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Utilizing Social Network Analysis to Study Communities of Women in Conflict Zones

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Abstract

This article proposes to study the plight of women in conflict zones through the lens of social network analysis. We endorse the novel idea of building a social network within troubled regions to assist in understanding the structure of women's communities and identifying key individuals and groups that will help rebuild and empower the lives of women. Our main argument is that we can better understand the complexity of a society with quantitative measures using a network analysis approach. Given the foundation of this paper, one can develop a model that will represent the connections between women in these communities. This model can then support work aiming to help women in zones of conflict.

1. Introduction

To understand the plight of women in troubled regions it is important to take into account their cultural, religious, economic and political experiences. One has to learn the roles of women in times of peace to understand their circumstances during times of war. A question that may arise is: Are the women in the region seen as equal members of society or are/were they subordinate to men [9]? Although women and men both struggle in zones of conflict for rights and representation, "women often encounter structures

of patriarchal authority in the national movement, the military, the private sphere and through the discourses and practices of dominant belief systems" [9]. In order to help empower these women, one has to take into account their whole experience.

This paper puts forth a discussion of women in conflict zones and presents a possible framework, a social network model analysis, to assist in rebuilding troubled regions by understanding the connections that lie within these communities. First, in Section 2, we provide a definition for *conflict* and *conflict zones*, and discuss some causes of conflict. In Section 3, we explore what women and their communities endure in conflict zones. In Section 4, we discuss how a social network model can assist in addressing the needs of women in these regions by providing the mathematical methods needed to analyze collected data. With a network model in place, some policies can be constructed to further benefit the lives of women in these zones. We conclude this paper with a section (Section 5) on how to collect the necessary data to implement a social model, including a sample survey.

2. Conflict Zones

We define *conflict* as "competitive or opposing action of incompatibles: antagonistic state or action (as of divergent ideas, interests, or persons)" [16]. The term *conflict zone* is more difficult to pin down as it can be viewed differently by different factions. We will define a conflict zone as a "land area that encloses flash points and critical areas of conflict" [14]. We distinguish between three main types of conflict zones: terroristic, incursion and territorial conflicts [4]. In the case of *terroristic conflicts*, the government control is firm but there may be cases of isolated incidents of violence. The *incursion* type of conflict is characterized by the situation in which government holds control but there are still frequent armed incursions and withdrawals organized by the opposing groups. *Territorial conflict* relates to the case where government loses control over the region and is usually engaged in direct fighting with the opposition [4].

Though a developmental stage perspective may be desirable, it is often difficult to distinguish between pre-conflict, conflict, and post conflict areas, because conflict zones are sites of both change and continuity [10]. To facilitate a more coherent view of conflict zones it is useful to identify where people, interest and events reinforce each other, where they are contested,

and even where they diverge [10]. There are various interests in conflict zones, including simple survival; furthering of political and social agendas; status and profit. The fact that these are not mutually exclusive shows the importance of research and policy that examine the interests, motives, and strategies of those within conflict zones.

2.1. Causes of Conflict

There is no single cause of conflict. Conflicts can be caused by a combination of the following factors as described in [3]:

- Political and institutional factors: weak state institutions, elite power struggles and political exclusion, breakdown in social contract and corruption, identity politics;
- Socioeconomic factors: inequality, exclusion and marginalization, absence or weakening of social cohesion, poverty;
- Resource and environmental factors: greed, scarcity of national resources often due to population growth leading to environmental insecurity, unjust resource exploitation.

The triggers for these factors include: single acts, events or the anticipation thereof that set off violent conflict or its escalation (e.g. elections, behavior of political actors, sudden collapse of currency, increased food scarcity) [3]. While a history of conflict does not necessarily guarantee the further reignition of tensions in an area, it does indicate the presence of socioeconomic and political conditions that predispose a community to conflict [3].

Conflict is governed by a system of rules and norms. When there is an absence of such systems to manage conflict and channel it into constructive areas, it can become negative and destructive. Unfortunately, conflict in such cases often creates temperamental and dangerous situations for vulnerable populations, specifically women. Women and children are substantially more affected by these kinds of circumstances and thus have a larger stake in conflict resolution. And while women continue to be poorly represented in formal peace processes, they contribute in many informal ways to conflict resolution.

3. Plight of Women in Conflict Zones

It is difficult to make universal statements about the impact of conflict on the lives of women because the extent to which conflict restricts women's freedom of movement depends on a number of factors. Differences in culture, geography, and context play a role in the impact of conflict on women. In the agricultural sector, women may take over responsibility for working the land, caring for livestock, trading, or carrying out wage labour outside the home. One key issue, though, is that women are often denied access to, owning, and inheriting productive resources in their own names. In urban areas, a kind of "feminization" of the informal sector takes place during conflict. Women may regard work in the informal sector as a way of liberation and empowerment or as a means of exploitation and survival.

For example, if we focus on forced displacement, in some cases displacement can lead to greater mobility for women. In other contexts, women may be perceived as less threatening and thus may have more mobility to carry out economic activities which men are no longer able to do. Women may also assume additional responsibilities such as taking on the role of primary breadwinner. In some cases, women may be given priority for training and development programs in health and education, as well as in income-generating activities. The skills women gain enable them to assume new roles within their households, becoming the main breadwinners. Men however may react to these changes with depression, alcoholism, and an escalation of violence against women in public and private [21]. The relatively small gains women obtain during displacement do not necessarily translate to more equitable gender relationships. These gains are usually not accompanied by any change to the overall paradigms of gender differences, leaving women with new roles to fulfill but no institutional leverage to fulfill them effectively [21].

Conflict is a gendered activity: women and men have different access to resources, power, and decision making before, during and after conflicts [22]. The experience of women and men in situations of tension, war, and post-conflict reconstruction is significantly different. Approximately 80% of today's civilian casualties are women and 80% of all refugees and internally displaced people worldwide are women and children [22]. As emphasized in the Platform for Action of the United Nations Fourth World Conference on Women, "while entire communities suffer the consequences of armed conflict and terrorism, women and girls are particularly affected because of their status in society and their sex" [22].

Women are caught in a paradox: while they are the main civilian victims of conflicts, they are often powerless to prevent conflicts and likely to be excluded from the negotiations when it comes to their resolution. Women are often confined to a marginal role in the post-conflict reconstruction and reconciliation efforts. This exclusion of women from decision-making positions prior to, during, and following violent conflicts, reinforces their victimization [24].

The importance of including women and gender perspectives in the planning and implementation of peace operations is increasingly recognized. This has led to some milestone achievements, such as the deployment of the first all-female peacekeeping unit in Liberia; mediation efforts to end conflicts in Uganda, Sudan, and the Democratic Republic of Congo; supporting initiatives aimed at strengthening the presence and capacity of female officers in peace operations, in places such as Afghanistan; strengthening the development of gender-sensitive early warning strategies to prevent the outbreak of conflict in Colombia and the Solomon Islands; advocating for women's inclusion in the design, implementation and conduct of post-conflict elections in Burundi; providing gender expertise in a variety of peace operations. In order to rebuild these conflict areas women have to be directly involved in the process [24]. However, women are still significantly underrepresented in most areas of UN peace operations, in peace negotiations, and in national governance, particularly at senior levels. And while many policies have surfaced to protect women in times of conflict, women's issues are still often given low priority and inadequate support. We propose that the mathematics of social networks can and should be utilized in order to address the roles of women in these processes. Once the connections and roles of individual women are better understood, information can be better collected from or disseminated within the community.

4. Model: Social Network Model

A social network approach to understanding the relationships between women and their communities can assist in understanding how relationships are formed and organized. When conflicts arise, instability within a region causes social structures to break down. Often, women in these regions come from communities where there is a strong emphasis on the relationships and bonds between people [20]. In these communities, women depend much more

on each other than women do in western societies [20]. In order to begin to rebuild communities in conflict zones, we must first understand relationship dynamics. Since women play a central role in economic, social, and family life, understanding how they organize the community might be a first step; and, a social network model will assist in understanding the structures of these groups.

A few questions that a social network model/approach might be able to address include:

- How do relationships between women form, organize into groups, and exert influence under challenging conditions?
- Which actors have the most influence in a group?
- How do groups relate to one another?
- Who are the most connected individuals?

The social network model can also assist in zones of conflict where outside forces might become involved. In the example of Western World involvement in African affairs, there can be communication challenges and cultural differences; however, an understanding of the local social networks might help alleviate some of the tension and stress by acknowledging how a particular society organizes especially under taxing conditions. Thus utilizing a network, task forces can be of greater assistance in conflict zones where they are not a part of the community.

To reconstruct a community in devastated parts of the world, we propose to start by rebuilding the lives of women within these conflict zones. This approach differs from other attempts in trying to rebuild nations after conflict in that it is concentrated on first rebuilding the lives of individuals and communities and not the entire country all at once. Rebuilding communities comes from understanding the diversity and cultural needs of women. This approach allows one to view how human relationships interact and form and requires more investment in detailed resources. This approach is sustainable as it allows the rebuilding of communities to happen organically. A social network model can support an understanding of how to optimize the use of resources.

The modelers must make sure to incorporate women's groups and their activities. Furthermore they must be mindful of the cultural sensitivities of the region and the historical role of women within the particular society. Once the network is created, the next step is to examine the model to find patterns and use the mathematical techniques discussed in the next subsection to seek out which communities have connections to understand the links for cooperation and rehabilitation.

4.1. Mathematical Methods

A *social network* is a graph comprised of nodes and links. The nodes are called *agents*. They are connected by *links* which describe the relationship between agents. The analysis of social networks can explain how strong the connections are and which agents are the most influential. The analysis can also spot patterns and subgroups which may not have been noticeable before. A network analysis approach is an innovative method in that every observable entity is a part of the network as opposed to just a sample of the population. We are also able to utilize the idea that networks can be embedded in other networks. The complexity of a society can then be understood with quantitative measures using a network analysis approach.

Social networks have already been used from mapping terrorist networks to mapping the HIV positive field [12]. A social network model will strive to identify central people in a network. In conflict regions it is rare that only one individual can influence everyone; however, individuals must form connections with others to get things accomplished [19]. We propose to use social network analysis to exploit these bonds and links in order to further understand the roles of women in conflict zones.

Due to the difficulty of gathering data in conflict zones, there is a dearth of readily available network data to completely address the concerns in this paper. Thus we will use a jazz musician social network [6] to demonstrate what can be done to work on issues in conflict regions when the data from these zones becomes available; see Figure 1. When we construct a social network model addressing women in conflict zones, women will be the agents and their relationships will be represented by the links. Our example will nonetheless allow us to show how one can calculate centrality measures that help determine the most influential members in the network. We utilize the definitions given in [15] for these centrality measures.

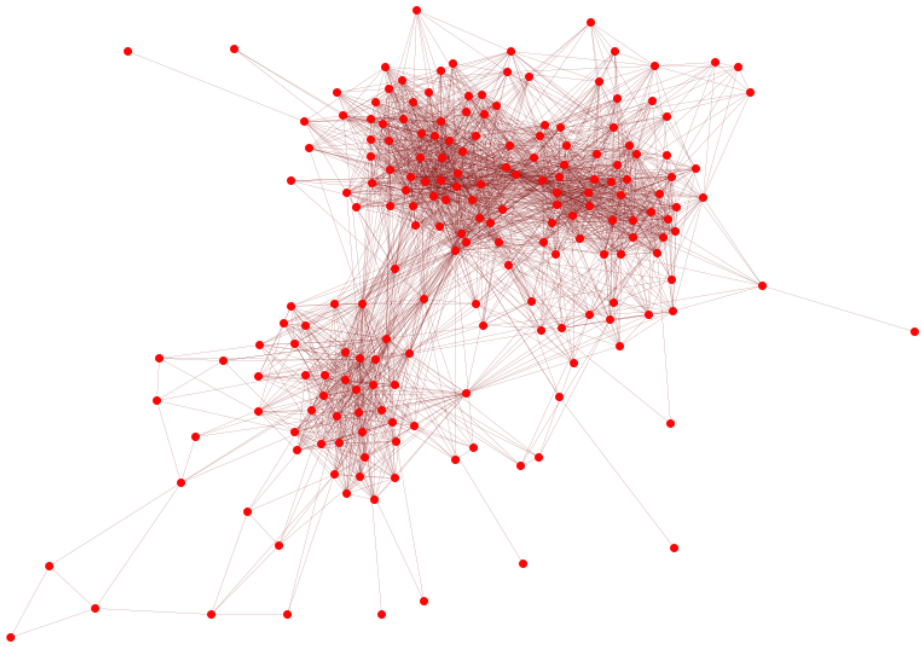


Figure 1: Jazz Musicians Network. The graph representation was created by the authors using data from [6].

4.1.1. Degree Centrality

Degree centrality was historically the first centrality measure introduced, and it is conceptually the simplest. The *degree* of an agent is defined by Equation (4.1):

$$D_i = \sum_{j=1}^{n} a_{ij} \tag{4.1}$$

where

$$a_{ij} = \begin{cases} 1 & \text{if agent } n_i \text{ is connected to agent } n_j \\ 0 & \text{if agent } n_i \text{ is not connected to agent } n_j. \end{cases}$$

Note that the degree can be interpreted as the number of direct connections an agent has. In this setting, therefore, we measure the centrality of an agent to its network by the size of its degree.

An agent with high degree centrality is directly connected to many other agents in the network; see Figure 2 for an example. Given that this person is highly connected to other people, there is a high probability that they have readily available all the information flowing through the network. In a region of conflict, such agents can be used to assess how and what information is flowing through the network.

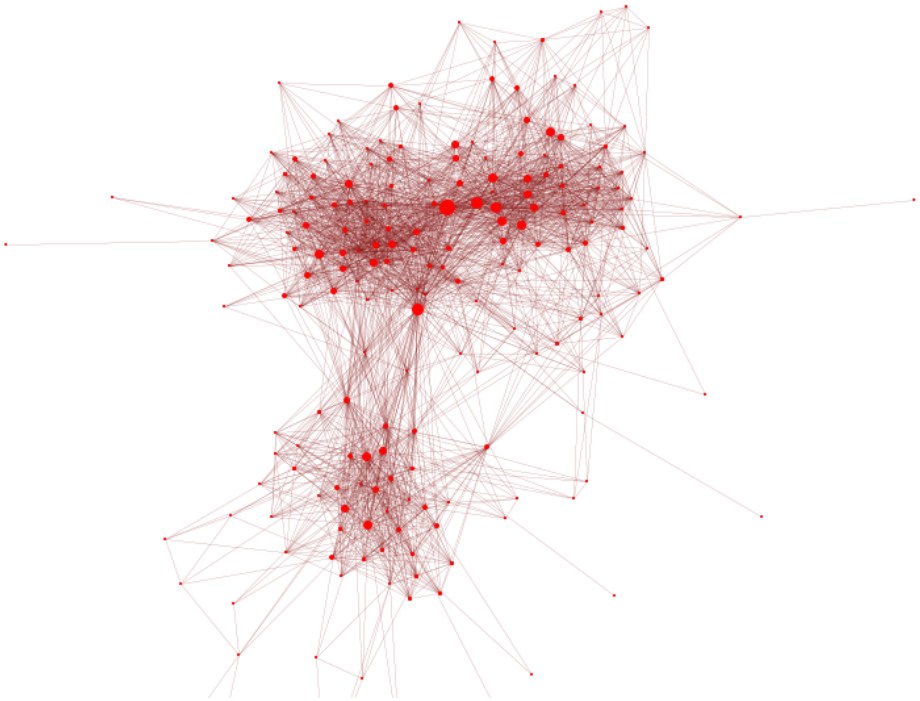


Figure 2: Jazz Musicians Network with degree centrality illustrated. The larger the node, the higher the degree centrality measure. The graph representation was created by the authors using data from [6].

4.1.2. Closeness Centrality

This measure expresses the average social distance from each individual to every other individual in the network. The concept of social distance is easily understood by considering the example of the "Erdős number" of a mathematician, calculated by finding the shortest path of connections from any one mathematician to Paul Erdős based on "collaborative distance" defined via joint authorship of mathematical papers [5]. Someone who has

written a paper with Erdős is considered to be 1 degree away, while anyone who has written a paper with someone who wrote a paper with Erdős is 2 degrees away, and so forth.[1] This same concept can be applied to any social network and is known as *closeness centrality*.

To calculate closeness centrality we use the following definition:

$$C_i = \left[\sum_{j=1}^{n} g_{ij})\right]^{-1}.$$

Here g_{ij} represents the number of links in the shortest path connecting agents n_i and n_j. In this way an individual with a direct tie to everyone else ends up with the largest closeness value. An example demonstrating this notion is provided in Figure 3 below.

One property of closeness centrality is that it tends to give high scores to individuals who are near the center of network communities in an overall larger network. High closeness centrality individuals tend to be important influencers within their local network community. They are often respected locally and they occupy short paths for information spread within their network community. If we can identify the agents with high closeness centrality measure in a conflict zone, important information can be released to these few agents and spread among the population fast.

4.1.3. Betweenness Centrality

Betweenness is another measure that uses the concept of counting the shortest paths between individuals in a network. It has different properties, however, from closeness centrality. To calculate betweenness centrality, we start by finding all the shortest paths between any two agents in the network. Then, we count the number of these shortest paths that go through each agent as in Equation 4.2. This number is *betweenness centrality*.

$$B_i = \frac{\sum_{i<j} g_{jk}(n_i)}{g_{jk}} \tag{4.2}$$

[1] **Editor's note:** A recent paper in *Journal of Humanistic Mathematics* studies the Erdős collaboration graph and its evolution as the Human Genome Project has developed; see "Some Effects of the Human Genome Project on the Erdős Collaboration Graph" by Chris Fields, Volume **4** Issue 2 (July 2014), pages 3–24, available at http://scholarship.claremont.edu/jhm/vol4/iss2/3/, accessed on January 12, 2017.

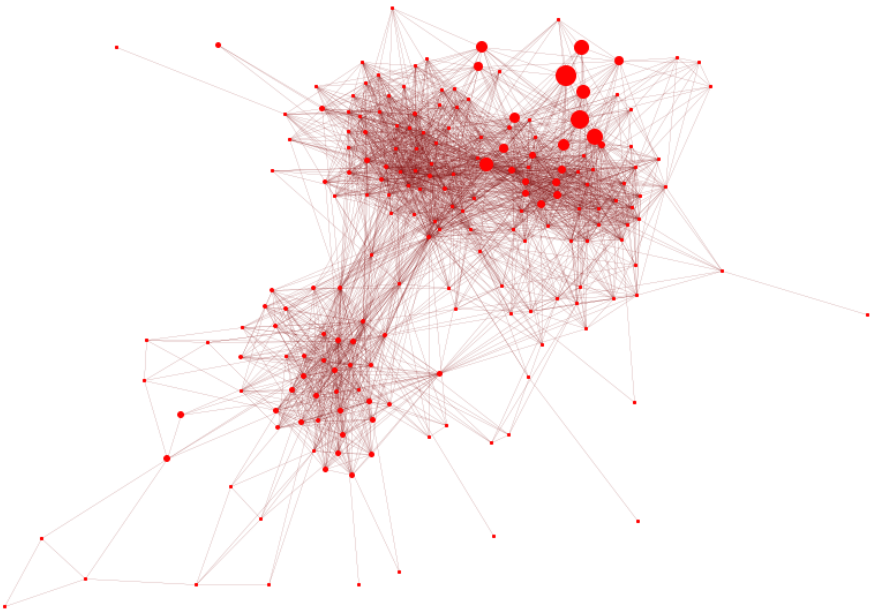


Figure 3: Jazz Musicians Network with closeness centrality illustrated. The larger the node, the higher the closeness centrality measure. The graph representation was created by the authors using data from [6].

Here g_{jk} is the number of links in the shortest path connecting agents n_j and n_k, and $g_{jk}(n_i)$ is the number of these paths that contain agent n_i.

The results of this calculation can help us find the individuals who are necessary conduits for information that must traverse separate parts of the network. These are usually very different individuals from those with high closeness. High betweenness individuals often do not have the shortest average path to everyone else, but they have the greatest number of shortest paths that necessarily have to go through them; see Figure 4 for an illustration in our jazz musicians network example. Another example would be the highway map of the United States. Cities in the Midwest like Chicago and Denver have higher betweenness centrality than New York or Los Angeles because many shortest paths that include cities on the east and west coast have to pass through those cities. In a social network, high betweenness individuals are often found at the intersections of more densely connected

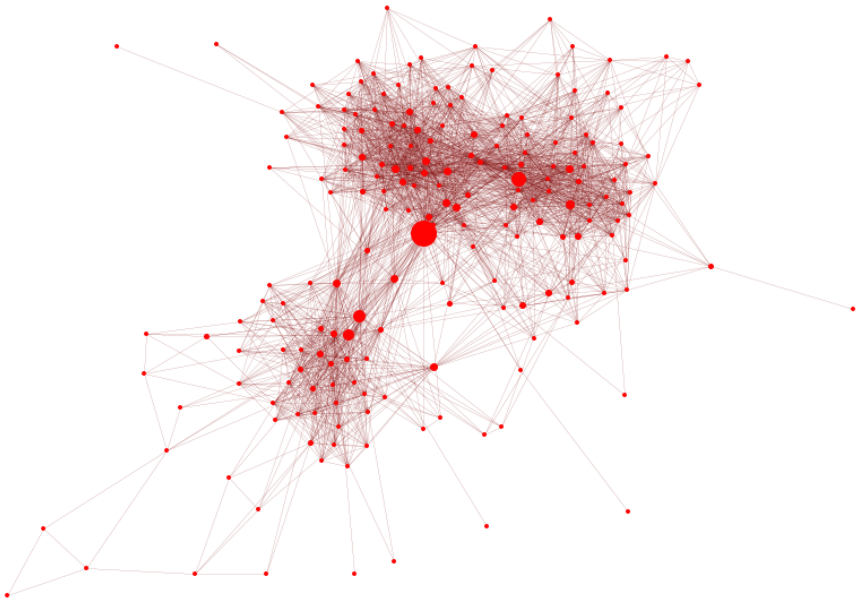


Figure 4: Jazz Musicians Network with betweenness centrality illustrated. The larger the node, the higher the betweenness centrality measure. The graph representation was created by the authors using data from [6].

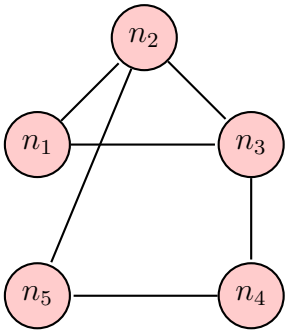
network communities. These agents are known as *brokers*. They are well positioned to perform brokering roles across these clusters in the sense that they connect otherwise disconnected people who yet may benefit from an exchange of information.

Brokers are often critical to social networks in conflict zones as they collaborate across social clusters and can maintain the spread of information through an entire network. Because of their locations between network communities, individuals with high betweenness are often overlooked. This occurs because they are not central to any single social cluster, and instead reside on the periphery of several such clusters. These clusters tend to engender more trust and admiration within rather than outside of the cluster. Women in conflict zones that have a high betweenness measure can assist in sharing information among various clusters of a social network.

4.1.4. Eigenvector Centrality

Probably the most mathematically sophisticated centrality measure, eigenvector centrality measures how well connected an agent is to other well connected agents, reminiscent of the catchphrase: *It is not what you know but who you know.* High eigenvector centrality represents a highly connected agent that is connected to other highly connected agents.

To calculate eigenvector centrality, we first construct an adjacency matrix, A, that describes who is connected to whom in the social network. We use equation a_{ij} for our entries in the matrix; see Figure 5 below. Using the eigenvalue equation, $Av = \lambda v$, we calculate the eigenvalues λ that are the scalar solutions to this equation. There can be many different λ values; we choose the largest eigenvalue. After making this choice, we then find the associated eigenvector. This eigenvector, v, provides us the eigenvector centrality measure for each agent in the network. The largest component in the eigenvector corresponds to the agent with the highest eigenvector centrality.



$$A = \begin{pmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{pmatrix}$$

Figure 5: Sample graph and adjacency matrix. Example graph with 5 vertices and 5 edges and its adjacency matrix A_G.

High eigenvector centrality individuals are usually the leaders of the community. These are the agents in the network that governments, organizations, and those who are catalysts for change would seek out to better understand the needs of the community. They can also be utilized to create global changes to the social network. When studying women in conflict zones, it is important to connect with these leaders to find what information and resources are needed in the community.

An example demonstrating this notion in the context of our jazz musicians network is provided in Figure 6 below.

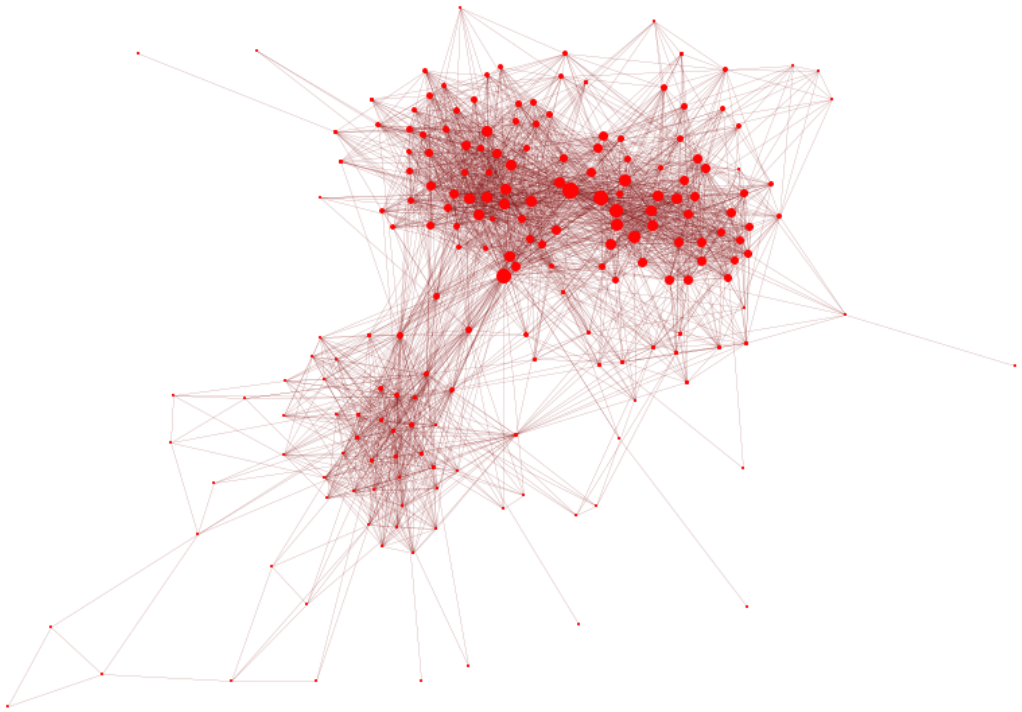


Figure 6: Jazz Musicians Network with eigenvector centrality illustrated. The larger the node, the higher the eigenvector centrality measure. The graph representation was created by the authors using data from [6].

5. Data Collection

One way to determine the well being of women in conflict zones is to conduct surveys. When conducting a survey, one can try to ask questions that will lead to information about an individual's family, community and social structure. In Appendix A we provide an example of a survey with specific questions that could help develop a social network model. Gathering all the data and incorporating the findings into several social network graphs, one can begin to see the social structure among women. One can then analyze the data collected by utilizing the methods discussed in Section 4. Communicating constantly with women involved in these surveys will build trust and can also empower them to take control of their situation or at least utilize the power they have to rebuild their lives.

Although we believe that this is an appropriate tool to approach women in conflict zones, there are limitations to this course of action to gathering data. As with any survey, researchers must ask themselves the following questions before embarking on the study:

- Which communities do we want to study?
- How do we define community?
- What are the cultural biases we as the researchers bring to the study?
- What are the aims of the study?
- Who in the community is included and excluded in the study?

Researchers must be cautious and understand the challenges of collecting data in conflict zones. Because political events associated with conflict can lead to destabilization and chaos, researchers must be aware of issues such as apathy, displacement of families, refugee status, and negative repercussions from opposing forces. Also, researching in such a zone is not a "neutral" activity [1, 2]. Situations in these zones are fluid and results drawn from survey data may or may not be valid conclusions of the true impact. Researchers should also consider that they have some impact during conflict, even if minimal. Furthermore standard survey processes might or might not be applicable when drawing conclusions. A researcher in a conflict zone also has to take into account that there will be numerous unpredictable parameters. With all these caveats, we enthusiastically endorse the idea that building a social network model within troubled regions based on these surveys will help us understand the structure of women's communities and identify key individuals and groups that will in turn help rebuild and empower the lives of women.

A. Sample Survey

1. Id Number_____
2. What is your Age?_____
3. Which gender do you identify with?
   a. Female ☐
   b. Male ☐
   c. Other ☐

4. Where geographically do you reside (your community group)?

5. Who are the members in your community?
   (Family members, friends, associates, etc)

6. With whom do you communicate with on a daily basis?

7. Who do you respect and value to make decisions in your life? Or whose opinion do you consider when making decisions?

8. Which groups do you associate with or are a part of?
   (Church groups, community organizations, places, etc)

9. Do you hold any leadership position in any organization?

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