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About the Image: Diffusion Dynamics in an Historical Network

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For the *Structure and Dynamics* journal logo the editors chose an image that would exemplify visually some of the themes involved in analyzing structure and dynamics in social science and history. Krempel and Schnegg explain here the project behind the image, what it represents, and how it came to be. Their figures 1-3 help to explain the network configurations for actors and events in their longitudinal network analysis. Events involving the diffusion of political action as seen in the three time periods represented in the logo (a dynamic gif) are now seen in detail in their figures 4-6. Their figure 7 shows the barycentric locations of occupations of the actors involved both in political events and location in the social and institutional network landscape. ─ Editors' note

The dynamic image of the *Structure and Dynamics* journal logo is based on overlapping memberships of more than 1200 people in 68 historical events: associations, citizen initiatives, and committees organizing local charities and political institutions in the German town of Esslingen during the Vormärz of the German Revolution 1848/49. The data were compiled by Carola Lipp at the Institute of European Ethnology at the University of Göttingen, Germany. The 68 institutions and events are shown schematically in Figure 1, in which the sizes of nodes represent the numbers of people involved. The bigger the nodes for institutions the greater their membership, and the bigger the nodes for events the more people took part. Although the politically colored events, such as the nodes colored red, yellow and blue, were relatively small, they had a huge impact through network diffusion.

Figure 1: Structure of Events
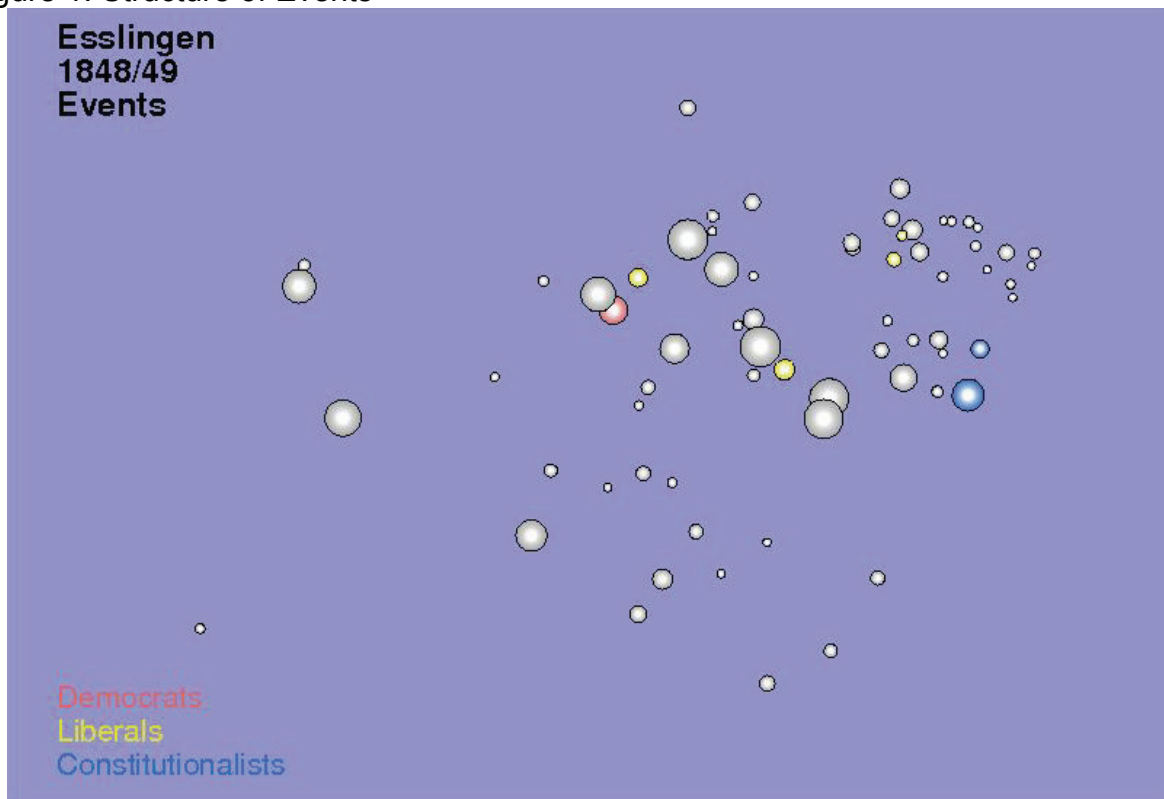
In figure 1 institutions and events that lay very close to one another in the image share many common participants and those that are far apart share only a few or none. The layout developed by Lothar Krempel involves a special spring embedder for two mode graphs which also performs a double normalization on the data (Krempel 1999). The result arranges the people and the events simultaneously.

Figure 2 shows the 2-mode network of same data, this time with the institutions and events flattened, and the added nodes for individuals visually differentiated as spheres of all the same small size. The placement algorithm moves people linked to several events to their barycenter. Hence people attached to many events are typically placed closer to the centre of the total system (in the upper right). Actors involved in single events only are shown in the direct neighborhood of this event. A more systematic outline of the graphical methodology, which uses placements, the size of symbols, and color schemes to translate multivariate information can be found in Krempel (2005).

Figure 2: People and Events or Institutions
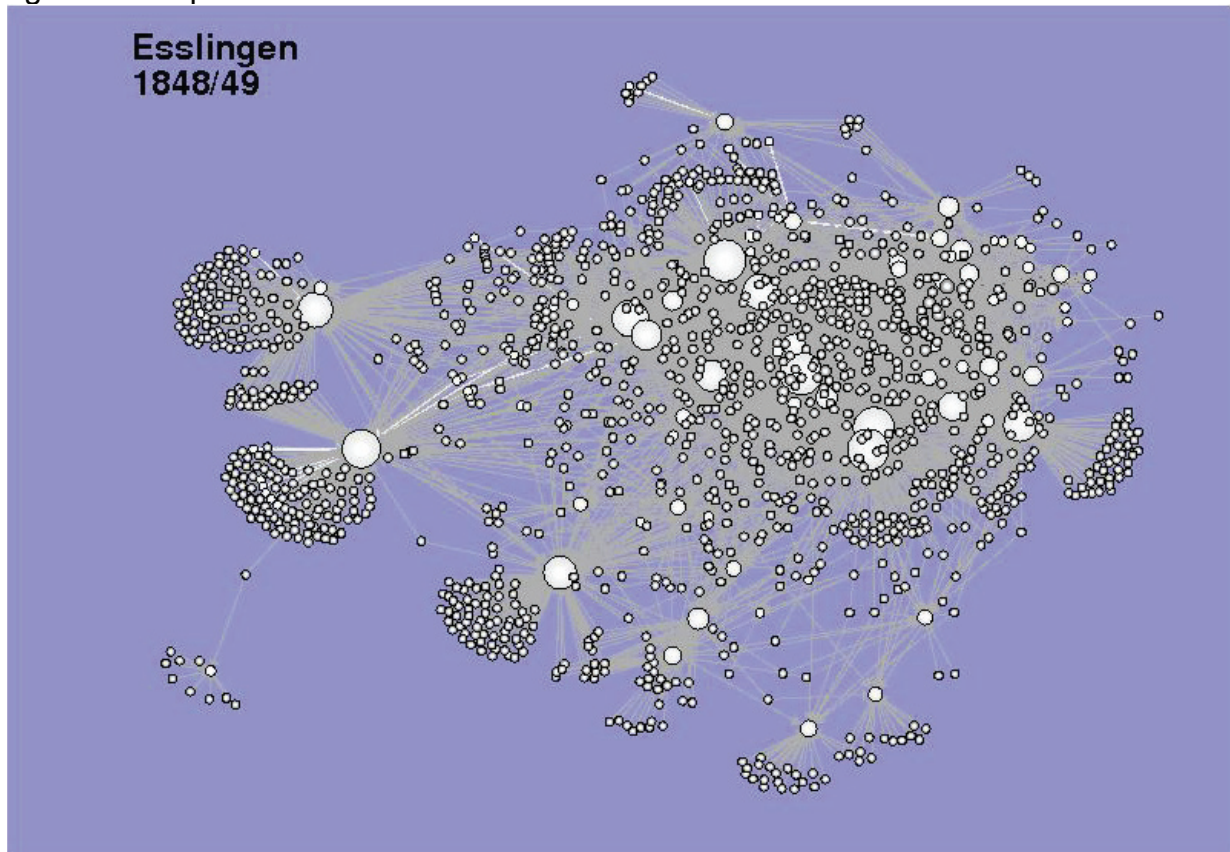
Identification of the explicitly political events allows a first orientation in the social landscape. To facilitate the orientation we use different colors to illumine the position and influence sphere of opposing political agents, as in Figure 1. The democrats, marked in red, are at the left end of the political spectrum. They were most radical in their call for changes and demanded not only the abolishment of the monarchy and the demotion of the King of Prussia but the establishment of a democratic regime under a new constitution. Almost on the opposite side of the social space we find the group representing the opposing political ideology: conservatives and constitutionalists, marked in blue. They did neither question the traditional rights of the privileged classes nor did they want change in the overall political and social organization and in the distribution of power and privileges. Finally, the liberal groups, who were the earliest but not the most radical voice against the monarchic regime, are marked in yellow. During the revolution their claim for a compromise between the democratic rule and the monarchic regime put them in a mediating position. The liberals pictured a constitutional democracy as the golden bridge between old and new political ideas, ideologies, and realities. This ideological position is also reflected by their position within the social landscape: They are in the middle of the two extremes and share members with both of them.

Figure 3 removes the colors of political events but adds colors for individuals and for lines that connect them to events and institutions. The occupational colorings convey an additional correspondence between the six major occupational groupings and the social, institutional and political event space that has been independently configured by the spring embedder for the two mode graph as seen in Figure 2. We now see higher densities of workers (red), craftsmen (yellow), peasants (green), employees (cyan), entrepreneurs (pink), and academics (blue) as we move counterclockwise from the left to upper right in Figure 3. Recall that each node has one or more lines of the same occupational color for each connection to an event or institution. The weak alignment of the political colors of events and institutions in Figure 1 and the colors of lines connecting to people classified by occupational groups is neither accidental nor an artifact of the spring embedding. It contributes to a visual understanding of complex social structural and social movement alignments, namely, that the political events differ in their occupational members.

Figure 3: Persons colored by Occupations
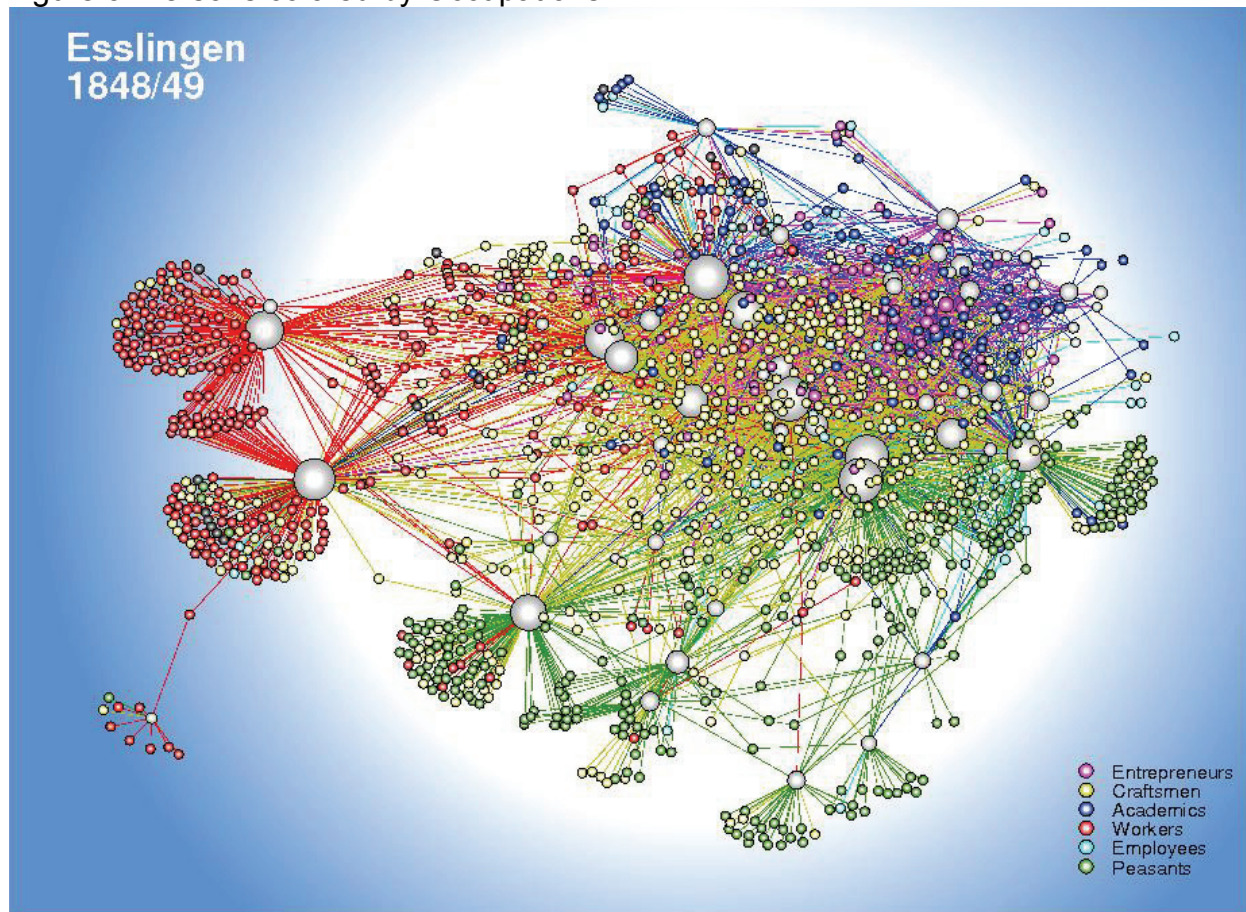
In addition to the social network of people and events in the dynamic image of the logo, which now will be shown in detail, the three temporal images help to visualize how revolutionary activities were spread in Esslingen. Thus the dynamic image visually explores where the Revolution started and how it diffused. During the German Revolution of 1848/49 a common way to express protest against the existing political system was the petition movement. These petitions expressed specific claims and were individually signed and addressed to different governmental institutions. Because we know who of the 1200 individuals signed which petition we can map this information onto the social landscape. This allows us to study the interplay of petitioning and social structure dynamically.

We have divided the Revolution into three phases to facilitate the analysis. The first phase starts before the German Parliament in Frankfurt was established, the second during the existence of the Parliament in Frankfurt, and the third phase after the abolition of the parliament and the defeat of the revolutionaries by the Prussian troops.

To explain the spread of the Revolution we assume that individuals are affected by the political activism in their social surrounding. We expect that the chance to become active (and to sign a petition) is directly related to the amount of activism to which an actor is exposed. This is called the individual level of exposure. To compute the individual level of exposure we count for each event how many petitioners it had at different points in time. The exposure of an individual is then defined as the total number of active people an individual is connected to through events. An exposure meter is shown as a histogram at the bottom of Figures 4-6, red being the most intense (and less frequent) radicalism, and blue the least intense (and more frequent) conservatism.

## Figures 4-6: Levels of Exposure at different times
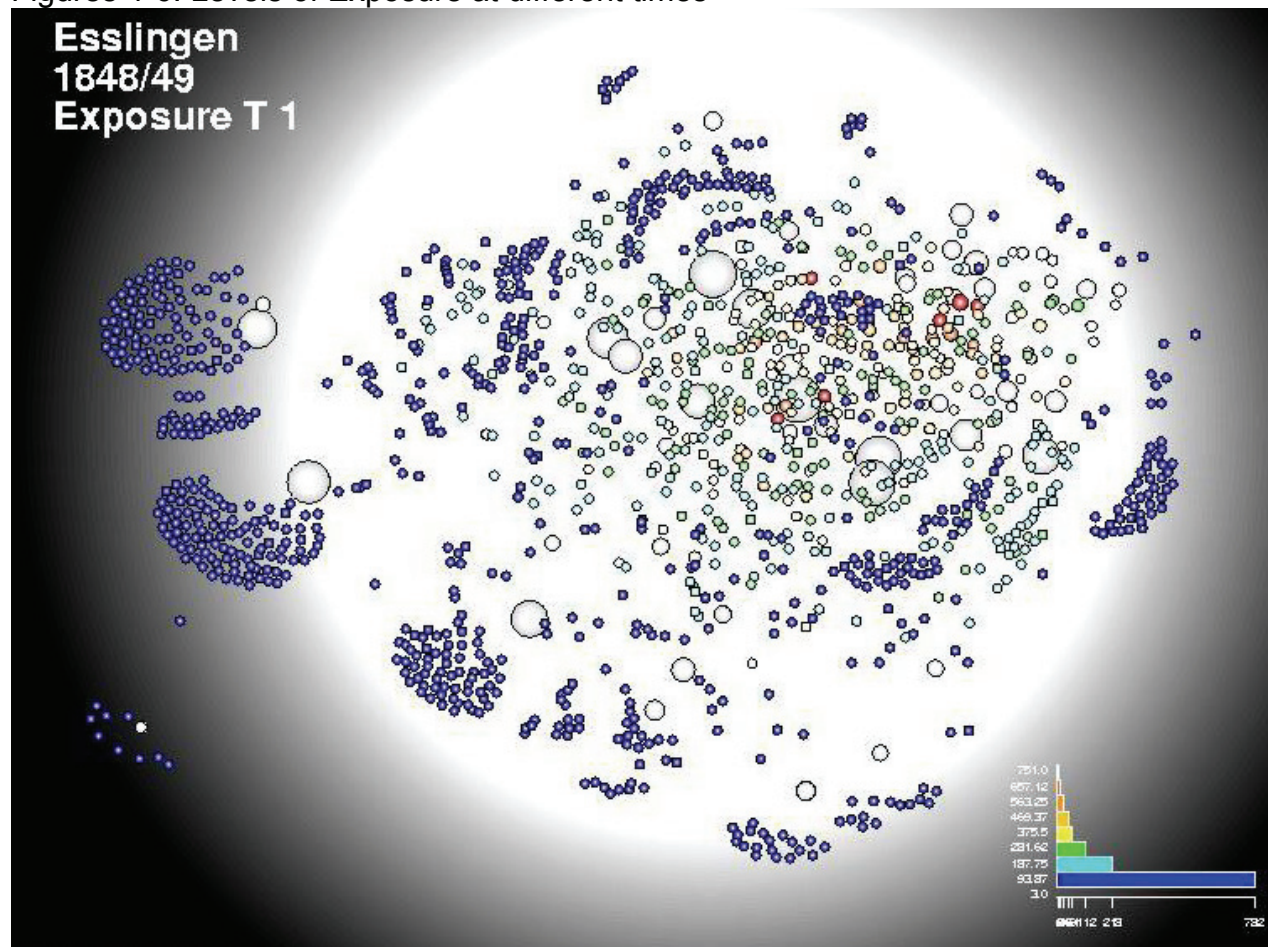
The color scheme in figures 4-6 thus differentiates in time and social landscape the levels of individual exposure. The three images viewed as successive time phases show the dynamics of the system. It reveals to some extent how the existing structure contributes to the diffusion of political activism through time (red indicates high levels of exposure and activity whereas people marked in blue were relatively unaffected). The spread of exposure starts in the center and accelerates over all three time points. Already at the second phase the exposure reaches many people in the periphery, whereas at phase three the level of exposure increases further in the center and in the middle periphery.
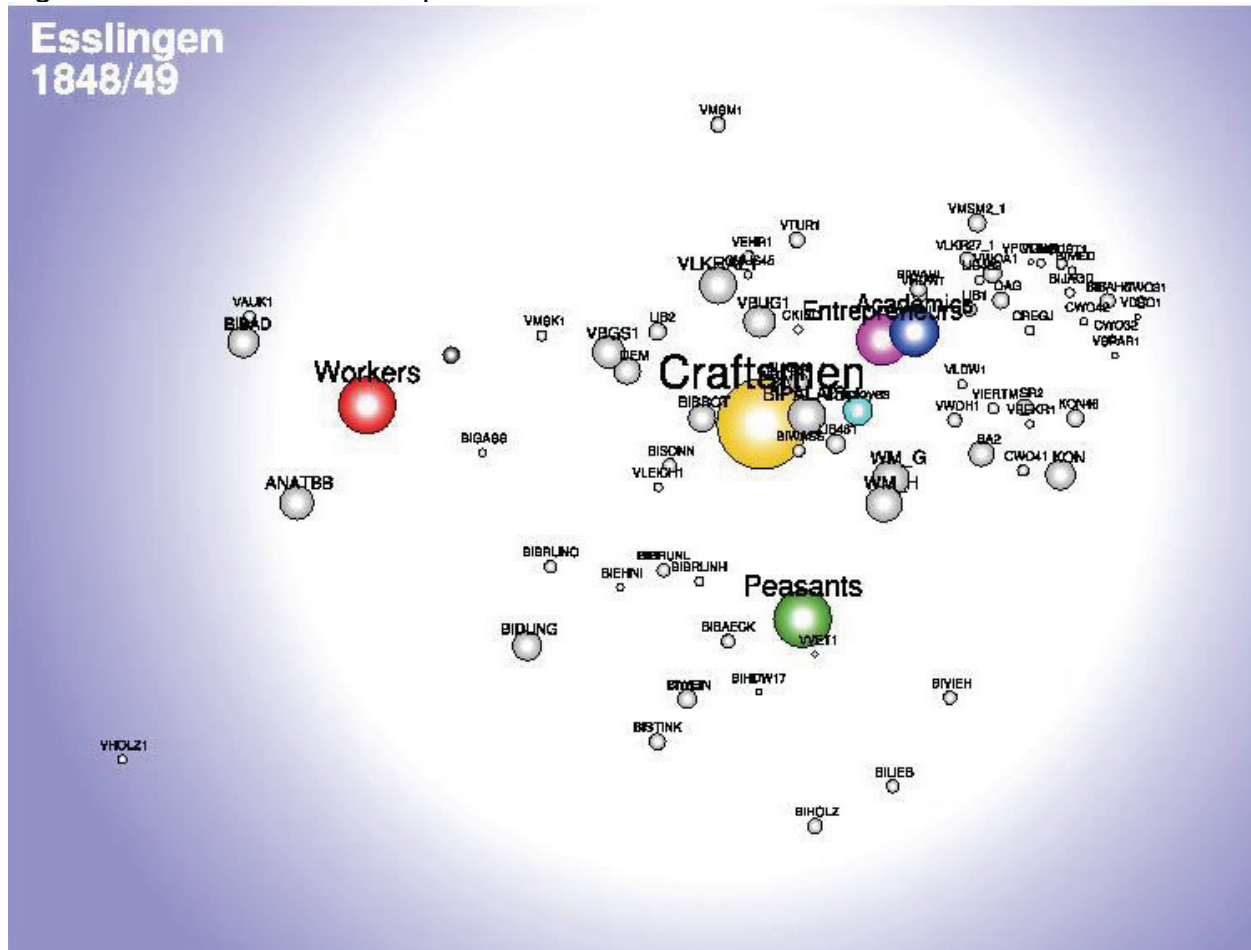
Esslingen
1848/49
Exposure T 2
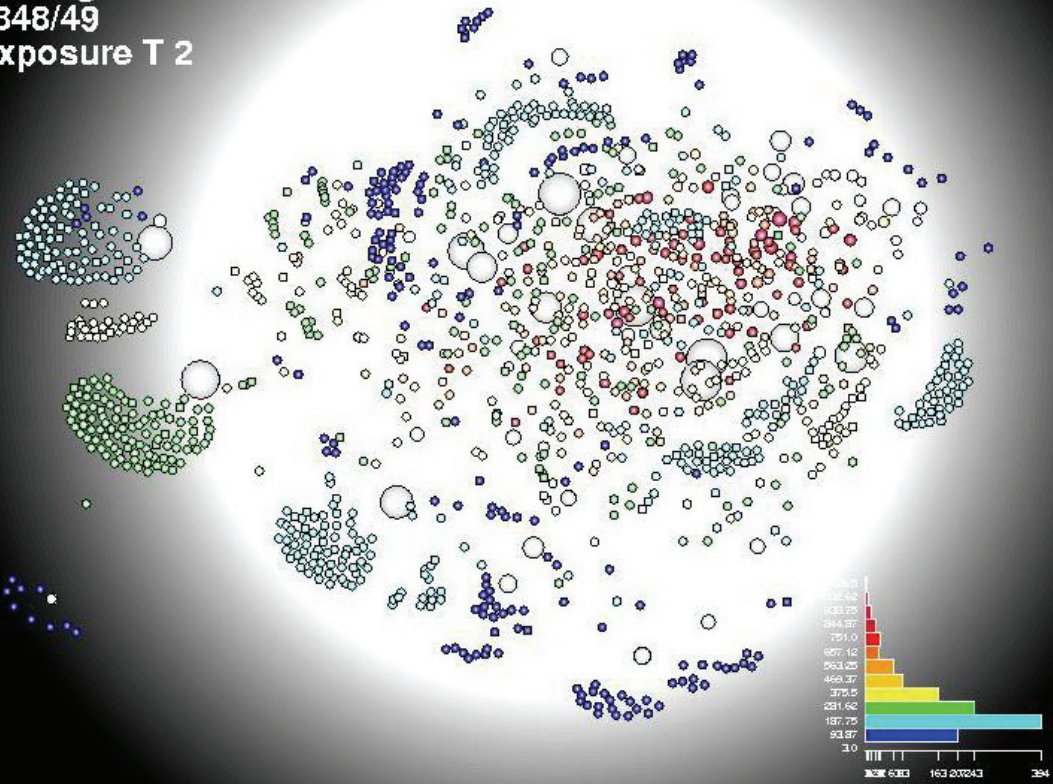
Esslingen
1848/49
Exposure T 3
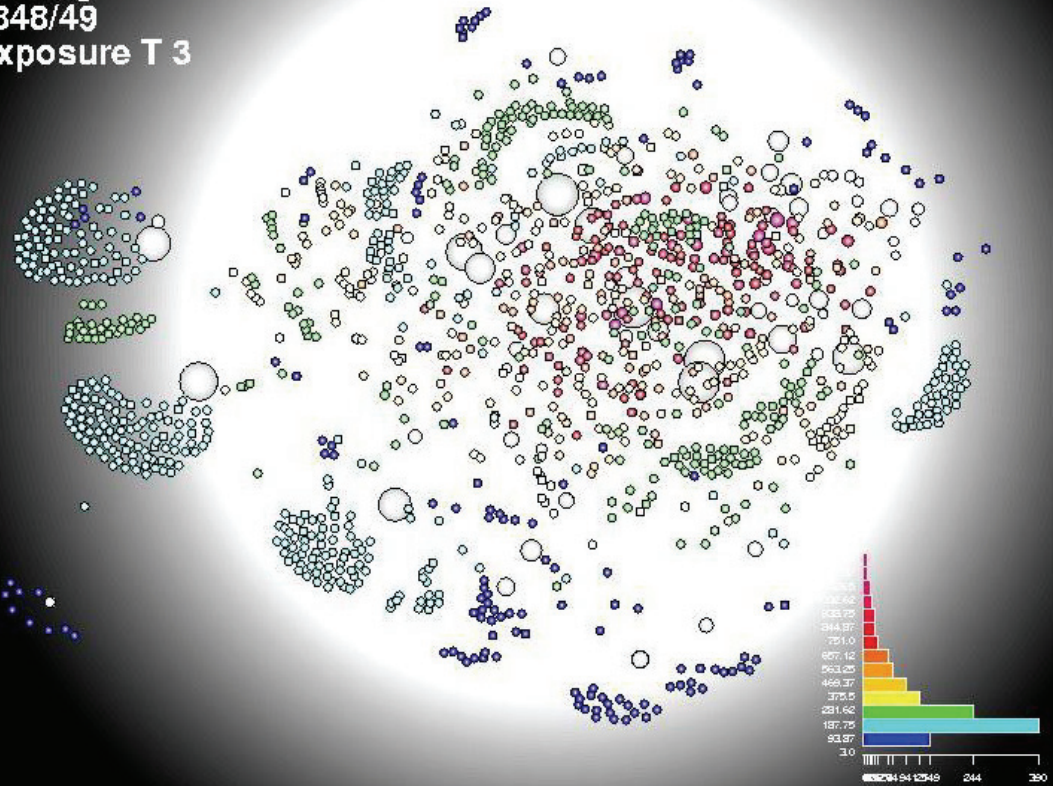
In figure 7 the colors indicate the barycenters of the different occupations: Entrepreneurs (pink), craftsmen (yellow), academics (blue), workers (red), employees (cyan), and peasants (green).

Figure 7: Distribution of Occupations

A closer view on the separate stages of the process and the behavior of different social groups yields a differentiated picture. Within the whole process of mobilization the merchants (entrepreneurs) hold a central position. They not only initiate the protest, but they stay highly active throughout the whole revolution. The group that fits best with our model of diffusion is the craftsmen. Their degree of participation rose drastically. This growth is of fundamental importance to the whole process since they are the numerically biggest group. Their mobilization was a process that took place by and large within the structure. In contrast, workers and vintners are the two groups that entered the revolution in the second phase for reasons only partly understood from structural considerations. In sum, the images show how a combination of different information can explain the dynamics behind social processes.

In connected papers, Krempel & Schnegg (1998) and Lipp & Krempel (2001) interpret the error terms of a logistic regression analysis between the level of exposure and activism. The overall model to explain mobilization as the result of contacts to activists accounts for a large amount of the observed variations. The statistical analysis and methods for constructing the visualizations are internally consistent, and hence mutually reinforcing while adding complementary understandings of historical processes.

References

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