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# A Database Interface for Link Analysis

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## ABSTRACT

*Understanding data gathered so far in a criminal or terrorist threat investigation is of great importance, particularly in guiding the future course of the investigation. One established method of better understanding the data is to visualize it as a network, showing how objects of interest are connected. In this article, we briefly describe this form of visual data analysis, the products available to support it and why current database support is lacking; plus, we present an experimental database interface for exploring data in this manner.*

**Keywords:** *crime; database interfaces; intelligence analysis; investigative systems; link analysis; networks; terrorism*

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## INTRODUCTION

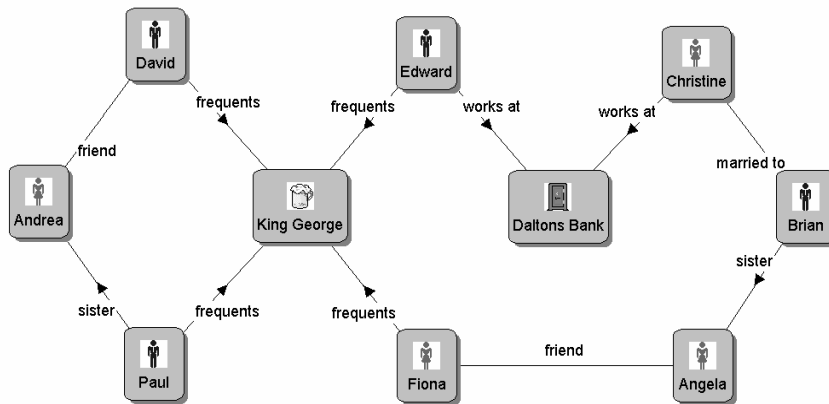
Data is best comprehended when presented as a network if connections between the objects of interest in the problem domain, such as people or locations, are of as great an importance, if not more so, than the information known about objects, such as the age or occupation of a person. For example, if we have the information that David is a friend of Andrea, who is the sister of Paul, who frequents the King George public house, as does David, Fiona and Edward, who works at Daltons bank where he has a colleague called Christine, who is married to Brian,

who is the brother of Angela, who is Fiona's friend, then this information may be presented as in Figure 1.

Presenting such data in this manner increases its comprehensibility and enables the user to establish visually if objects are connected. Thus, if we ask if there is a connection between Christine and Paul, who we believe are not known to each other, the possible connections are easily seen.

Visualizing the information we have as a network of connections in this way is of importance in investigative work, whether of particular serious crimes or atrocities or of terrorist or criminal net-

Figure 1. The connections between a set of people displayed as a network



works. It has been found to aid considerably a good understanding of what is known so far, which is necessary to guide and direct further lines of enquiry in the most timely and productive way.

In an investigation of a murder with an unknown perpetrator, say, we may well begin by investigating the social network of the victim(s), their friends, the places they visit, their work colleagues and so on in looking for possible motives and suspects; and then build a link chart to clearly understand what we know so far as we proceed. If investigating a suicide terrorist attack, the approach is necessarily similar. Identify the immediate perpetrator(s) and then investigate where they are from, what is their social network, from where did they obtain the explosives, what was their personal motive, the organization behind them and so on; again, building one or more link charts to record and understand what we know as we proceed. In this chapter, we discuss and argue for the development of database interface systems based on this link-charting paradigm for use as a tool during the course of such investigations.

The visualization of information as shown in Figure 1, generally termed *Link*

*Analysis (LA)*, is now a tool of wide applicability and also used in the study of Social Networks (Freeman, 2000). In relation to terrorism it can also be used for after-the-event studies of the social networks of those involved using the techniques of Social Network Analysis. A good example of this use can be found in the paper by Krebs (2002), which studies the network of relationships among those reported in the press as having been involved or connected with the immediate perpetrators of the Al Qaeda air terrorist attacks of September 11, 2001. Krebs' information comes from the press, but nonetheless, the link charts he gives in his paper, although restricted only to nodes of type person and links indicating the strengths of their connectedness, are interesting examples to which the reader is referred of the general link analysis approach. Doubtless more sophisticated charts involving these persons were built up by the investigators of September 11 during the course of their work and containing information well beyond that which appeared in the press. Krebs then goes on to study the nature of the networks he has constructed from a sociological perspective using the metrics of social network

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