

Developing Ideological Networks using Social Network Analysis and Writeprints: A Case Study of the International Falun Gong Movement

Yi-Da Chen, Ahmed Abbasi, and Hsinchun Chen, *Fellow, IEEE*

Abstract—The convenience of the Internet has made it possible for activist groups to easily form alliances through their websites to appeal to wider audience and increase their impact. In this study, we investigate the potential of using Social Network Analysis (SNA) and Writeprints to discover the fusion of activist ideas on the Internet, focusing on the Falun Gong movement. We find that network visualization is very useful to reveal how different types of websites or ideas are associated and, in some cases, mixed together. Furthermore, the measures of centrality in SNA help to reveal which websites most prominently link to other websites. We find that Writeprints can be used to identify the ideas which an author gradually introduces and combines through a series of messages.

Index Terms—ideological networks, Falun Gong, fusion, Internet, Social Network Analysis, Writeprints

I. INTRODUCTION

The Internet nowadays is not merely a digital platform to exchange data or information but is also a communication channel to share beliefs and ideas. People discuss topics of interest in forums and post their comments and opinions in homepages and blogs. Through hyperlinks, individuals can link their own posts and pages to the websites they agree with or are opposed to. Gradually, “ideological networks” are formed on the Internet in which websites with similar ideas are connected together via hyperlinks. One may easily find other websites relevant to her/his interests by just following the hyperlinks of a targeted or seed website.

Such ideological networks on the Internet enable activist groups to be more effective and influential worldwide [4]. An Internet user who looks for information on pets may be redirected via an article hyperlink to the website of an animal group against whale hunting. The convenience of hyperlinks among websites also facilitates the tactical alliance of activist

Yi-Da Chen is with the Artificial Intelligence Lab, Department of Management Information Systems, The University of Arizona, Tucson, AZ 85721, USA (e-mail: ydchenb@email.arizona.edu).

Ahmed Abbasi is with the Artificial Intelligence Lab, Department of Management Information Systems, The University of Arizona, Tucson, AZ 85721, USA (e-mail: aabbasi@email.arizona.edu).

Hsinchun Chen is with the Artificial Intelligence Lab, Department of Management Information Systems, The University of Arizona, Tucson, AZ 85721, USA (e-mail: hchen@eller.arizona.edu).

groups to achieve greater impact [4] [6]. For example, the website of a democracy group may have friendly linkages to human rights groups. Through such links, activist groups not only appeal to a wider audience but also amplify the claims for their issues. In some cases, an activist group may use various websites to connect to several different ideological networks to reach potential supporters. For example, Falun Gong (法輪功) related websites cover the content of Qi-Gong exercises (氣功), art performance, spiritual guidance, scientific discussion, human rights, and democracy.

In this study, we aim to investigate the potential of using Social Network Analysis and Writeprints to identify the spread and fusion of activist ideas on the Internet.

II. RELATED WORKS

A. Social Network Analysis

Social Network Analysis (SNA) is a graph-based method to analyze the network structure of a group or population and its impact on group dynamics and social interactions. It was developed by sociologists and has been applied to the studies of social movements, adolescent behavior, and disease transmission [7] [10]. In SNA, individuals are represented as nodes in a graph and linked with lines indicating relationships. For example, in a study of AIDS spread, patients are linked together by their sexual partners, social contacts, drug use, and needle sharing to form a sexual contact network for investigation [7].

The structure of a network is quantified via network measures, many of which originate from graph theory, such as degree and the number of components. Each measure shows different properties of a network and has its own implication for social behavior. For example, degree refers to the number of links for a node in a graph. When it is applied to a social network, it may indicate individual popularity since the most popular person generally has the most intensive interaction with others [11] [13].

Many researchers have used networks to study activist movements [5] [6]. Gerlach and Hine examined the structure of several social movements and found that the most common type of structure was not centralized or bureaucratic but segmentary, polycentric, and networked [5]. Rosenthal et al.

reconstructed and examined the network of 19th-century women reform leaders in New York State [10]. They found that strong ties linked major women's organizations in a movement but weak ties bridged several clusters and channeled the communication to diverse publics. Ackland et al. used their VOSON system to demonstrate the usefulness of network visualization in the analysis of environmental groups on the Internet [3].

B. Writeprints

Because of its anonymous nature, the Internet has become a major medium for cybercrime ranging from illegal sales and phishing to terrorist communication. In order to increase the awareness and accountability of users, many studies have been devoted to developing techniques to identify authors in the online environment [1]. Authorship identification is a process of matching unidentified writings to an author based on the similarity of writing styles between the known works of the author and unidentified pieces [1] [2]. Four major categories of style features have been extensively used to identify writing styles: lexical, syntactic, structural, and content-specific [1]. Among these four categories, lexical and syntactic features are frequently used because of their high discriminatory ability and portability across domains.

In 2006, Abbasi and Chen [2] proposed a visualization technique for authorship called Writeprints, which is similar to the fingerprint biometric system. Unlike other studies of authorship visualization using n-gram features for discrimination, Writeprints used lexical, syntactic, structural, and content-specific features to apply to a large number of authors in an online setting. It adopted Principle Component Analysis (PCA) to reduce dimensionality of feature usage, and a sliding window algorithm to generate data points on a two-dimensional space for the creation of the Writeprints. Writeprints outperformed the Support Vector Machine (SVM) in classification of online messages in their study [2].

III. RESEARCH DESIGN: A CASE STUDY OF THE INTERNATIONAL FLG MOVEMENT

1) The Falun Gong Movement

This study focuses on the Falun Gong (FLG, 法輪功) movement. FLG was developed by Hongzhi Li (李洪志) and introduced to the public in Mainland China in 1992 [9]. It focuses on the concept of cultivation and has two main components: practice and principle. The practice component includes five sets of gentle exercise movements which are similar to Qi-Gong (氣功) exercises. The principle component emphasizes the importance of truthfulness, compassion, and forbearance (真善忍). FLG practitioners believe they can enhance their physical health and elevate their mind at the same time.

On July 20, 1999, the Chinese government designated FLG as an evil cult and banned all its public activities [12]. This suppression is widely believed to be related to the mass petition

of Falun Gong practitioners in Zhongnanhai, Beijing on April 25, 1999 [9]. After the official ban, Hongzhi Li stayed in the United States and used FLG websites, such as Clearwisdom.net (法輪大法明慧網), to release his articles and continue his teaching. Currently, FLG has local websites of practitioners in over 38 countries and 5 continents. It holds several conferences annually in North America and Europe.

Before the suppression, there was no evidence that FLG or Hongzhi Li had any political agenda against the Chinese government. On January 23, 2001, a self-immolation incident by five FLG practitioners in Tiananmen Square in Beijing was reported by the international news media. In 2002, FLG websites began releasing accounts of persecution against practitioners in Mainland China, including pictures, stories, and persecution methods. In late 2004, the Epoch Times (大紀元), which is related to FLG, published "Nine Commentaries on the Communist Party" (九評共產黨) and held a "Quitting the CCP (Chinese Communist Party)" (退黨) campaign.

B. Data Collection and Analysis

Since the fusion of activist ideas can occur in websites, forums, and messages, we perform three levels of data collection and analysis.

1) Website Level

FLG has four core websites which distribute FLG news, Hongzhi Li's articles, and accounts of persecution of FLG practitioners in Mainland China. These four core websites are Clearwisdom.net (法輪大法明慧網), FalunInfo.net (法輪大法新聞社), FalunDafa.org (法輪大法), and EpochTimes.com (大紀元). Each website offers more than ten language versions and has multiple domain names.

We spider FLG relevant websites, including those of other activist groups having hyperlinks to FLG websites, with two levels of inlinks and outlinks via 31 seed websites, which include the four core websites and another 27 FLG websites identified by Google search. A total of 425 relevant domain names were found during spidering and 172 were deemed relevant. Most of the relevant websites were found to be directly linked to the core websites as shown in Table I.

TABLE I
SPIDERING OF FLG RELEVANT WEBSITES VIA SEED WEBSITES

| Seed Website | Outlink Level 1 | Outlink Level 2 | Inlink Level 1 | Inlink Level 2 | Total |
|---------------------------------|--------------------|--------------------|-------------------|-------------------|-------|
| FalunDafa.org (法輪大法) | 85 | 3 | 3 | 0 | 91 |
| EpochTimes.com (大紀元) | 26 | 0 | 1 | 1 | 28 |
| Clearwisdom.net (法輪大法明慧網) | 15 | 4 | 1 | 1 | 21 |
| GuangMing.org (澳洲光明網) | 12 | 0 | 1 | 0 | 13 |
| FalunInfo.net (法輪大法新聞社) | 4 | 2 | 1 | 0 | 7 |
| SoundOfHope.org (希望之聲電台) | 2 | 2 | 0 | 0 | 4 |
| GrandTrial.org (全球公審江澤民) | 3 | 0 | 0 | 0 | 3 |
| GlobalRescue.net (全球營救FLG學員) | 2 | 0 | 0 | 0 | 2 |
| ZhuiChaGouJi.org (追查迫害FLG組織) | 0 | 1 | 0 | 0 | 1 |
| NtdTV.com (新唐人電視台) | 0 | 1 | 0 | 0 | 1 |
| Minghui-School.org (明慧學校) | 1 | 0 | 0 | 0 | 1 |
| Total | 150 | 13 | 7 | 2 | 172 |

In order to understand the main ideas of these websites and how they link together, we perform SNA to analyze their network structure. Two measures of centrality in SNA are used to investigate which websites are prominent in this network: degree and betweenness. The degree of a node is the number of links it has, reflecting its activity level. Betweenness is a measure of the frequency with which a node lies on the shortest geodesic paths of pairs of other nodes. It can be used to detect the extent to which a node plays the role of a gatekeeper to control the communication of others [11].

2) Forum Level

At the forum level, we use Google search and website linkage to find FLG forums. Four forums were found, but only one forum, Falun Dafa Universal (世界法輪大法研究會), is still active and has more than 50 authors contributing to it. Therefore, we concentrate on the analysis of threads and messages in this forum. Falun Dafa Universal, located at city.udn.com (網路城邦), was established in 2005. It has 120 members and 28 discussion boards covering Hongzhi Li's articles, persecution accounts, and the FLG universal and science database. This forum circulates lots of articles from the four core websites. Thus, the average length of messages is long, 1288 characters per messages, but the average reply rate is low, 0.89 reply messages per thread. A total of 740 threads and 1399 messages were collected in this forum.

We perform two types of analysis: thread topic and author interaction. In the thread topic analysis, we investigate how many topics are covered in this forum and how those topics relate to each other. Since Falun Dafa Universal is a Chinese forum, we first use MI, a Chinese phrase extraction tool developed by Ong and Chen [8], to extract key Chinese phrases from the threads and convert those threads into vectors of those key phrases. The top 20 key phrases based on frequency of

appearance are shown in Table II. We then use the cosine coefficient to calculate the similarity between threads and display those threads in a two-dimensional map. For author interaction analysis, we extract the authors' responses to other's threads and perform SNA based on their interaction history.

TABLE II
KEY CHINESE PHRASES OF FORUM MESSAGES

| Rank | Phrase | Rank | Phrase |
|------|------------------------|------|--------------------|
| 1 | 法輪 (Falun) | 11 | 政府 (Government) |
| 2 | 法輪功 (Falun Gong) | 12 | 醫院 (Hospital) |
| 3 | 中國 (China) | 13 | 修煉 (Cultivation) |
| 4 | 學員 (Practitioner) | 14 | 問題 (Problem) |
| 5 | 器官 (Organ) | 15 | 國際 (International) |
| 6 | 迫害 (Persecution) | 16 | 人類 (Human) |
| 7 | 美國 (the United States) | 17 | 個人 (Individual) |
| 8 | 蘇家屯 (Sujiatun Camp) | 18 | 國家 (Country) |
| 9 | 大法 (Dafa) | 19 | 集中營 (Labor Camp) |
| 10 | 社會 (Society) | 20 | 人民 (People) |

3) Message Level

At the message level, we aim to investigate what kinds of ideas an author introduces and combines through a series of messages. We are particularly interested in studying the role of Hongzhi Li's articles in the FLG movement. In order to highlight the characteristics of his writing, we use Writeprints, developed by Abbasi and Chen [2], and compare his articles with other articles written by the editors of Clearwisdom.net. From Clearwisdom.net, we collect 135 articles from Hongzhi Li and 74 articles from the editors. Those articles concentrate on the discussion of three topics: teaching/principles of FLG, the position of FLG on political issues especially related to Mainland China, and summaries of various FLG conferences. The summary of these two sets of articles is in Table III. Compared to the editors' articles, Hongzhi Li's are much longer in length.

TABLE III
SUMMARY OF ARTICLES IN MESSAGE-LEVEL ANALYSIS

| Source | Number of Articles | Words per Article | Duration |
|------------|-----------------------|----------------------|------------------|
| Hongzhi Li | 135 | 1,430 | 5/1999 ~ 2/2007 |
| Editors | 74 | 670 | 3/2000 ~ 12/2006 |
| Total | 209 | 1,161 | 5/1999 ~ 2/2007 |

IV. RESEARCH RESULTS

In this section, we present our research results.

A. Website Level

The 203 FLG relevant websites, including seed websites and newly found ones, are classified into five main categories: FLG cultivation, human rights, democracy, anti-FLG, and mixture (topics of more than one category). The network of these websites, displayed with a spring embedded algorithm, is shown in Fig. 1. The network has three main components: human rights and democracy on the left-hand side, FLG cultivation on the right-hand side, and mixture (and anti-FLG)

in the middle. The mixture websites, including Clearwisdom.net and EpochTimes.com, act as bridges connecting the other two main components. The human rights and democracy websites are somewhat mixed together.

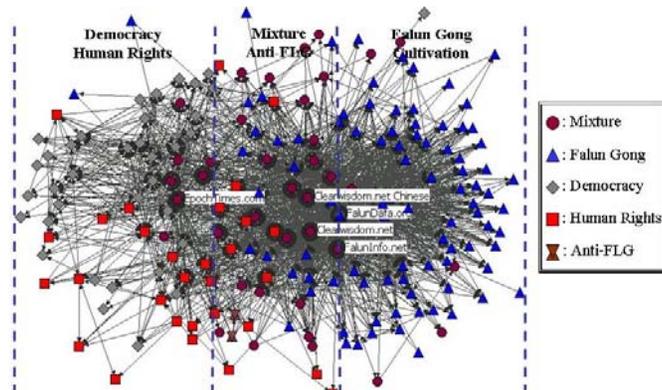


Fig. 1. Network of FLG relevant websites

We use two centrality measures, degree and betweenness, to identify the most prominent websites within this network. Here, the degree or in-degree is calculated by the number of inlinks and reflects the popularity of a website. The betweenness measures the potential that a website may be a gatekeeper controlling the interaction with other websites. The top 10 prominent websites in this network are listed in Table IV. The four core FLG websites are at the top of the list.

TABLE IV
TOP 10 WEBSITES IN FLG NETWORK BASED ON CENTRALITY

| Rank | In Degree | | Betweenness | |
|------|---|------|---|----------|
| | Website | Deg. | Website | Bet. |
| 1 | FalunDafa.org (法輪大法) | 113 | FalunDafa.org (法輪大法) | 14657.33 |
| 2 | FalunInfo.net (法輪大法新聞社) | 99 | EpochTimes.com (大紀元) | 6166.15 |
| 3 | Clearwisdom.net (法輪大法明慧網英文) | 90 | Clearwisdom.net Chinese version (法輪大法明慧網中文) | 4318.54 |
| 4 | Clearwisdom.net Chinese version (法輪大法明慧網中文) | 88 | GuangMing.org (澳洲光明網) | 2533.59 |
| 5 | EpochTimes.com (大紀元) | 78 | Clearwisdom.net (法輪大法明慧網英文) | 2298.31 |
| 6 | ZhengJian.org (正見) | 65 | FalunInfo.net (法輪大法新聞社) | 2014.37 |
| 7 | Fofg.org (法輪功之友) | 54 | ZhengJian.org (正見) | 1335.54 |
| 8 | ClearHarmony.net (歐洲圓明網) | 50 | SoundOfHope.org (希望之聲電台) | 1276.49 |
| 9 | SoundOfHope.org (希望之聲電台) | 50 | ClearHarmony.net (歐洲圓明網) | 1077.36 |
| 10 | NtdTV.com (新唐人電視台) | 48 | HriChina.org (中國人權) | 792.51 |

We use the inlinks or outlinks of the connected websites to check the role of the FLG core websites in this network. The results are shown in Fig. 2. EpochTimes.com is mainly responsible for the linkage of human rights and democracy websites. Clearwisdom.net is located in the middle of the

network and connects other major mixture websites. FalunDafa.org focuses on FLG cultivation and links local FLG practitioners' websites.

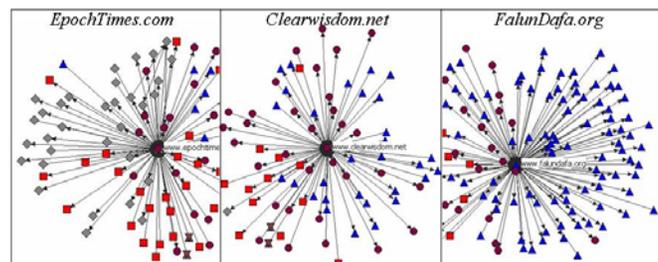


Fig. 2. Roles of FLG core websites in FLG Network

B. Forum Level

1) Thread Topic Analysis

In the 740 threads collected from the forum “Falun Dafa Universal,” ten main topics were identified based on the content of the threads: persecution accounts (學員迫害真相), FLG success story sharing (修煉心得分享), FLG ideology (法輪功哲學), FLG articles (法輪功書籍文獻), anti-Chinese Communist Party (anti-CCP, 反對中國共產黨), life philosophy (生活哲學), mysterious phenomena (宇宙科學與神秘現象), social issues (社會議題), health issues (健康議題), and general messages (網站管理訊息). The ten topics and their descriptions are listed in Table V.

TABLE V
TEN MAIN TOPICS OF FORUM THREADS

| Main Topic | Description |
|---------------------------------------|---|
| Persecution accounts (學員迫害真相) | Detailed description of torture process and methods |
| FLG success story sharing (修煉心得分享) | Describe how a practitioner benefits from FLG |
| FLG ideology (法輪功哲學) | Share personal beliefs about Dafa rectification, cultivation, and righteous thoughts |
| FLG articles (法輪功書籍文獻) | Include articles and books from Hongzhi Li and FLG |
| Anti-CCP (反對中國共產黨) | Criticize CCP for organ harvest, human rights, and religious freedom |
| Life philosophy (生活哲學) | Share inspired life stories and words of wisdom |
| Mysterious phenomena (宇宙科學與神秘現象) | Distribute articles about the origin of the cosmos and unexplainable phenomena |
| Social issues (社會議題) | Discuss social issues, such as the role of news press and impact of violent video games |
| Health issues (健康議題) | Distribute health-related news and healthy recipes |
| General message (網站管理訊息) | Messages about the forum management and arguments |

The distribution of threads over these ten topics is summarized in Table VI. Although life philosophy has the highest number of threads, anti-CCP has the highest average reply rate. Major discussions in this forum are often about anti-CCP topics.

TABLE VI
DISTRIBUTION OF THREADS OVER TEN TOPICS

| Main Topic | Threads | Messages | Reply Rate |
|---------------------------|---------|----------|------------|
| Persecution accounts | 100 | 214 | 1.14 |
| FLG success story sharing | 10 | 16 | 0.6 |
| FLG ideologies | 112 | 256 | 1.28 |
| FLG articles | 29 | 29 | 0 |
| Anti-CCP | 112 | 336 | 2 |
| Life philosophy | 166 | 255 | 0.54 |
| Mysterious phenomena | 87 | 107 | 0.23 |
| Social issues | 16 | 39 | 1.44 |
| Health issues | 86 | 105 | 0.22 |
| General message | 22 | 42 | 0.9 |

Fig. 3 displays the threads based on their similarity. We can see that the persecution accounts and anti-CCP are aligned and at some degree mixed together on the upper parts of the circle. Such a mixture is due to the high usage of the same key phrases, such as organ harvest (器官活摘) and labor camp (集中营). In the lower part, Falun Gong ideology is closely aligned with life philosophy and mysterious phenomena. From the relative positions of these three topics, we may infer that Falun Gong is similar to a religion, which not only teaches a certain life philosophy but also explains the origin of life.

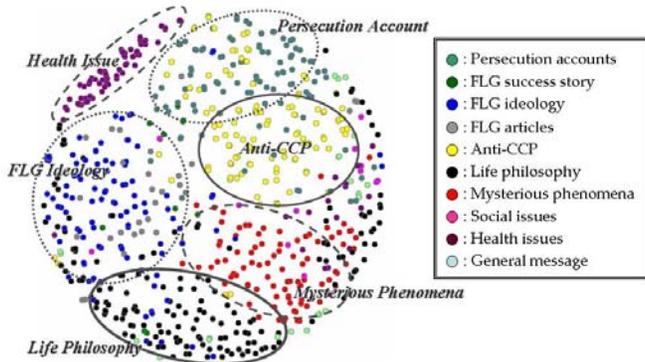


Fig. 3. Display of threads according to their similarity

From the display of threads, we can further see which topics an author primarily contributes to. Fig. 4 shows the distribution of threads of the top 2 active authors in the forum. The author ‘‘Sujcs888’’ focuses on Falun Gong ideology, life philosophy, and mysterious phenomena; while the author ‘‘LoveTender’’ targets the topics of persecution and anti-CCP.

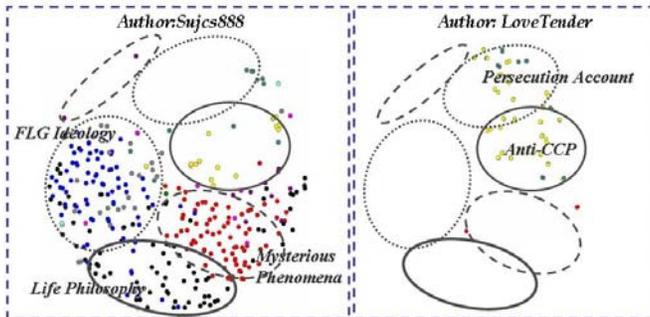


Fig. 4. Distribution of topics of the top 2 active authors in the forum

2) Author Interaction Analysis

In order to see which topics have more intense discussion

among authors, we measure the interaction networks of the top 5 topics above with average degree and clustering coefficient. The average degree shows the overall activity or interaction density of authors in a network. The clustering coefficient reflects clusters, which can indicate cliques or groups [13]. The results of these two measures are summarized in Table VII. The most intense interaction occurs in the discussion of FLG ideology and anti-CCP. However, compared to FLG ideology, anti-CCP has lower average degree but a much higher clustering coefficient. This implies that those authors are more likely to create discussion groups around this topic.

TABLE VII
DEGREE AND CLUSTERING COEFFICIENT OF FIVE MAIN TOPICS

| Main Topic | Degree | Clustering Coefficient |
|----------------------|--------|------------------------|
| FLG Ideology | 2.400 | 0.086 |
| Life Philosophy | 2.080 | 0.093 |
| Mysterious phenomena | 1.00 | 0.000 |
| Persecution | 1.733 | 0.000 |
| Anti-CCP | 2.261 | 0.128 |

Fig. 5 shows the interaction networks relating to FLG ideology and the anti-CCP topic. Authors discussing FLG ideology seem to follow the ideas and preaching of master practitioners (the node in the center of the network). In anti-CCP discussions, authors are more likely to share their opinions and interact with each other freely (as shown in small clusters of interactions).

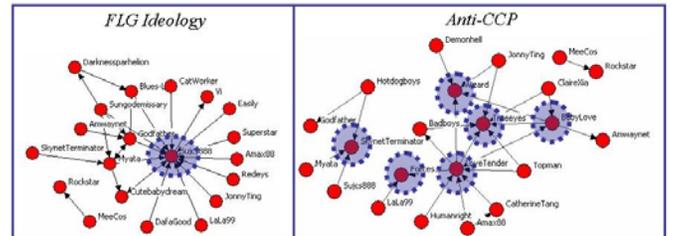


Fig. 5. Interaction network of authors in FLG ideology and anti-CCP

C. Message Level

Writprints illustrate the characteristics of words that authors frequently use to express their opinions or ideas. Fig. 6 shows the Wrintprint of Hongzhi Li. His discussion revolves around the teachings of Falun Dafa (法轮大法) and has neither significant temporal variation nor concentration on sub-topics. However, in his bag of words, the word ‘‘evil’’ is used frequently.

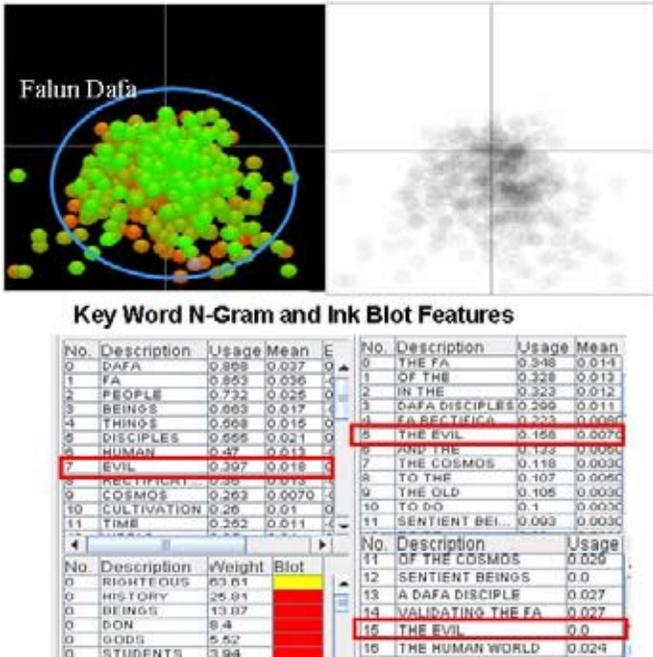


Fig. 6. Writetype of Hongzhi Li

The Writetypes of the editors of Clearwisdom.net, as shown in Fig. 7, consistently revolve around three major topics between 2000 and 2006: Dafa rectification (正法), righteous thoughts (發正念), and persecution of FLG practitioners (學員迫害真相). Comparing the Writetypes of Hongzhi Li and the editors allows us to see their roles in the FLG movement. Hongzhi Li's articles focus on the central concepts of FLG cultivation but provide some hints of his political attitude (e.g., against evil). The editors' articles, on the other hand, provide their interpretations of Hongzhi Li's teaching.

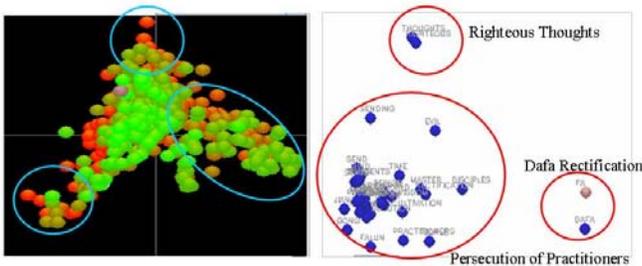


Fig. 7. Writetype of the editors of Clearwisdom.net

V. CONCLUSIONS

In this study we investigate the potential of using SNA and Writetypes to identify the fusion of activist ideas, using the FLG movement as our case study. We find that network visualization is very useful to reveal how different types of websites or topics are associated and, in some cases, mixed together. For example, in the network of FLG relevant websites, the websites of democracy groups are intertwined with those of human rights groups. The core websites of FLG act as bridges to join the local websites of FLG practitioners to those of human rights and democracy groups. We use Writetypes to identify the ideas which an author introduces and combines

through a series of messages. We find that the writing of Hongzhi Li, the leader of FLG, centers on the teaching of Falun Dafa. The articles of the FLG website editors are more concrete and specific in certain areas, such as Dafa rectification and righteous thoughts.

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