficiency and difficulty in personalization of clinical treatments in the past. xiao-Wei Wang et al. have implemented a machine-learning method for the analysis of emotional states from EEG data using AI. EEG data to classify emotional states[10] , Johanna Habicht developed AI personalized automated chatbot Limbic Access based on multiple machine learning models that can be predicted and in diagnosis[11] , The emergence of AI has brought unprecedentedly powerful aids to clinical psychiatry in many ways.

The topic of "Agents' Cognitive" occupied a significant proportion of the topic before 2015, when there was extensive discussion of the moral and ethical and cognitive issues that might arise from the emergence of AI, and the keyword "cognitive" has gradually become more uniform after 2015. After 2015, the keywords of the topic gradually became unified, and "cognitive" started to be the representative word of the topic from 2019 onwards, and similar to the trend of "Agents' Cognitive" are Similar to "Agents' Cognitive", the topic of "Information Recognition (detection)" is represented by the word "behavior", which implies that the detection of false information is closely related to the behavioral norms of intelligences, and in the final analysis, the detection of false information is closely related to the behavioral norms of intelligences. This implies that the detection of false information is closely related to the behavioral norms of intelligences, and the ultimate

problem is how to realize the alignment between intelligences and humans, and some mainstream models can already reflect their value tendency from their outputs. We should make clear the goal of alignment, and the realized aspects of alignment should include command compliance, understanding of human intentions, understanding of human preferences, understanding of values, etc. In the topic of Information Under the topic of "Information Recognition (detection)", how to regulate the behavior of intelligent bodies and suppress the generation of false information will become a major research topic in the future.

4. Discussion

4.1 Key Findings and Insights

This study reveals the evolutionary patterns of development and future trends at the intersection of artificial intelligence and social sciences through a systematic analysis of 7011 relevant literatures over the period 1970-2024. The study finds several important features:

The temporal evolution is characterized by significant features: research fervor shows explosive growth after 2015 and peaks in 2022, a trend closely linked to breakthroughs in deep learning technology and the rise of generative AI. This growth pattern reflects the deepening process of academia's perception of the social impact of AI technology.

The distribution of topics shows a hierarchical structure: the seven core topics are, in order of importance, " Science Technology", "Agents' Cognitive", "Network information", "Media and driving", "Mental health", " Information Recognition (detection)", "Development and Environment". This distribution suggests a research pattern in which technological development and ethical concerns go hand in hand, and application areas and risk prevention go hand in hand.

Trend changes in sub-topics reflect the focus of society's concern: the Detection sub-topic continues to increase in concern, especially in the areas of false information detection and behavior recognition, which reflects society's growing concern about the authenticity and reliability of AI-generated content.

4.2 Trend Forecasting and Direction of Development

Based on the TF-IDF weight change trend and topic evolution analysis, we predict that future research will focus on the following directions:

1. Human-computer collaboration and trust mechanisms: The continued high weight of the keyword "behavior" signals that in-depth research on the interpretability of AI behavior and trust mechanisms in human-computer interaction will become a priority.

2. Digital intervention in mental health: The rising trend in the weight of terms such as "mental" and "depression" indicates that the application of AI in the field of mental health will usher in a period of rapid development, and that personalized treatment and early warning systems will become a key breakthrough point.

3. Information authenticity governance: With the popularization of generative AI, the research demand for false information detection and content authentication technologies will continue to grow, and cross-modal detection and real-time monitoring technologies will become the focus of

development.

4. Sustainable development and social impact assessment: The rise of the "Development and Environment" topic reflects the academic community's concern about the social responsibility and sustainability of AI technologies, and more interdisciplinary impact assessment research will be needed in the future.

4.3 Response to research questions

In response to the three core questions posed in this study, we draw the following conclusions:

RQ1 Response: The shift in attention to the Detection sub-topic is driven by developments in media technology, the spread of disinformation and the need to regulate social media. The sub-topic of Information Recognition is more similar, and together they form the technological support system for information governance.

RQ2 Response: the impact of AI development on the content of social science research is reflected in the digital transformation of research methods, the expansion of research objects (from traditional social phenomena to human-computer interaction behaviors), and the change of research paradigms (from qualitative description to quantitative prediction).

RQ3 Response: There is a spiraling interaction between Science Technology and Agents' Cognitive topics. Technological advances drive attention to Agents' Cognitive, and ethical concerns promote normative development of the technology.The decline of the Agents' Cognitive topic after 2017 reflects the maturation of the technology's application, while the rebound in 2023 is associated with a new round of ethical discussions triggered by large models such as ChatGPT Related.

5. Conclusion

This study provides a systematic framework for visualizing and analyzing the intersection of AI and the social sciences, and its main contributions include:

Combining topic modeling, time window analysis, and multidimensional visualization provides a new combination of methodological tools to use for trend analysis of cross-disciplinary research. Based on large-scale literature data, it reveals the seven core topics and their evolution patterns in the field, which provides data support for understanding the social impact of AI technology. Trend analysis through time window-based visualization provides data-based predictions of future research directions, which helps optimize the allocation of resources for future cross-disciplinary research and provides scientific decision support for future policy formulation.

This study has some limitations, such as the source of the data is the WOS core database, which may lead to this low potential geographic and linguistic bias in the data, the subjectivity of the topic modeling may also affect the accuracy of the topic interpretation, and the use of the year as the time window may affect the accuracy of the trend analysis.

In the course of future in-depth research, we will reduce the possible subjective bias of the data by expanding the data sources to include more databases, and in cross-disciplinary research, we will also incorporate the latest theoretical research in social sciences and artificial intelligence to improve the accuracy of topic modeling.

Through this study, we not only provides a comprehensive overview of the intersection of AI and social sciences, but also provide data-based scientific guidelines for future research and practice. As AI technology continues to evolve, we expect this intersection field to find a better balance between technological innovation and social responsibility, and make greater contributions to the sustainable development of human society.

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