**LIU — Study**

<7 figures, 3 tables>

**A Study of Symbolic Element Networks in National Emblems**

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Human social life is a repository of symbols in various forms to mark, celebrate, and glorify social groups (Durkheim, 1976). Following the development of modern nationalism, national symbols are devised to identify attachment to specific territories and forge a national unity of particular ethnic and cultural heritage (Smith, 1999). The political, cultural, and ideological identity of an independent country is mostly proclaimed by three symbols: the national flag, the national anthem, and the national emblem (Firth, 1973; Geisler, 2005). The universal adoption of these ethno-cultural identity signifiers provides a great research opportunity to understand the global and regional characteristics of group symbolism in humanity (Butz, 2009; Elgenius, 2011).

In this paper, we study the similarity and divergence of symbolic elements in ethno-cultural identity with a focus on national emblems. We apply the data analytic method of social network analysis to a total of 205 national emblems such that relational characteristics of symbolic elements and human communities are examined at multiple levels of composite granularity. We conduct exploratory functionalities of the symbolic analytic framework. The results indicate the potential of fruitful discovery in deciphering symbolism in humanity. As a case of application, this study shows the value of digital humanities research in complementing traditional methods of sampled observation and subjective induction.

**National Emblems and Data Model**

A national emblem is an abstract or representational pictorial pattern that signifies the history, myth, or value of a nation and is regarded as one of the core national symbols. This pictorial pattern is designed to reflect and project a nation’s image with a layout of elementary entities in a set of colors. Every nation and state in the modern world has adopted a national emblem—sometimes also called a great seal or an official coat of arms—of its own for both domestic and international use, such as on the cover of a national passport. Compared to national flags, national emblems, in most cases, seem to contain more elements that encode rich anthropological and ethnic features. For example, the national flag of France (see Figure 1a), is a tri-color layout featuring three vertical bands in blue, white, and red, while the coat of arms of France (Figure 1b) is designed with stronger historical and cultural ingredients and attached with vivid symbolic meaning.

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| Figure 1a. French national flag. | Figure 1b. French national emblem. |

A national emblem is a graphical form of expression that encodes information both at the syntactic and semantic levels. At the syntactic level, we observe the surface forms of the elementary entities and the colors. The French national emblem is composed of entities such as an ax, a rod, an oak branch, a laurel branch, a lion’s head, an eagle’s head, a shield, and a monogram, in yellow (golden) and brown. These elementary entities symbolize justice, wisdom, victory, and name at the semantic level. We retrieve descriptive data of the national emblems of a total of 205 countries from Wikipedia. Each record includes the syntactic data of elementary entities with colors and the semantic data of symbolic meaning. The syntactic data of entities are further aggregated into class and meta-class to provide a three-level granularity of data analysis. For example, ‘ax’ and ‘sword’ at the entity level are aggregated into ‘weapon’ at the class level and ‘man-made objects’ at the meta-class level. Similarly, individual countries are also aggregated into region and continent levels. Table 1 outlines the three levels of data classification, the corresponding data size, and partial data content.

Table 1. Syntactic Data Model of National Emblems

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| Data Type | Data Level | Data Size | Data List |
| Symbolic Element | Meta-class | 6 | animal, plant, natural/physical objects, human, man-made objects, human ideas |
| Class | 32 | amphibian, quadruped, bird, celestial body, crop, tree, text, weapon, . . . , etc. |
| Entity | 308 | eagle, lion, sun, moon, star, rice, torch, ribbon, knight, dragon, diamond, . . . , etc. |
| Color | — | 9 | black, white, grey, red, blue, green, yellow, orange, brown |
| Human Community | Continent | 5 | Africa, Asia, America, Europe, Oceania |
| Region | 20 | East Asia, Southeast Asia, Central Asia, South Asia, Western Asia, North America, Central America, . . . , etc. |
| Country | 205 | Malaysia, Cambodia, Venezuela, Finland, Niger, Oman, Fiji, . . . , etc. |

**Applying Social Network Analysis**

*Affiliation Network Model*

Social network analysis is a data analytic model that encodes relations among a set of entities and reveals the structural characteristics of their interaction pattern (Wasserman and Faust, 1994). For the national emblem data, social network analysis provides a systematic mechanism to explore and analyze the ideological and cultural relations among human communities. The current study focuses on syntactic data and separates the syntactic variables of symbolic element and color. In network modeling, we construct affiliation networks consisting of a set of symbolic elements (or colors) and a set of human communities. A symbolic element (or color) is linked to a community based on membership in national emblem composition. For dual perspectives, this two-mode bipartite network can also be projected or reduced to two one-mode networks (Newman, 2001; Zhou et al., 2007). One is the element (or color) co-membership network where elements are connected to each other when they share membership of a national emblem composition. The other one-mode network is the community affinity network, where ties represent mutual adoption of the same element (color) in national emblems. All ties in either two-mode or one-mode networks are valued by occurrence frequency to reflect the strength of the relationship.

*Network Indicators*

Social network can be analyzed at different levels for inspecting the embedded relations among entities. Among the many proposed network measurements, we adopt a set of core indicators to observe the essential characteristics of similarity and divergence of self-projected ideology and values among global human communities. The calculation of these network indicators and the network visualization are done with Gephi, a network analysis software package developed by Gephi Consortium.

• Node level: *Degree centrality* measures the extent to which a node is involved in extensive relationship. *Betweenness centrality* estimates how much a node lies on the paths between any two other nodes. Node ranking by both centrality indicators helps classify a node’s location as core, peripheral, or intermediary in the network.

• Sub-group level: *Modularity* is a clustering measurement that detects sub-groups where there are more intensive links between nodes within than among the rest of the network (Newman, 2006). This indicator may be useful in identifying families of ideological elements and human communities at different levels.

**Analytical Results**

The integration of a flexible analytical framework of social network analysis and the size and depth of the emblem symbolic data obviously provide a wide horizon of relational characteristics. For example, based on the syntactic data model of Table 1, we can construct two affiliation networks, color-human\_community, and symbolic\_ element-human\_community, one at 1 x 3 and the other at 3 x 3 composite granularity levels. Each affiliation network can also be projected into two one-mode networks. This will result in a total of 36 networks that encode different aspects and various granularities of relational information. Limited by the space of this paper, we demonstrate two distinct analytic functions and present the results of a few interesting discoveries.

*Discovery by Observation*

We first observe how the nine primary colors are used in national emblems across the world. Figure 2a shows the color-country affiliation network where the size of color nodes is proportional to its degree (frequency of use by country). The top three colors are yellow (149), white (133), and red (129), followed by blue (107), green (73), and black (41). All other colors are significantly minor.

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| Figure 2a. Overview of  color-country affiliation network. | Figure 2b. Unique and strong association of color-region. |

Next we examine the color and region relations and apply the modularity measurement to approximate the separation of cohesive sub-groups (Barber, 2007). As shown in Figure 2b, several unique associative patterns between region and color are identified that provide interesting information. For example, the color blue is a common symbol of Northern Europe, Western Europe, and the Caribbean, while the color green uniquely represents Western Asia and East Africa. This analytic observation based on systematic data exploration can complement traditional symbolism research in sociology and anthropology (Kolsto, 2006; Podeh, 2011).

For entity-country affiliation, it is observed that a total of 308 unique element entities are used 1,624 times in 205 national emblems with a long-tailed distribution. The top 10 entities are listed in Table 2 and account for 38.2% of occurrence frequency. When the one-mode entity co-membership network is constructed, several cohesive subgroups are identified. One of the interesting patterns of entity association is shown in Figure 3, with shield, eagle, lion, cross, crown, and spear as members of the primary core, and seems to indicate a strong European flavor.

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| Table 2. Symbolic element distribution.   |  |  |  |  | | --- | --- | --- | --- | | Rank | Entity | Freq. | Perc. | | 1 | ribbon | 110 | 6.8% | | 2 | shield | 109 | 6.7% | | 3 | motto | 97 | 6.0% | | 4 | star | 64 | 3.9% | | 5 | sun | 51 | 3.1% | | 6 | lion | 44 | 2.7% | | 7 | nation name | 43 | 2.6% | | 8 | eagle | 36 | 2.2% | | 9 | crown | 34 | 2.1% | | 10 | mountain | 33 | 2.0% | |  |
| Figure 3. A sub-group of entity co-membership with European flavor. |

*Discovery by Query*

Another way to decode the embedded information from the various affiliation networks is to conduct a focused exploration for specific questions. Suppose we start with the questions of how regions share the use of similar symbolic elements and what the overall diversity is across regions. An entity-region affiliation network may provide partial answers with appropriate granularity. Results of applying network indicators are shown in Table 3, where 20 regions are divided into nine subgroups based on common use of symbolic entities. Several families of regions emerge that reveal different aspects of similarity and divergence in symbolic expression of humanity. Sub-group 1 share a common cultural heritage, even though North America is geographically separated from other members. Members of sub-group 2 are both geographically distant and culturally independent. This grouping presents an interesting phenomenon and calls for further investigation. Sub-groups 3, 4, and 5 seem to be both geographically and culturally connected, while the remaining sub-groups are more isolated from others. Figures 4a and 4b show the entity-region networks of sub-groups 1 and 2.

Table 3. Regional grouping by common use of symbolic entities.

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| Sub-  group | Region(s) | Core Entity | Degree Centrality | Betweenness Centrality |
| 1 | Southern Europe, North America, Western Europe, Central Europe | ribbon | 18 | 2313.8 |
| shield | 18 | 2174.9 |
| eagle | 15 | 1310.0 |
| spear | 12 | 1032.0 |
| olive | 11 | 972.4 |
| 2 | South Asia, Northern Europe, North Africa | star | 18 | 2344.3 |
| motto | 16 | 1930.7 |
| lion | 17 | 1831.2 |
| moon | 12 | 990.1 |
| sword | 12 | 927.9 |
| crown | 13 | 819.9 |
| 3 | Southeast Asia, Central Asia,  East Asia | sun | 16 | 1838.7 |
| nation name | 15 | 1736.1 |
| mountain | 13 | 1280.2 |
| wheat | 10 | 609.3 |
| river | 9 | 512.4 |
| 4 | West Africa,  East Africa, Central Africa | flag | 13 | 1250.8 |
| palm (tree) | 10 | 875.9 |
| ship | 10 | 734.9 |
| helmet | 9 | 656.6 |
| 5 | Western Asia, Eastern Europe | sea | 10 | 737.0 |
| arrow | 7 | 368.3 |
| oak | 8 | 357.9 |
| horse | 7 | 270.1 |
| 6 | Caribbean, Oceania | chain | 7 | 375.9 |
| stripe | 5 | 194.8 |
| 7 | Central America | triangle | 6 | 260.2 |
| cogwheel | 6 | 258.1 |
| 8 | Southern Africa | man | 6 | 357.9 |
| rifle | 4 | 130.9 |
| sheep | 4 | 77.5 |
| 9 | South America | bow | 5 | 270.1 |
| ax | 5 | 241.2 |
| coffee | 5 | 185.2 |

**Discussion and Conclusion**

Symbolism is a fundamental form of humanity expression. While a national emblem forms an integral context of correlated symbolic elements, we believe that a single symbolic element is itself a unit of idea expression and can be examined by an objective data analysis. It is the interpretation of analytic results that needs to take into account the contextual information. In this proposal, our purpose is to show the methodological process of analyzing the inter-relations among symbolic elements while cautiously refrain from making conclusive interpretation. Through the co-occurrence of the lexical and geographical presence of the emblem symbols, we utilize social network analysis as an effective tool to reveal the emergent information.

This study demonstrates the great potential of employing a data analytic framework for explorative discovery in sociology and anthropology. Our approach helps unlock the less than obvious information in the symbol-location relationship by presenting a lexical-based concept in a non-linear fashion, opening it up for interpretations that are not so readily available via standard appearance of materials. Furthermore, it allows the lexical-based concept to speak in its multiplicity. The initial results seem to provide rich implications for better understanding global humanity’s similarities and divergences. Our future work includes interdisciplinary research with sociologists and/or anthropologists for more in-depth investigation and interpretation, as well as an extension to analyzing the relations of symbolic semantic meaning in national emblems.

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| Figure 4a. Entity-region network of sub-group 1. | Figure 4a. Entity-region network of sub-group 2. |

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