

# Visual Analysis of Literature Evolution on Gender Imbalance in Organization Leadership

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## Abstract

**Objective/Significance:** Gender imbalance in organizational leadership is one of the important issues in human social activities that need to be clarified. It is of great significance to study and reveal the evolution path and research hotspots of gender difference and transformative leadership relationship in China. **Methods/Process:** Based on bibliometrics, this paper uses SCI, SSCI kinds of literature in Scopus and Web of Science databases as research sources and uses Vosviewer and Cite Space visualization software to systematically analyze the evolution of gender imbalance in organizational leadership in the past 10 years, and combine with Origin Photoshop mapping software, conduct display and post-classification processing on the results. **Results/Conclusion:** The research shows that the research on the relationship between gender difference and transformational leadership has formed a hot frontier field, including gender difference and corporate performance, life balance adjustment, and social background leadership strategy. In addition, this paper uses the slope B index of the first-order function fitting curve to quantify the growth rate of literature. The research provides a reference value for the theoretical and practical research on gender imbalance in China. The information post-processing method in this paper is beneficial to the development of visual information retrieval.

## Keywords

Bibliometrics, Gender Difference, Transformational Leadership, Visualization

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## 1. Introduction

Visualization can effectively convey information or knowledge so that readers can quickly understand the essence and rules of things. Efficient and intuitive

knowledge visualization is the most important feature and purpose. Simplicity and clarity are the two basic principles of cartographic visualization, which are also applied in knowledge visualization (El Beheiry et al., 2019; Keller & Tergan, 2005; Metze, 2020; Otten et al., 2015). Information visualization analysis is a form of data analysis in exploration. It plays an important role in analyzing and presenting scientific data. In essence, it is an arrangement of one or more groups of information to facilitate quick and reasonable conclusions about the data relations between these groups. Especially when data information is quantitative or all sets are qualitative, it can usually be expressed in the form of graphs or charts (Hwang & Chen, 2022; Wang et al., 2020). So far, innovation and development in the field of information visualization of bibliometrics have produced significant influence, study including the design of the data access retrieval screening analysis algorithm of relations between the data of rendering, such as research purpose is to display knowledge development and structure, the relationship between the visual technology is used to describe the knowledge and its carrier, mining construction analysis Map and display knowledge and its interrelationships. Therefore, how to use information visualization to deepen the study of knowledge discovery and innovation in bibliometrics has become a major challenge in the networked era of library and information science (Rogers, 2020; Parker et al., 2016). Today, the majority of scholars and organizations are facing the fact that must track the research in front of the latest development to find innovation opportunities. In their competitive environment, identifying the direction of discipline development hot spot and the discovery is very important Monitoring areas emerging research direction, therefore, the scientific literature has become an important task for the researchers and policymakers (Wang & Zhang, 2021).

American scholar Chen Chaomei developed Citespace software based on the timing duality of research frontier and knowledge base, which provides an effective tool for researchers to analyze the hotspot and frontier of knowledge base research in professional fields (Chen, 2017; Wang & Lu, 2020). Vos Viewer is more professional in knowledge clustering analysis, while other Histcite, CARAR, SciMAT, and other software have their characteristics and limitations, but they all have data processing visualization and analysis functions, which promote the development of knowledge visualization (Eppler & Burkhard, 2008).

Gender imbalance in organizational leadership is an important problem that needs to be clarified and solved in human social activities (Hong et al., 2019; Shen & Joseph, 2021). In the upper echelons of the company and government system, the proportion of female leaders is small, and the proportion of women holding elite leadership positions is even smaller. The phenomenon of gender hindering promotion is called the “glass ceiling” (Soleymanpour Omran et al., 2015). The phenomenon of gender imbalance in leadership makes the relationship between leadership and gender difference a concern for researchers in many fields for a long time (Rincón Diez, 2017). In-depth research shows that female

leaders show more transformational leadership characteristics and behaviors than male leaders, thus bringing advantages to their organizations and better adapting to the change of the times and the development of organizational change (Lemoine & Blum, 2021). This viewpoint provides a new perspective for re-examining gender differences in leadership in the context of today's changing times.

Leadership areas are men's significant advantages, and women are in a weak position, in the study of leadership, the characteristics of successful leaders are often described as masculine characteristics significantly, including being aggressive, strong rational, and positive attitude. This understanding, however, contains cultural world outlook and the social environment influence of leadership style (Sanchez-Hucles & Davis, 2010). In addition, studies show that women have an advantage when it comes to higher education, that there is a correlation between higher education and leadership, and that women attend higher education at significantly higher rates than men (Carnes & Lupu, 2016). Statistics show that the proportion of female college students in China is significantly higher than that of male students. In 2012, female students accounted for 51.35% of college students in China, exceeding male students. In 2018, the percentage of female students was 57.74%, 15.5% higher than that of male students. In 2020, female students accounted for 52.04 percent of college students in China, while male students only accounted for 47.96 percent. Female students are significantly better than male students in language ability, image thinking, memory, detail observation, and other aspects, which may be the reason why female students are higher than male students in the higher education system (Ng, 2018; Zhao, 2022). In addition, statistics show that the average financial performance of businesses run by female entrepreneurs is significantly higher than the national average (Elias, 2018). Women leaders are also more collaborative and transformative on complex issues (Stempel et al., 2015). Female leaders are more adaptable to the complex environment of large multinational companies, and this leadership style in turn is more conducive to the success of multinational leaders (Evans, 2014).

Ibrahim AH Mohamed highlights the relationship between organizational learning and transformational leadership, arguing that transformational leadership is of great importance to organizations, and there is a positive correlation between organizational learning and transformational leadership, which directly affects the development of organizational creativity, skills, innovation, and capabilities (Mohamed & Otman, 2021). Soyeon Kim conducted an empirical study on gender issues related to transformational leadership, which showed that female transformational leaders had a more significant impact on male subordinates, and believed that organizations should use more female leaders (Kim & Shin, 2017). Munir studied principals' transformational leadership behavior and gender relationship, proving that the gender of transformational leadership has an impact on teachers' academic efficiency (Munir & Aboidullah, 2018). Shellden Simola studied the relationship between transformational leadership and a

leader's caring model and found that the caring model of managers significantly affected the effect of subordinates on transformational leadership, which indicates that women have advantages as transformational leaders (Simola et al., 2012).

Because of this, this paper studies the literature evolution trends in the field of transformative leadership and gender difference from 2010 to 2021, and uses bibliometrics and visualization analysis methods to explore the basic development of this field visual research on the hot spots and evolution process of research can help scholars accurately grasp the important academic findings and evolution direction of gender imbalance in organizational leadership in the past 10 years, and promote the in-depth academic research in this field.

## 2. Data Sources and Research Methods

### 2.1. Data Sources

This paper is based on Scopus and Web of Science literature database SCI and SSCI as the research source. The main search terms are “transformational leadership” “female leader” and “gender difference”. The time zone spans from 2010 to 2021, and the literature types are Article, Letter, and Review. A total of 1345 kinds of literature are retrieved from the above databases, and 1308 scientific literature are obtained after deleting duplicate and irrelevant articles.

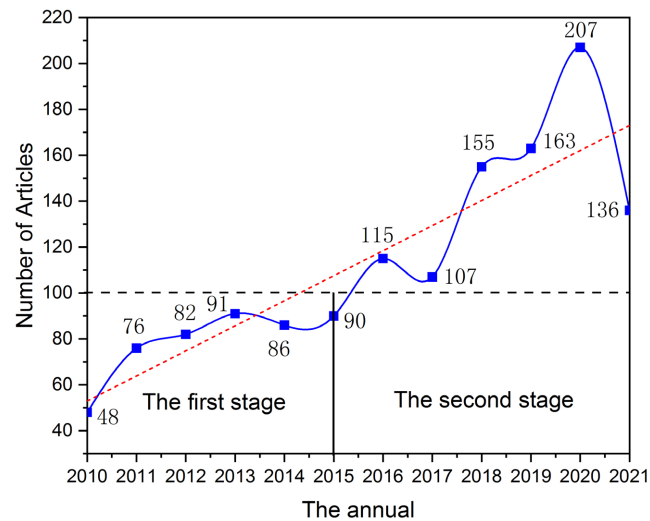
### 2.2. Data Processing and Research Methods

The research method is mainly a scientific measurement method and visualization method, using a combination of qualitative and quantitative methods, to explore the law and trend of its existence. In this study, Vos Viewer and CiteSpace information visualization software were used to analyze the visual information of retrieved scientific literature, and Adobe Photoshop image-processing software and Origin mapping software are used to analyze the visibility of literature data, revealing the evolutionary trend and hot frontiers of knowledge.

## 3. Result Analysis and Discussion

### 3.1. Temporal Trends of the Literature

The change in literature quantity over time is an important indicator of literature measurement. **Figure 1** shows the year-to-year change curve of scientific literature quantity on transformative leadership and gender relationship (2010-2021). CiteSpace software was used to retrieve the original data of the annual number of articles. Origin color dot plot and function fitting were used to divide the publishing stages with dotted lines, which visually and clearly showed the trend of the number of articles in this field over time. The blue line shows the spline curve of the number of literature in this field with years, and the red dotted line is the linear function fitting line of Origin based on the literature year curve.



**Figure 1.** The Year-to-year curve of the number of scientific literature in the field of transformative leadership and gender relations.

The mathematical principle of first-order linear function fitting adopted in this paper is based on an advanced mathematical numerical analysis method, and the first-order linear equation of the transformed variables is obtained according to the principle of the least square method. It is a scientific quantitative method of first-order function fitting (Aspers, 2009). The standard formula is  $Y = A + BX$ , and the fitting curve is unique.  $B$  is the slope, the rate at which  $Y$  changes concerning  $X$  in a function.

The annual variation trend of the quantity of scientific literature is often an important reference for scholars to select their research direction (Wang et al., 2018). However, it is still difficult to make a horizontal comparison of the annual changes in the quantity of scientific literature in different directions. It mainly relies on readers to make a comparative analysis of graphs or quantitative comparison of extreme values on curves. The former is a qualitative study, while the latter can only reflect local information on curves. High-value research directions are often reflected in the year-by-year change curve of literature quantity, which is the rapid increase of literature quantity year by year (Chen et al., 2014). This growth information is currently lacking a quantitative measure. Therefore, how to provide a scientific quantitative method to measure the curve trend of the number of scientific literature changes year by year is of great significance, to provide clearer and more comprehensive information for horizontal comparison of different research directions. The slope  $B$  obtained by fitting the curve with a linear function quantifies the annual growth rate of literature quantity, which helps researchers quickly grasp the growth trend of literature quantity in multiple research directions and provides quantitative comparative information for the selection of research directions. This information is important for researchers to select a research direction, and also provides a quantitative method for horizontal comparison of annual changes in the literature of different directions.

As shown in **Figure 1**, slope  $B$  is  $10.91608 \pm 1.856$ , and the first linear fitting equation is  $Y = 42.045 + 10.9616X$ . It can be seen that the number of the literature shows a rapid upward trend. In this paper, the index slope  $B$  of the spline curve fitted by a one-time function is used to quantify the upward speed of literature over the years.

As can be seen in **Figure 1**, 2010-2015 is the first stage, during which the number of articles per year is no more than 100, the number of articles in 2010 is 48, and the number of articles in 2011 rapidly increases to 76. This is attributed to the research findings in 2010 that female leaders show more transformational leadership characteristics than male leaders (Stempel et al., 2015), and female leaders are better able to adapt to the change of the times and the development of organizational change (Bourne, 2015). This point of view provides a new perspective for re-examining gender differences in leadership in the context of changing times, making the gender imbalance in organizational leadership once again attract the attention of scholars in various fields. In the following four years, the annual number of articles is about 80 - 90. 2015-2021 is the second stage. At this stage, the annual number of articles is above 100, from 115 in 2016 to the peak of 207 in 2020. In 2021, the number of articles decreased to 136, which may be related to difficulties in obtaining research data due to the worldwide isolation of COVID-19.

### 3.2. Major Research Institutions and Countries

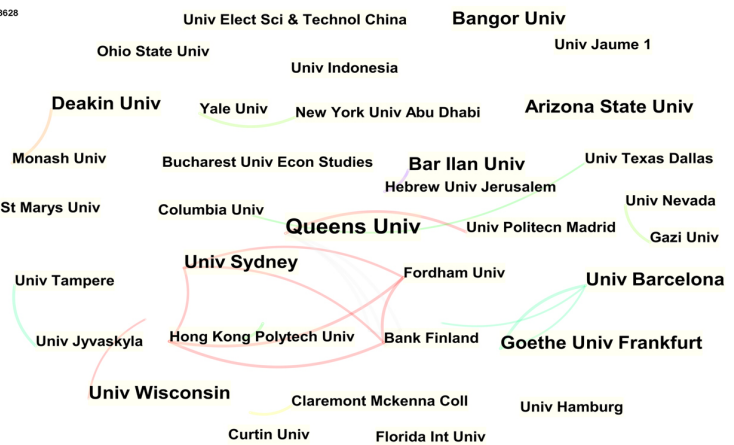
**Figure 2** is the literature unit map of the relationship between transformative leadership and gender. The analysis of the literature unit map shows the major academic units in this field and the cooperation between them. In this paper, the original English atlas of CiteSpace was post-processed by PhotoShop, including 1) indicating the country after the research institution; 2) Using different colors to display research institutions in different countries; 3) The font size of Chinese characters represents academic contribution; 4) The correlation lines between the main academic units are retained. The processed atlas allows readers to quickly capture key information such as the country's academic contribution of major research institutions and the institution association.

As shown in **Figure 2**, the University of Queensland is the research institution with the largest academic contribution in this field and is at the center of academic research. Other major research institutions include the University of Sydney, University of Barcelona, University of Wisconsin-Frankfurt, University of Hong Kong Polytechnic University, etc. There are 12 major research institutions in the United States shown in rose, which is the country that carries out the most research. The University of Queensland in Australia, the University of Sydney, Fordham University in the United States, and the Hong Kong Polytechnic University have more academic cooperation and association.

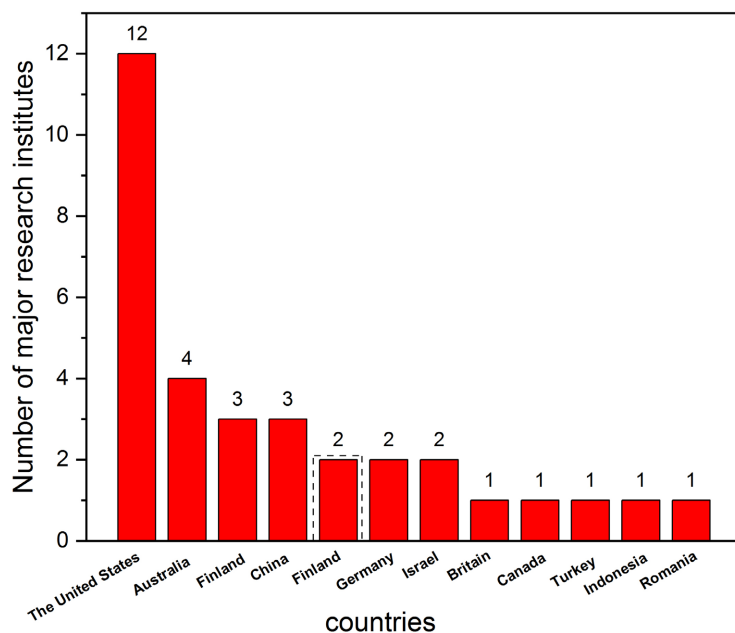
**Figure 3** is the statistical chart of the number of major research institutions in the field of transformational leadership and gender relations owned by different countries, using the scientific drawing software Origin. 1) The bar chart shows

the number of major research institutions in different countries. 2) Adopt a quantitative classification method. According to the number of major research institutions, the contribution of different countries is divided into three levels based on the number of major research institutions, the first level is no less than 5 major research institutions. 2 - 5 major research institutions are in the second tier, and one major research structure is in the third tier; 3) Three background colors of light yellow, light green, and light red show three levels of countries; 4) For the convenience of Chinese readers, the position of China is marked with a dotted box.

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 January 19, 2022 4:23:10 PM CST  
 WoS: F:1, L:1, 2011, 18.8kz-1-8kdata  
 Timespan: 20, 10, 2021 (Slice Length=1)  
 Selection Criteria: g-index (k=10), LRF=3.0, L/N=-1, LBY=8, e=2.0  
 Network: N=135, E=99 (Density=0.0076)  
 Largest CC: 6 (3%)  
 Nodes Labeled: 1.0%  
 Pruning: Pathfinder  
 Modularity Q=0.9289  
 Weighted Mean Silhouette S=0.8628  
 Harmonic Mean(Q, S)=0.7275



**Figure 2.** Unit atlas of literature in the field of transformative leadership and gender relations.



**Figure 3.** Statistical chart of the number of major research institutions owned by different countries.



As shown in **Figure 3**, tier 1 on the far left has only the United States and contains 12 major research institutions. Level 2 intermediate regions include Australia, Finland, Spain, China, Germany, and And Israel. The third echelon area on the right includes Britain, Canada, Turkey, Indonesia, Romania, North America, Europe, Oceania, and Asia, indicating that gender imbalance in organizational leadership has attracted wide attention in the world.

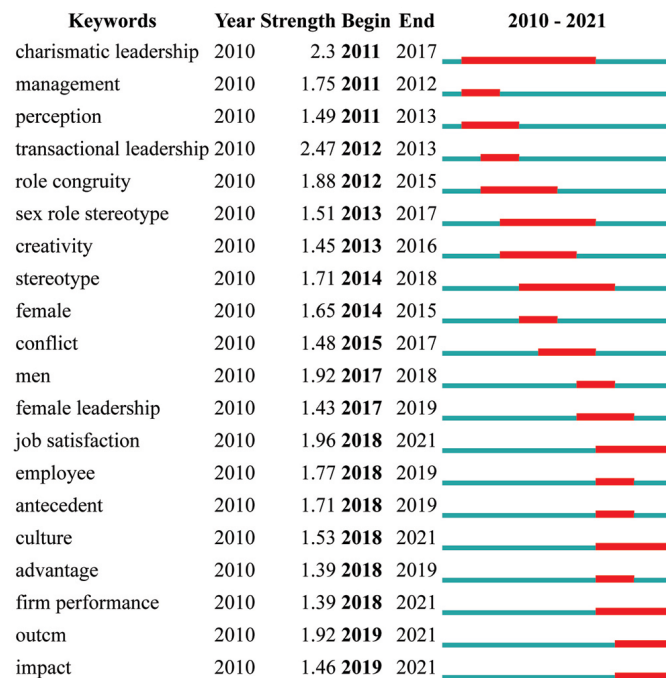
Compared with the traditional index of publications, this paper adopts the index of the number of institutions to measure the research level of a country, which represents the scientific community's attention to this field and reflects the development speed and degree of this field in a certain sense (Rodríguez-Navarro, 2011). The national publication scale indicates the degree of research activity in the field in the study country (Su & Chen, 2020; Tsay, 2008; Wang et al., 2014; Wang & Lu, 2020). The number of institutions used to measure the national research level is similar to the number of national key laboratories used by domestic first-class universities to measure the level of discipline construction in universities, which can also reflect the research level of a country to a certain extent. Researchers need to track the research trends of important research institutions during their research because important research institutions have the most important scientists in their disciplines, are the main undertaking units of important research projects, and have made most of the important discoveries. Important research institutions around the world are leading the field of research. Therefore, it is important to pay attention to the country's major research institutions. When a country has a small number of institutions, but a large number of publications, it still means that the country has significant research strength.

### 3.3. Research Evolution Analysis

The mutation words and their intensity in the 2010-2021 study are shown in **Figure 4**. The blue line segment represents the period from 2010 to 2021, while the red line segment represents the generation and duration of mutant words. The blue line segment and the red line segment clearly show the evolution process of mutant words from 2010 to 2021. In 2011, the research reached its first peak, with three keywords appearing "transformational leadership" "organization" and "cognition", transformational leadership, in particular, gained momentum from 2011 to 2017. The reason is that the research finds that female leaders show more transformational leadership characteristics than male leaders, and women are better able to adapt to the change of the times and the development of organizational change (Parent & Lovelace, 2015). This view provides a new perspective for re-examining gender differences in leaders in the context of the current era of change. From 2012 to 2017, the research was further deepened, and the main keywords included "inherent impression", "disagreement", "gender role stereotype" and "role agreement", etc. The study argues that gender issues arise by evaluating women by men's standards. The research found that transformative leadership can be divided into three dimensions: charisma, intelligence, and



## Top 20 Keywords with the Strongest Citation Bursts

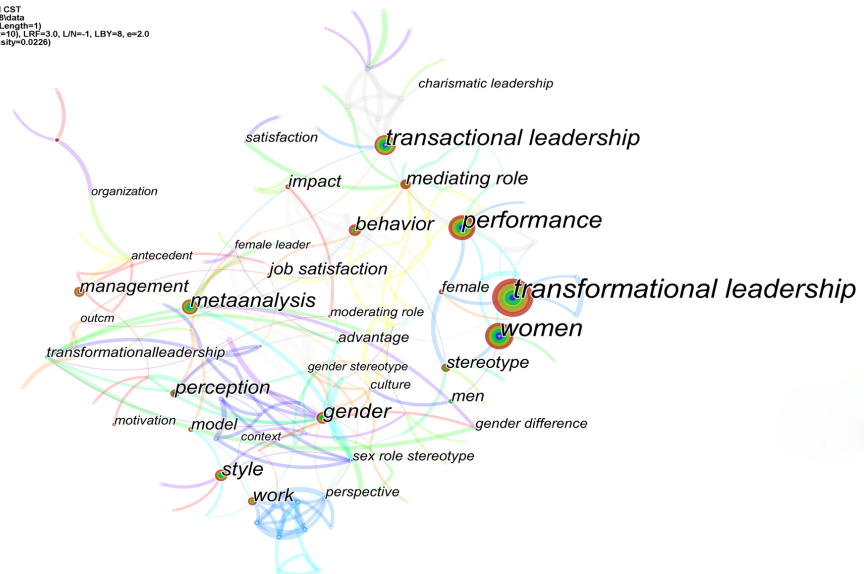


**Figure 4.** Mutation words and their intensity from 2010 to 2021.

personalization (Lawlor et al., 2015). The structure of the transformational leadership style is dynamic, and the structural change will have a transformative effect on the organization (Hallinger, 2003). 2018-2019 is the second peak of the study, mutation words include “job “satisfaction”, “experience”, “corporate performance”, “culture”, and “effects”. In-depth research shows that gender differences in leadership are influenced by social culture and values, and gender differences are not caused by genetic factors, but by the social environment, which is the result of social evolutionary reconstruction. In a rapidly changing society, how to improve the efficiency of organizations to achieve their goals and visions of organizations has become a research focus (Taiwo & Lawal, 2016). In this context, it is of practical significance to study the impact of female leaders’ behaviors on organizations. The research in this period was oriented by the results of organizational behavior, and the research heat from the effects of mutation words on corporate performance and job satisfaction has continued until now, and may remain hot in the next few years.

The keywords of the paper are the extraction and induction of the core content and innovation points of the paper, and the description of the co-occurrence relationship of the keywords can grasp the hot issues and research trends in the research field (Yuan et al., 2022). **Figure 5** further shows the co-occurrence relationship between transformative leadership and keywords in gender relations. Different node sizes represent the co-occurrence frequency of keywords. The

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 Network: N=147, E=243 (Density=0.0226)  
 Largest CC: 144 (97%)  
 Nodes Labeled: 1.0%



**Figure 5.** Cooccurrence atlas of transformative leadership and gender relations.

core of the co-occurrence of high-frequency words is centered on transformational leadership, performance evaluation, exchange leadership, gender issues, and fixed impression. The six nodes of comprehensive analysis, perception, inherent impression of gender role, style, perception, and model are closely related to other keywords. In addition, the whole atlas network is closely related, indicating that the research in this field is carried out around the above core. Therefore, scholars focus on the coupling relationship between female leadership traits and organizational relations, including achieving organizational goals and improving organizational efficiency.

As shown in **Figure 6**, the cluster diagram of transformative leadership and gender relations indicates that the research is mainly focused on the performance of transformational leadership and its inherent perceptions of gender, incentives and bonuses, quantitative calculation and modeling, interactive justice, the advantages of female leadership, self-denial tendency (McDowelle, 2009). The clustering results show that the research has the following characteristics: 1) Attach importance to research methods based on research data analysis; 2) Pay attention to organizational performance and implementation approaches.

As shown in **Figure 7**, the evolutionary path of research on transformational leadership and gender relations from 2010 to 2021 can be summarized into three stages:

#### The First Stage: Initial Stage of Research (2011-2012)

At this stage, the study found that female leaders showed more transformational leadership characteristics than male leaders and were better able to adapt to the change of the times and the development of organizational change, which provided a new perspective for the study of gender differences. The main findings include: 1) There are significant gender differences in transformational behavior between men and women, and women score higher in quantitative evaluation.

tion of organizational contribution. Male leaders showed a task-oriented transformational leadership style, while female leaders showed an interactive relationship-oriented transformational leadership style, which was more conducive to task completion (Cuadrado et al., 2012). 2) Gender sociology research: the characteristics of women’s adaptation to change are influenced by social environment rather than biological influence (Agadjanian, 2000).

The Second Stage: Research Deepening Stage (2013-2016)

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 Largest CC: 200 (97%)  
 Nodes Labeled: 1.0%  
 Pruning: Pathfinder  
 Modularity Q=0.7486  
 Weighted Mean Silhouette S=0.8978  
 Harmonic Mean(Q, S)=0.8164

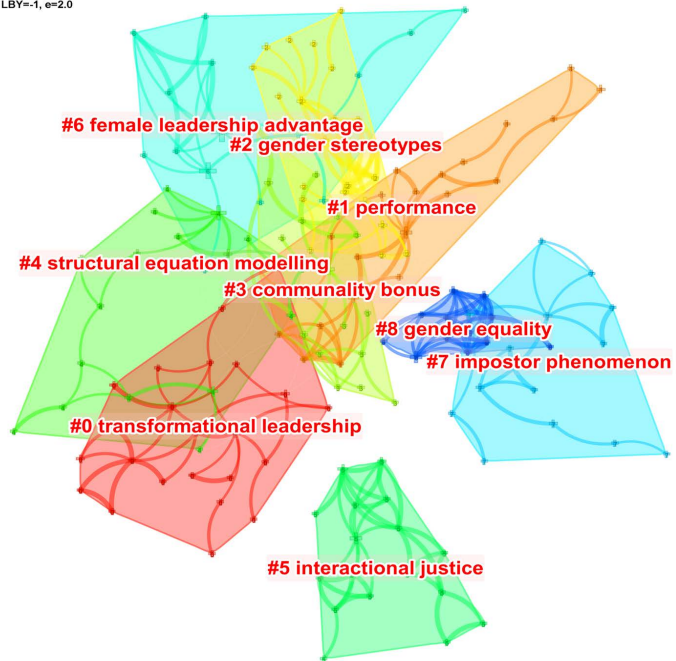


Figure 6. Transformational leadership and gender relations domain cluster map.

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 Timespan: 2010-2021 (Slice Length=1)  
 Selection Criteria: g-index (k=10), LRF=3.0, L/N=-1, LBV=8, e=2.0  
 Network: N=187, E=245 (Density=0.0228)  
 Largest CC: 144 (97%)  
 Nodes Labeled: 1.0%  
 Pruning: Pathfinder  
 Modularity Q=0.8289  
 Weighted Mean Silhouette S=0.8628  
 Harmonic Mean(Q, S)=0.7275

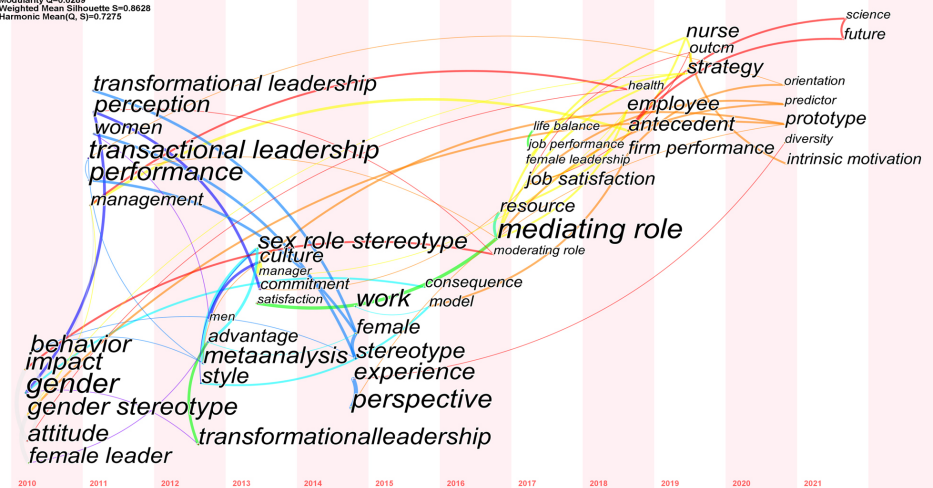


Figure 7. Time series diagram of transformational leadership and keywords in gender relations.

At this stage, the first significant feature is the extensive use of quantitative analysis methods to study the impact of women's transformational leadership traits on organizations. The second is to study the gender difference in transformational leadership from the perspective of culture and organizational performance evaluation. The main findings include: 1) Transformational leadership style is divided into three dimensions: charisma, intelligence, and personalization. Other studies hold that it is composed of four dimensions: moral model, vision, inspiration, personalized care, and leadership charm (Xie et al., 2018). 2) Transformational leadership is divided into six behaviors, including strategic planning, intellectual motivation, and encouragement, setting an example, promoting cooperation, and providing support. 3) Male leaders emphasize authority and purpose, while female leaders tend to form a collaborative network with their organization members, playing a coordinating, communicating, and supporting role in the network, which enhances team cooperation. 4) Social and cultural origins of gender differences: Male leaders show masculine characteristics, while female leaders often show bisexual characteristics. The results showed that men were task-oriented, and women were interpersonal-oriented.

The third stage: Diversification Research Phase (2017-2021)

At this stage, the research began to diversify, and as can be seen from Figure 7, the research enthusiasm continues to this day. The main research findings and hot topics include 1) Gender gap and corporate performance research. The World Bank conducted a large data survey of 9281 companies, showing that about 8% of companies have at least one senior female manager, and companies with female leaders have a significant advantage in business performance, such as annual sales growth, labor productivity growth, and company capacity utilization (Ali & Shabir, 2017). 2) Work-life Balance for Women Leaders. The study explores work-life strategies and support resources that women leaders use to balance work and non-work areas to advance their leadership roles (Brue, 2019). 3) Research on the moderating effect of female leaders on organizations. Female managers establish close and positive relationships in organizations, which can

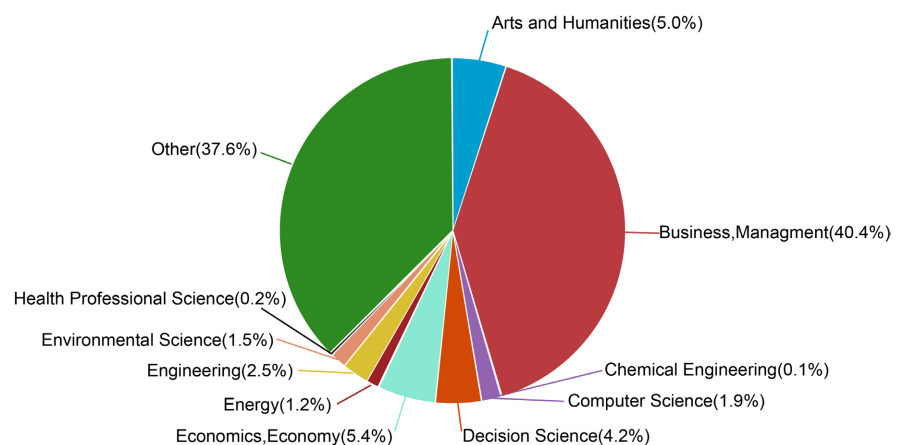


Figure 8. Disciplinary distribution of transformational leadership and gender relations.

motivate subordinates' work and cultivate team creativity (Chen et al., 2021). 4) Research on family and social background of female leaders. Female leaders are more dependent on family relations than men and tend to obtain necessary resource support (Baturu & Gray, 2018). 5) Gender Difference and Leadership Strategy Research. Gender differences can have an impact on leadership in decision-making and business organizational strategies (Casile et al., 2021).

**Figure 8** shows the disciplinary distribution of transformative leadership and gender relations. The subject of this question is business and management (40.4%), economics (5.4%), arts and humanities (5.0%), and decision science (4.2%), while 37.6% is in other disciplines.

#### 4. Conclusion

Based on two information retrieval software, bibliometrics and Cite Space Vos Viewer, this paper conducted a visibility measurement analysis of literature on the relationship between transformational leadership and gender differences from 2010 to 2021. The research focuses on the publication trend of this field, the evolution of hot spots, and the view expression of regional keywords evolution. It presents the evolution of the research frontier of transformational leadership and gender issues in the past decade. To answer "why there are so few women leaders", this important sociological question provides support.

In this paper, the linear function fitting spline curve slope B index is used to quantify the increasing speed of literature with the year, and Origin and Photoshop drawing software are used to carry out the display and post-processing of the visual results that the results are clearer and more intuitive. The results show that there has been a significant increase in literature on the relationship between transformational leadership and gender differences in the past decade, which means that gender differences in transformational leadership have received extensive attention from scholars around the world. The study found that traditional gender stereotypes influence leadership behavior, with men and women often leading in different ways and making different contributions to organizations. At the same time, the research also shows that the hot research directions in this field include the following five directions: gender difference and corporate performance; work-life balance for women leaders; research on the moderating effect of female leaders on organizations; research on the family and social background of female leaders; gender differences and leadership strategies. This study can be used as a reference for the gender imbalance in organizational leadership in China. At the same time, graphics software is used to post-process the visualized information and images, which can present the information more clearly and directly, and contribute to the further research of information retrieval visualization.

#### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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