Semantic Interpretation of Social Network Communities

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Abstract
A community in a social network is considered to be a group of nodes densely connected internally and sparsely connected externally. Although previous work intensely studied network topology within a community, its semantic interpretation is hardly understood. In this paper, we attempt to understand whether individuals in a community possess similar Personalities, Values and Ethical background. Finally, we show that Personality and Values models could be used as features to discover more accurate community structure compared to the one obtained from only network information.

Personality & Values Model
In this paper we examine Personality and Values models to understand semantic homogeneity of network communities. The Big 5 Personality model [Openness (O), Conscientiousness (C), Extroversion (E), Agreeableness (A), Neuroticism(N)] is being used to understand the characteristics or blend of characteristics at individual level, whereas the Schwartz Values model [Achievement (AC), Benevolence (BE), Conformity (CO), Hedonism (HE), Power (PO), Security (SE), Self-direction (SD), Stimulation (ST), Tradition (TR), Universalism (UN)] is being used to understand and analyze inter-personal dynamics of societal sentiment (see SI Text for further details).1

The Personality labeled gold corpus (10K Facebook status updates of 250 users and their Facebook network properties), released in WCPR’13 workshop, was used to build the Personality model. For the Values model we crowd-sourced a Twitter corpus using the Amazon Mechanical Turk. Self-assessments were obtained using the Portrait Values Questionnaire (PVQ). At the end of the data collection process, data from 367 unique users had been gathered, having 1,608 average tweets per user (see SI Text for details).

For the automatic categorization of Personalities and Values, several psycholinguistic features were tested including Linguistic features (LIWC2, Harvard General Inquirer, MRC psycholinguistic feature, and Sensicon3), network properties (Network size, betweenness centrality, density and transitivity), and Speech-Act classes.

Table 1: Performance of Personality and Values Models.

<table>
<thead>
<tr>
<th>Features</th>
<th>Model</th>
<th>F-Score (SVM)</th>
<th>F-Score (LR)</th>
<th>F-Score (RF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lexicon</td>
<td>Personality Values</td>
<td>0.78</td>
<td>0.62</td>
<td>0.65</td>
</tr>
<tr>
<td>+Non-Linguistic</td>
<td>Personality Values</td>
<td>0.79</td>
<td>0.66</td>
<td>0.68</td>
</tr>
<tr>
<td>+Speech-Act</td>
<td>Personality Value</td>
<td>0.80</td>
<td>0.70</td>
<td>0.71</td>
</tr>
<tr>
<td></td>
<td>Value</td>
<td>0.81</td>
<td>0.63</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Support Vector Machine (SVM), Logistic Regression (LR), and Random Forest (RF) were tested for the classification tasks. The best performing Personality classification system (Verhoeven, Daelemans, and De Smedt 2013) at WCPR’13 achieved an average F-Score of 0.73. In Table 1, we see that our SVM-based model outperforms their system by achieving an average F-Score of 0.80. The Values model achieves an accuracy of 0.81.

Semantic Interpretation of Communities
The Twitter network, released by SNAP (Leskovec and Krevl, 2014) (nodes: 81,306, edges: 1,768,149) has been used to study community structure. We considered 1,562 ground-truth communities (after discarding communities having size less than 5 and with tweets less than 100).

In order to analyse whether people within the same community tend to be homogeneous with respect to their Personality and background Values/Ethics, we measure Shannon’s Entropy (measure of the uncertainty) for each dimension separately. Higher entropy scores suggest lower similarity. Cross-relational entropy scores both for Personality and Values models are reported in Table 2a and Table 2b respectively. In these tables, rows represent communities having less entropy scores for the corresponding psychological dimension. For example in Table 2a, the first row AC (Achievement) represents all the communities having less entropy scores for achievement. Columns represent the fuzzy orientations of community members in rest of the dimensions. Resulting entropy scores for different Personality and Values differ greatly across communities. Therefore we normalize entropy scores using:

\[ x_{scaled} = \frac{x - x_{min}}{x_{max} - x_{min}} \]

which keeps the range between (0,1). Entropy scores are further normalized based on the community size since the

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1https://aishwarya-nr.github.io/AAAI.pdf
2http://www.liwc.net/
3https://hlt-nlp.fbk.eu/technologies/sensicon
number of members in different communities may vary. We then consider communities below the calculated threshold (median of \(x_{\text{scaled}}\) value) for further analysis. In Table 2a, we can observe from the column-wise distribution of the Achievement (AC: row 1) that the Security (SE: col. 6) people find it difficult to manage in any achievement oriented group, as SE people always want to be safe and are unwilling to go against rules; whereas AC people are always very keen to achieve their goals and are ready to take risks for the same. Another interesting observation is that Traditional (TR: col. 9) people can hardly manage themselves in any achievement oriented group, as SE people always want to be safe and are unwilling to go against rules; whereas AC people are always very keen to achieve their goals and are ready to take risks for the same. 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