Graph-Drawing Supported Identification of Influential Students at Schools

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Abstract

We consider the real-world problem of identifying a set of "influential" students at schools for a workshop on tolerance. We report on a tool that visualizes the networks of social connections between students, identifies sets of influential students, and lets one explore and understand the solution space with a focus on usability for teachers who are untrained in network analysis.

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Category Poster Abstract

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1 Problem Scenario

The "Together for Tolerance" (T4T) intervention (a subproject of the "INCLUSIVITY" project [5, 6], led by developmental psychologists and education workers) aims at promoting intergroup tolerance in high schools, especially under polarized conditions where schools become increasingly divided into groups with contrasting opinions, beliefs about social issues, and conflictual behavior. The central idea is to conduct special week-long workshops for the students, led by (school-external) trained personnel.

Since a typical German high school has about 1000 students, it is cost-prohibitive to do so with all students. Thus, the workshops are done with only a comparably small group of students, between 15 and 20, called *social referents* [4], who are highly connected to others via social relationships and have outstanding network positions within the school. Their network positions are thought to make them most influential, as their behavior is exemplary for and observed most by other students. The formally "best" way to select students is an active field of research and part of the T4T project lead by developmental psychologists.

We know, however, that teachers are not accurate in identifying social referents; one intervention even showed that teacher-selected social referents (instead of selections done by other adolescent students) had no or even detrimental influences on their fellow students [2].

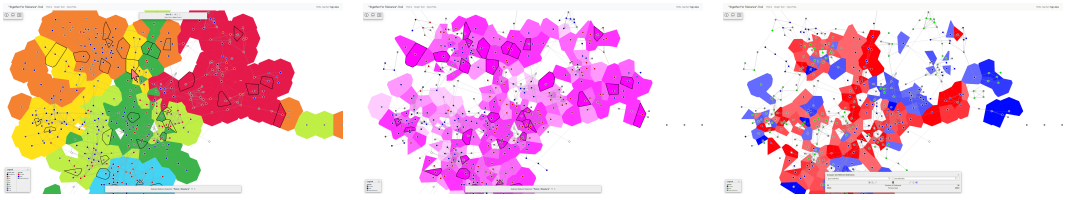

Figure 1 (left) Network of a school with 1000 students, regions are colored according to class year, nodes according to gender, social referent selection in black borders. **(middle)** Visualizing distances to the selected students. **(right)** Comparing two different selections (red=better and blue=worse than second selection).

Thus, we design a web-tool to not only select students, but equally important to visually and intuitively "explain" the selection to the involved teachers. Overall, our web-tool can be seen as the core of step 2 in a 3-step pipeline:

1. Acquiring the social network between the students via questionnaires by developmental psychologists [5]. The network is a multi-graph with node attributes, and edges are mapped to their originating question ("with whom do you spend time?", "with whom would you like to spend time?", "whom do you avoid?", etc.).
2. The T4T WebTool allows to visualize and inspect the network. It also computes one or more social referent selections (independent of the specific visualization), and allows to investigate, modify, and compare them.
3. The students of the final social referent selection are invited to the workshop. Their knowledge and behavior acquired at the workshop should permeate through the network.

In the current test schools, step 2 is performed by researchers. With the project being conducted in more schools, this task should be done by teachers who will be trained in T4T workshops, but have no further experience in network analysis. Furthermore, several practical decisions – e.g., the "best" questions to ask in step 1, how to aggregate the questions into edges, which measure to use for the selection process, etc. – are still ongoing research in the psychological community. As such, the T4T WebTool shall also play a double role for the researchers to help them investigate these questions. They, of course, expect and can deal with a much richer network visualization interface.

2 T4T WebTool

The frontend is written in JavaScript using Vue.js; the backend server in Python using the Django framework. Within the backend server, there is a SQLite database and a C++-bridge to the *Open Graph Drawing Framework* [1]. The tool supports the computation and numerical comparison of several different group centrality measures (sometimes enriched by node-attribute specific adaptations) to use for the social referent selection; despite being an interesting topic in itself, this is beyond the scope of this abstract. Apart from typical operations like zooming, panning, node inspection, etc., the tool has some distinctive features:

- The graphs are drawn using OGDF's implementation of the FM^3 algorithm [3]. To obtain context-aware drawings, we temporarily extend the network with suitably weighted dummy edges to, e.g., (a) cluster students within the same class, and (b) spread the students of the social referent selection over the drawing area, cf. Fig. 1(left). Clearly, we can obtain different drawings for different social referent selections.
- Within the drawing, we compute Voronoi regions around the nodes which are used both as clickable regions corresponding to the nodes, as well as for coloring purposes.

- The social referent selection can be visualized, Fig. 1(middle), where the saturation of a region's color encodes the distance between the student and their closest social referent.
- Two selections can be visually compared, Fig. 1(right), where a region's color encodes which selection is better for the respective student; the saturation encodes by how much.

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