Chapter 16
Visualization and Analysis of Frames in Collections of Messages:
Content Analysis and the Measurement of Meaning

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ABSTRACT

A step-by-step introduction is provided on how to generate a semantic map from a collection of messages (full texts, paragraphs, or statements) using freely available software and/or SPSS for the relevant statistics and the visualization. The techniques are discussed in the various theoretical contexts of (i) linguistics (e.g., Latent Semantic Analysis), (ii) sociocybernetics and social systems theory (e.g., the communication of meaning), and (iii) communication studies (e.g., framing and agenda-setting). The authors distinguish between the communication of information in the network space (social network analysis) and the communication of meaning in the vector space. The vector space can be considered a generated as an architecture by the network of relations in the network space; words are then not only related, but also positioned. These positions are expected rather than observed, and therefore one can communicate meaning. Knowledge can be generated when these meanings can recursively be communicated and therefore also further codified.

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1. INTRODUCTION

The study of latent dimensions in a corpus of electronic messages has been part of the research agenda from different disciplinary perspectives. In linguistics, for example, these efforts have been focused under the label of "latent semantic analysis" (LSA; Landauer *et al*., 1998); in communication studies, "framing" is a leading theoretical concept for studying the latent meanings of observable messages in their contexts (e.g., Scheuffele, 1999); and in social-systems theory and socio-cybernetics, codes of communication which can be symbolically generalized (Parsons, 1963a and b; 1968; Luhmann, 1995 and 2002; Leydesdorff, 2007) are expected to operate latently or virtually as "a duality of structure" (Giddens, 1984; Leydesdorff, 2010). These efforts have in common that the analyst shifts his/her attention from the communication of information in observable networks to the communication of meaning in latent dimensions.

Latent dimensions can be operationalized as the "eigenvectors" of a matrix representing the network under study. Eigenvectors, however, operate in a vector space that can be considered as the architecture spanned by the variables (vectors) in observable networks. Statistical techniques for analyzing latent dimensions such as factor analysis and multi-dimensional scaling (MDS) are well-known to the social scientist—and where further developed for the purpose of analyzing communication (Lazarsfeld & Henry, 1968)—but the current enthusiasm for network analysis and graph theory has tended to push aside these older techniques in favour of a focus on observable networks and their structures. Spring-embedded algorithms that operate on networks such as Kamada & Kawai (1989) or Fruchterman & Reingold (1991) are integrated in software packages freely available at the internet such as Pajek and Gephi. These newer visualization capacities far outreach the traditional ones such as MDS.[2]

In this introduction, we show how one can use these newer visualization techniques with the older factor-analytic approach for distinguishing main dimensions in order to visualize the communication of meaning as different from the communication of information. The communication of information can be considered as the domain of social network analysis and its semantic pendant in traditional co-word analysis (Callon *et al*., 1983; 1986). Words and co-words, however, cannot map the development of the sciences (Leydesdorff, 1997). The architectures of the discourse have first to be analyzed and can then also be visualized. Using an example, we walk the user through the different steps which lead to a so-called Pajek-file which can be made input to a variety of visualization programs.

In other words, we provide a step-by-step introduction that enables the user to generate and optimize network visualizations in the vector space, that is, the space in which meaning is communicated as different from the communication of information in the network. Meaning can be generated when informations are related at a systems level. In cybernetics, one often invokes an "observer" to this end (Edelman, 1989; Von Foerster, 1982), but a discourse can also be considered as a relevant system of reference. Note that meaning is provided in terms of expectations and can be informed and updated by observations. The various bits of informations can be positioned in a vector space in addition to being related or not in terms of network relations (Burt, 1982). The absence of relations can then be as informative as their presence (Burt, 1995; Granovetter, 1973).

The software for the visualization and animation of the vector space uses the cosine values of the angles between the vectors (variables) of word occurrences in distributions. We explain below how the word-document matrix can additionally be used as input to the factor analysis; for example, in SPSS. Unlike "single value decomposition" (SVD) which has been the preferred method in latent semantic analysis, factor analysis is avail-