

## **An Introduction to Concept Mapping as a Participatory Public Health Research Method**

Jessica G. Burke  
Patricia O'Campo  
Geri L. Peak  
Andrea C. Gielen  
Karen A. McDonnell  
William M. K. Trochim

*In this article, the authors introduce concept mapping as a useful participatory research method for public health researchers interested in generating hypotheses and developing theory. The authors first provide an overview of concept mapping, which combines qualitative approaches with quantitative analytical tools to produce visual displays of the relationship between ideas. Then, they present an illustrative research application of the method to the exploration of women's perceptions of the relationship between residential neighborhood factors and intimate partner violence experiences. They give attention to the data collection and analysis procedures and to demonstrating the intricacies of using concept mapping for public health research purposes. Finally, the article concludes with a discussion of the unique contributions and challenges associated with concept mapping.*

**Keywords:** methodology; hypothesis generation; theory development

Over the past two decades, qualitative research methods have gained increased recognition and use within public health research (Power, 1998; Sofaer, 1999). Often used when little is known about a research topic or when additional exploration is necessary, qualitative approaches help to uncover information and to expand our understanding of the context surrounding health-related outcomes (Adler & Clark, 1999; Bernard, 2000; Miles & Huberman, 1994; Sofaer, 1999; Steckler, McLeroy, Goodman, Bird, & McCormick, 1992). Although individual in-depth interviews and focus group discussions are two qualitative approaches that have typically received much attention in public health research, a variety of other, underused, qualitative methods exists. Recently, for example, more participatory approaches to collecting, analyzing, and interpreting qualitative data have been introduced (Chambers, 1992; Scrimshaw, 1992). Concept mapping is one such

approach that has particular relevance for public health researchers interested in generating hypotheses and developing theory.

Concept mapping, developed by Trochim (1985), is a structured conceptualization process. It is a participatory qualitative research method that yields a conceptual framework for how a group views a particular topic or aspect of a topic (Galvin, 1989; Trochim, 1989). It uses inductive and structured group data collection processes, which allow for the collection of a wide range of participant-generated ideas and application of quantitative analytical tools (i.e., multidimensional scaling and hierarchical cluster analysis). Results from the quantitative analysis are used to produce illustrative cluster maps depicting relationships of ideas in the form of clusters. This method provides structure and objectivity to qualitative data. Although this method has been adopted by health promotion professionals interested in program planning and program evaluation (Trochim, 1989), it has been underused by public health researchers interested in capturing the lived experiences of target populations and exploring risk factors and experiences associated with specific health outcomes. To date, few public health researchers have used concept mapping as an explorative method for hypothesis generation and theory development.

Our goals in this article are to provide a brief overview of concept mapping, present an illustrative research application to demonstrate the intricacies of its use for public health research purposes, and discuss the unique contributions and challenges of the method.

## OVERVIEW OF CONCEPT MAPPING

Concept mapping is a process that traditionally involves six steps: (1) preparation, (2) generation, (3) structuring, (4) representation, (5) interpretation, and (6) utilization (Trochim, 1989). During the preparation or planning step, the focal areas are identified and the criteria for study participant selection are determined. Once the focus and participant selection criteria have been identified, the formal concept mapping group process begins. This process is guided by a facilitator trained in concept mapping.

In the second step, generation, recruited participants address the focal question and generate a list of items that will be used in subsequent data collection and analysis. The focal question is designed to elicit information to address the primary research questions. Most often, data are obtained through data collection processes such as "brainstorming" sessions. During Step 3, the structuring step, participants independently organize the list of items generated. Participants sort the items into piles of statements based on their perceived similarity. Then each item is rated in terms of its importance or usefulness to the focal question. During the representation step, the sorting-and-rating data are entered into specialized concept-mapping computer software (Concept Systems), which accomplishes the analysis of participant data. Results include both quantitative summaries of the participant data and a variety of visual representations of the relationship between and importance of items. These visual representations, typically referred to as concept maps, are based on a sequence of analyses that includes most prominently multidimensional scaling and hierarchical cluster analysis. In the fifth step, interpretation, participants collectively process and qualitatively analyze the concept maps. They assess and discuss the cluster domains, evaluate the items that form each cluster, and discuss the

content of the clusters. Finally, during the utilization step, the findings are discussed to determine how they best inform the original focal question.

Steps 2 through 6 can either be conducted during one very long group session or be broken up into multiple sessions. For example, participants can first be brought together during the generation step to list items and then again later to sort, rate, and analyze the items and discuss implications (Steps 3 through 6). In fact, with the development of new Web-based technology, several of the concept-mapping steps can now be conducted over the Internet (see Trochim, Milstein, Wood, Jackson, & Pressler, 2004, for an example).

Concept mapping potentially involves participants at every level of research, so that they become research collaborators, contributing more than responses to questions. Participants typically construct the focus question to be used to collect data organize and prioritize data, label findings, and discuss their relevance. They become involved in the generation of ideas through the identification of conclusions and the application of findings. They can challenge results and plan strategic actions to apply the findings to their own or general situations (Trochim, 1989).

Although concept mapping has been used in a variety of public health contexts, including state-level strategic planning (Trochim, Milstein, et al., 2004), the development of a conceptual framework of tobacco industry attempts to undermine public health (Trochim, Stillman, Clark, & Schmitt, 2003), and as a method for articulating a program theory in community mental health (Yampolskaya, Nesman, Hernandez, & Kock, 2004), little work has been done using the method for the generation of hypotheses and development of theory.

## CONCEPT MAPPING: A RESEARCH APPLICATION

As part of our Centers for Disease Control and Prevention-funded study called Community Pathways to Reducing Interpersonal Violence (Grant R49/CCR318515), we used concept mapping to gain insight into whether and how residential neighborhood-level factors are associated with experiences of intimate partner violence among inner-city women.

The recent resurgence of interest by public health professionals in the ecological perspective has generated increasing interest in how residential neighborhood context is associated with health-related outcomes. Intimate partner violence is one topic that has received increased attention in the field of neighborhood research. Researchers such as O'Campo, Gielen, et al. (1995); Miles-Doan (1998); Cunradi, Caetano, Clark, and Schafer (2000); and Browning (2002) have found significant relationships between neighborhood structural and social characteristics and women's experiences of intimate partner violence. For example, Cunradi et al. (2000) used U.S. Census data to examine the role of neighborhood poverty (percent of census tract population below the poverty line) on intimate partner violence and found that that couples who lived in impoverished neighborhoods were at an increased of intimate partner violence compared to couples who did not reside in impoverished neighborhoods. Although these studies provide evidence of neighborhood-level effects on intimate partner violence and lay the groundwork for more sophisticated analyses, this line of research is plagued by a number of limitations, such as the overuse of neighborhood indicators drawn from readily available

administrative data (e.g., the U.S. Census) and the lack of relevant theory to guide hypothesis generation and subsequent variable selection. In addition, existing studies do little to inform our understanding of the mechanisms and pathways by which neighborhoods affect health outcomes.

In the section below, we describe how we adapted the innovative method of concept mapping to address our research interests. Specific attention is paid to the data collection and analysis process. The goal of this section is to provide an illustrative research application of the method. A more detailed presentation of the results from this application can be found elsewhere (O'Campo, Burke, Peak, McDonnell, & Gielen, 2005).

### **Step 1: Preparation**

During the first step of concept mapping, the research investigators outlined the following research goals: (a) to obtain a participant-generated list of residential neighborhood characteristics thought to be related to intimate partner violence, (b) to develop a better understanding of the relative importance of those characteristics to different intimate partner violence outcomes (prevalence, perpetration, severity, and cessation), and (c) to explore the mechanistic pathways driving the relationship between the neighborhood factors and intimate partner violence experiences. We were particularly interested in moving beyond the existing limited quantitative findings regarding the relationship between neighborhood characteristics and intimate partner violence and toward the generation of new hypotheses specifically addressing the complex relationships.

It was during this preparation step that we also determined the participant recruitment process. The selection of study participants was guided by Trochim's (1989) recommendation that the identification of appropriate participants be based on to our research goals. Given our primary interest in the issues of intimate partner violence, we contacted participants from two prior studies on intimate partner violence to seek their participation in this research endeavor. The majority of participants from the concept-mapping activities were African American (97%), had completed high school or the equivalent (92%), and were over age 30 (89%). All participants were residents of Baltimore City, and a large majority had lived at their current address for 2 years or more (92%).

The primary focus of the concept-mapping activities was on participants' perceptions of how neighborhood context might be associated with intimate partner violence. We did not ask participants to talk about their specific experiences of abuse. To that end, we did not collect data regarding the number of participants experiencing current or past intimate partner violence. However, cognizant that the activities touched on personal and private matters that could be upsetting to participants, we provided a list of social service and community resources, hotlines, and shelters to each participant. In addition, because the activities address sensitive topics such as intimate partner violence, we took appropriate steps to protect the privacy of study participants.

Research protocols, consent forms, and appropriate monetary reimbursement amounts were submitted to and approved by the university's institutional review board prior to the conduct of data collection and analysis activities.

## Step 2: Generation

The goal of this second step was to obtain a list of neighborhood items thought to be related to women's experiences of intimate partner violence. We elected to conduct two separate brainstorming group sessions with a total of 14 women. Informed consent was obtained from the participants prior to the start of the sessions, and each participant received a monetary reimbursement of US\$25 for their time and thoughts.

Participants in each session were asked the following focal question: What are some characteristics of neighborhoods that could relate in any way, good or bad, to a woman's experience of intimate partner violence? Because we were interested in soliciting responses that included the resources and assets of neighborhoods, we specifically included the phrase "good or bad" in our focal question. Participants were reminded that although we were interested in their perceptions of how neighborhood context might be associated with intimate partner violence, we were not asking them to talk about personal abuse experiences.

At the beginning of the brainstorming sessions, we encouraged participants to generate several items and to contribute any item that they believed should be on the list. We also established guidelines early on regarding the importance of respecting each participant's contributions and of not criticizing the legitimacy of items. The group facilitator recorded each participant's response on sheets of newsprint visible to the entire group. During the second half of each brainstorming session, the items were reviewed and a final group list confirmed by eliminating duplicates and those that were deemed irrelevant. The brainstorming sessions were tape-recorded to allow an accurate summary of the discussion of items presented and the verification of the item lists obtained from each group, enabling us to make sure that no items were inadvertently missed on lists prepared during the sessions. Each brainstorming session lasted approximately 1½ hours and resulted in two separate item lists of 37 items in one group and 28 items in the second.

Once both brainstorming groups were conducted, the research investigators, drawing on both their expertise and published literature, worked together to consolidate the items generated in each brainstorming group into a final list of items. During this process, duplicate items were eliminated, and similar items were grouped together under one statement. For example, the item Relationships Within the Neighborhood was grouped with Community Networks into a single item. The final list contained 51 statements: 46 unduplicated items identified in the two brainstorm groups and 5 items not identified by participants but deemed salient based on existing research and the experiences of the investigators (Income/Wealth, People With Professional Jobs, Families With Young Children, Intimate Partner Violence Shelters, and Lots of People Moving In and Out). The final list of 51 items, grouped by cluster is shown in Table 1.

## Step 3: Structuring

Using the consolidated list of 51 items, we next conducted two separate sorting-and-rating sessions to gain a better understanding of how the neighborhood items are related to one another. The sorting and rating of the items provided the data needed to generate clusters and for the comparison of their relative importance to

**TABLE 1: Fifty-One Items Within Their Seven Clusters and the Average Ratings for Each Intimate Partner Violence Outcome**

<i>Cluster and Item Names (Item Number)</i>	<i>Prevalence Rating</i>	<i>Severity Rating</i>	<i>Perpetration Rating</i>	<i>Cessation Rating</i>
Deterioration contributors				
Poverty (40)	3.61	4.05	4.17	1.81
Evictions (38)	3.44	3.32	3.78	1.35
Isolated Location (41)	3.03	3.27	3.08	1.32
Lots of people moving in and out (51) <sup>a</sup>	2.37	2.24	1.97	1.32
Abandoned houses (27)	2.35	2.08	2.00	1.22
Lots of trash (6)	2.22	1.89	1.71	1.30
People who are hanging out (1)	2.54	3.32	3.42	1.47
Negative social attitudes				
Violence (42)	4.47	4.54	4.50	1.51
Access to drugs (5)	4.27	4.51	4.33	1.73
Unemployment (16)	4.11	3.92	4.31	1.70
People who do not care (7)	3.54	3.81	3.66	1.57
Children exposed to drugs on the street (9)	3.51	3.11	2.94	1.59
Police that do not care (32)	3.50	3.95	3.58	1.35
Public drunkenness (2)	3.27	3.92	3.91	1.38
Racial/ethnic segregation (21)	2.61	2.00	1.71	1.54
Violence attitudes and behaviors				
Macho attitudes about control (12)	4.51	4.41	4.47	1.62
Ignorance about intimate partner violence (3)	4.35	4.41	4.25	1.78
People who should know better (4)	4.22	4.51	4.31	2.16
Child abuse (36)	3.94	3.35	2.94	1.68
Layoffs (39)	3.72	3.92	4.28	1.62
Mental illness (11)	3.62	3.94	3.92	1.54
Absence of adults (10)	3.43	2.95	2.83	1.81
Youth homicide/child homicide (37)	3.14	3.00	2.42	1.65
Gossip (45)	2.94	3.19	3.36	1.62
Single mothers (8)	2.86	2.30	3.14	2.24
Neighborhood monitoring				
People who intervene themselves (31)	3.22	2.35	3.14	3.73
Families with young children (49) <sup>a</sup>	3.03	1.78	2.28	2.43
Income/wealth (47) <sup>a</sup>	2.94	2.14	2.67	3.03
Cultural norms (46)	2.58	2.08	2.36	2.65
People with professional jobs (48) <sup>a</sup>	2.44	1.46	2.14	2.89
Stabilization factors				
People who call 911, the police, authority (30)	3.61	2.05	2.61	4.54
Job availability (15)	3.39	2.43	3.14	3.49
People who take a stand (29)	3.25	2.08	2.61	4.38
Alertness/vigilance of people (44)	2.89	1.59	2.22	3.76
Curfew (13)	2.56	1.62	1.64	2.49
Home ownership (28)	2.08	1.41	1.61	2.65
Communication networks				
Police presence (23)	3.61	1.56	2.28	4.00
Churches (24)	3.19	1.11	2.06	4.35
People who are aware of resources (33)	3.08	1.73	1.78	4.19
Communication between neighbors (20)	2.58	1.81	2.25	3.41
Community networks (22)	2.56	1.14	1.92	3.86
Neighborhood meetings (43)	2.44	1.38	1.75	3.46
Playgrounds (17)	1.94	1.16	1.25	2.43

*(continued)*



TABLE 1 (continued)

<i>Cluster and Item Names (Item Number)</i>	<i>Prevalence Rating</i>	<i>Severity Rating</i>	<i>Perpetration Rating</i>	<i>Cessation Rating</i>
Community enrichment resources				
Intimate partner violence shelters (50) <sup>a</sup>	4.00	1.65	2.06	4.46
Women's groups (34)	3.53	1.62	2.00	4.65
Hotlines (25)	3.42	1.54	2.00	4.54
Outreach centers (35)	3.22	1.54	2.08	4.51
Emergency assistance programs (26)	3.03	1.30	1.94	4.35
Access to public health facilities (14)	2.56	1.30	1.56	3.95
Community centers (19)	2.06	1.14	1.50	3.78
Recreation centers for children (18)	1.89	1.16	1.22	2.97

a. Items added by the research investigators.

four intimate partner violence outcomes (prevalence, severity, perpetration, and cessation).

The original 14 women from the brainstorming sessions were eligible to participate in the sorting-and-rating sessions. In addition, to obtain an expanded sample, we recruited an additional 23 women to participate. The additional 23 women were also recruited from the participant list of two prior studies on intimate partner violence. A total of 37 women participated in the sorting-and-rating sessions.

These group activities took 3 to 4 hours each to complete (depending on the group) and were overseen by a trained facilitator. Again, informed consent was obtained from the participants, and they received a monetary reimbursement of U.S.\$80 for their time and thoughts.

The first data collection activity of this step involved an individual sorting activity that captured how participants categorized and sorted the individual items (Coxon, 1999; Rosenberg & Kim, 1975). Participants were presented with 51 index cards. Each card contained one item from the brainstorming session. They were reminded that the items were all generated in response to the question about the characteristics of a neighborhood that "you or people like yourselves" consider to be related to experiences of intimate partner violence. Participants were asked to "sort these cards into piles that make sense to you." The participants were informed that each card could be placed in only one pile, that they should refrain from sorting the items into fewer than three piles, and that all items cannot be placed into their own separate piles. We provided these instructions to avoid the problem of several one-item clusters or only a few clusters containing heterogeneous items. Once participants had sorted their items into piles, they were asked to provide a name or label for each of their piles. These data were then entered into the Concept System software by assistants to the facilitators while the group of participants began the second data collection activity.

The second data collection activity of this step involved collecting data regarding the perceived relative importance of items in relationship to women's experience of intimate partner violence. Participants were given a sheet that listed the 51 items and asked to rate each item on the list in terms of its importance to intimate partner violence prevalence. This rating was repeated for intimate partner violence severity, perpetration, and cessation. Table 2 contains the wording and Likert-type response categories that were used for the rating activity.

**TABLE 2: Description of the Rating Activity Language and Response Categories for Intimate Partner Violence Outcomes**

<i>Outcome</i>	<i>Rating Statement and Response Categories</i>	<i>Value Indicator</i>
Prevalence	Please rate on a scale of 1 to 5 how each item is related to women's experiences of intimate partner violence: 1 = no relationship; 2 = some relationship; 3 = moderate relationship; 4 = strong relationship; 5 = extremely strong relationship	Strength of perceived relationship between item and intimate partner violence
Severity	Please rate on a scale of 1 to 5 how each item might make women's experiences of intimate partner violence worse or more severe: 1 = not make worse; 2 = somewhat likely to make worse; 3 = moderately likely to make worse; 4 = strongly likely to make worse; 5 = extremely likely to make worse	Degree to which item worsens severity of intimate partner violence
Perpetration	Please rate on a scale of 1 to 5 how each item is related to a man's perpetration of intimate partner violence: 1 = no relationship; 2 = some relationship; 3 = moderate relationship; 4 = strong relationship; 5 = extremely strong relationship	Relationship of item to a man's perpetration of intimate partner violence
Cessation	Please rate on a scale of 1 to 5 how each item supports women's ability to end intimate partner violence: 1 = not supportive; 2 = somewhat supportive; 3 = moderately supportive; 4 = strongly supportive; 5 = extremely supportive	Degree to which item supports cessation of intimate partner violence

Once the piles were completed and the piles and pile labels had been checked for completeness, participants' sorting-and-rating responses were simultaneously entered into the computer by assistants to the facilitator. The concept-mapping software has built-in quality control for data entry, thus obviating the need for double entry.

#### Step 4: Representation

The representation step is the point at which computerized analyses are run and the data are summarized into concept maps. This step was conducted in two stages: the participant-processing stage and the researcher-processing stage.

The participant-processing stage was conducted during the group sessions at which structuring took place (see above). At each of the two sorting-and-rating sessions, we applied multidimensional scaling (Davison, 1983) to the group's sorting data to obtain maps depicting the relationships between items. The results of these analyses were immediately shared with the group to be examined and discussed. Specifically, we used a laptop computer attached to a projector to enlarge the concept-mapping output so that the entire group of participants could view the various maps simultaneously.

Figures 1 and 2, respectively, present the point maps for Groups 1 and 2. The distance between items, not the exact location of the items on the map, illustrates the degree of similarity between items. Items that were sorted together by more people appear closer to each other on the map. For example, Items 47 and 48 were considered related by participants in both groups, whereas Items 50 and 41 were felt by the participants in both groups to be less related to one another. We shared each group's point map, via the projector, with its members to introduce the participants to the



A scatter plot showing 50 data points, each represented by a small square and labeled with a number from 1 to 50. The points are distributed across the plot area, with a clear non-linear trend. The points are numbered as follows:

- 1: (45, 10)
- 2: (48, 12)
- 3: (42, 15)
- 4: (40, 10)
- 5: (45, 18)
- 6: (48, 20)
- 7: (45, 25)
- 8: (25, 20)
- 9: (48, 28)
- 10: (42, 30)
- 11: (45, 32)
- 12: (40, 35)
- 13: (45, 40)
- 14: (48, 42)
- 15: (35, 40)
- 16: (30, 30)
- 17: (45, 45)
- 18: (48, 48)
- 19: (50, 45)
- 20: (45, 50)
- 21: (48, 55)
- 22: (45, 58)
- 23: (42, 60)
- 24: (45, 62)
- 25: (45, 65)
- 26: (48, 68)
- 27: (45, 70)
- 28: (30, 60)
- 29: (35, 65)
- 30: (40, 68)
- 31: (35, 62)
- 32: (48, 75)
- 33: (42, 70)
- 34: (45, 72)
- 35: (45, 75)
- 36: (42, 78)
- 37: (45, 80)
- 38: (40, 85)
- 39: (30, 80)
- 40: (45, 82)
- 41: (40, 90)
- 42: (45, 88)
- 43: (45, 92)
- 44: (35, 85)
- 45: (48, 78)
- 46: (30, 70)
- 47: (25, 65)
- 48: (25, 70)
- 49: (25, 45)
- 50: (50, 45)

concept-mapping output, to solicit their feedback about the organization of the items, and to facilitate subsequent dialogue about the maps. The group facilitator, working with an assistant operating the laptop computer, walked the participants through the point map output. These point maps provided the basis for subsequent cluster analyses.

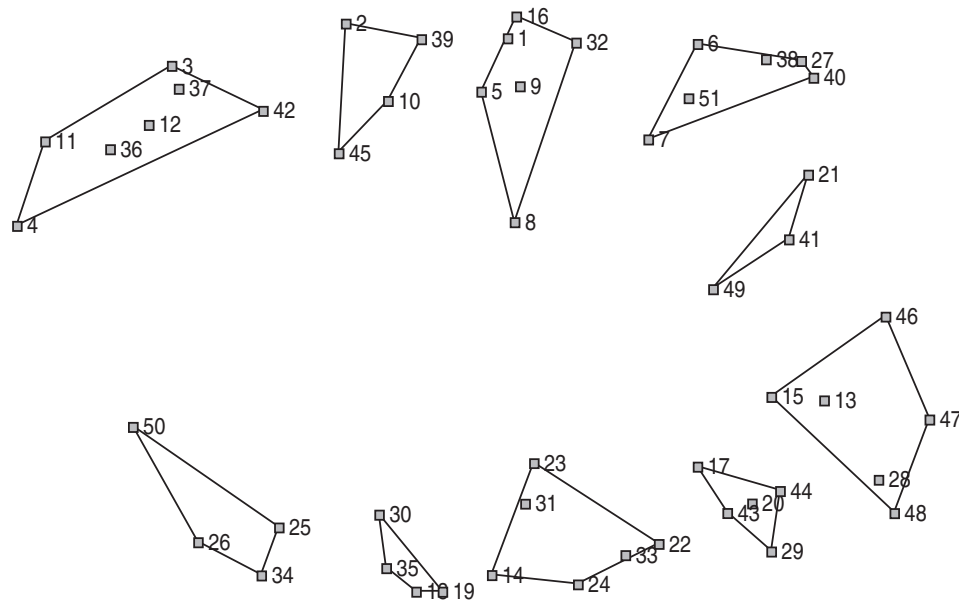


FIGURE 3: Group 1 Ten-Cluster Map

Then, at each sorting-and-rating session, we employed hierarchical cluster analysis (Everitt, 1980) using data from the point map to partition the map into distinct cluster domains of items. Each cluster of items represents a separate conceptual domain. Building directly on the results from analyses presented above, in a discussion led by the group facilitator, the participants in each of the sorting-and-rating sessions evaluated different cluster solutions. For example, starting with a 10-cluster solution and progressively moving down to a 4-cluster solution, the facilitator and group participants worked collectively to determine which arrangement of items and cluster domains most accurately reflects participant perceptions. Again, the mapping outputs were projected onto a screen at the front of the room and in clear view of all participants. The clusters content (i.e., items) was examined for each cluster solution, and discussion was encouraged. The process of determining final cluster solutions is driven by subjective participant preference.

During the cluster solution discussions, participants in Group 1 expressed a preference for a 10-cluster solution, and participants in Group 2 preferred a 6-cluster solution. Figures 3 and 4, respectively, illustrate the final cluster solution maps from sorting-and-rating sessions for Groups 1 and 2. This process of analyzing the data and discussing the results of the multidimensional scaling and hierarchical cluster analysis with the participants provided an opportunity for collecting their direct feedback on the clustering of items.

During the discussion, the facilitator encouraged participants to explore the items within each cluster and allowed participants to challenge the computer-generated arrangements. This discussion time enabled participants to review their personal choices regarding relationship of items in the context of the group results. We recorded insights to facilitate additional analysis by the research team. For example, Group 1 participants had little time for in-depth discussion of cluster contents, spending their discussion time on the arrangement and naming of clusters. Group 2

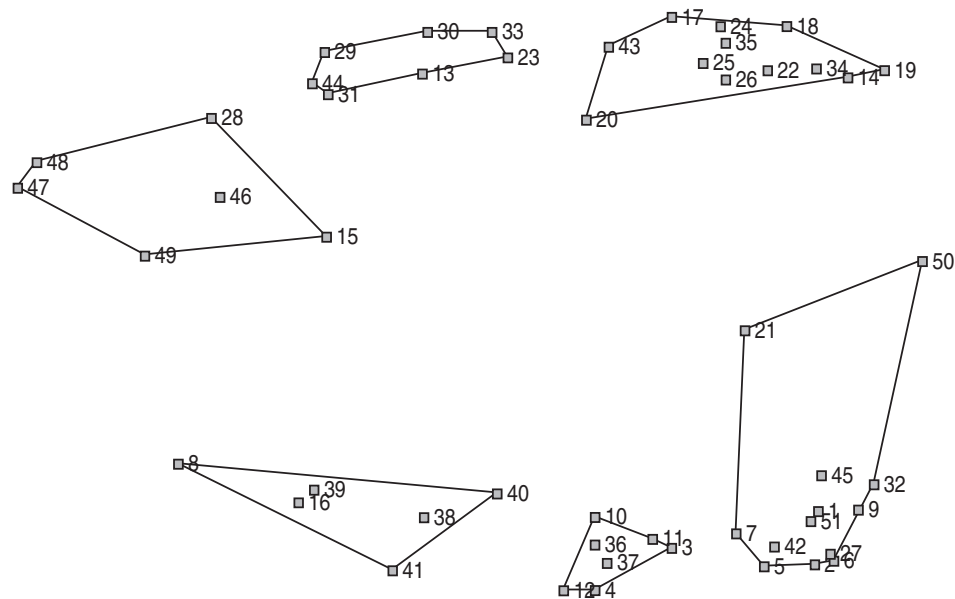


FIGURE 4: Group 2 Six-Cluster Map

participants were able to explore items within clusters in greater detail. They discussed the location of items and, in one case, challenged the location of an item (Item 50: Intimate Partner Violence Shelters). They suggested that Item 50 was not associated with the other items in the cluster and that it was more similar to other items directly above it (e.g., Community Centers).

Following the completion of the participant-processing stage, and prior to the next data collection step, the research investigators synthesized the results from the two independent sorting-and-rating sessions. During this researcher-processing stage, investigators worked to reconcile the two sets of results and choose a single map solution for all participants by reviewing the group discussions, the cluster labels provided by the participants, and the item contents within each cluster. Second, team members used the Concept System software to construct maps representing all 37 participants of the two groups combined. Team members noted the location of items and clusters and compared them to both the group map findings and the relevant discussion obtained during groups. Different cluster solutions were reviewed (from a maximum of 16 down to 3 clusters).

Above 9 clusters, the division of items became inconsistent with interpretations gained through the groups. Items became increasingly isolated; specifically, Item 50 (Intimate Partner Violence Shelters) became isolated into a group of one at 10 clusters but was joined with other community resources at 9 clusters, consistent with the concerns expressed by some participants. Looking stepwise at increasingly small configurations of clusters, the research investigators agreed that there was little benefit to a final cluster solution containing less than 7 clusters, because at those lower levels, items began to clump into very broad and nonspecific clusters. Thus, a 7-cluster solution was selected as the optimum result of the combined sorting-and-rating sessions (Figure 5).

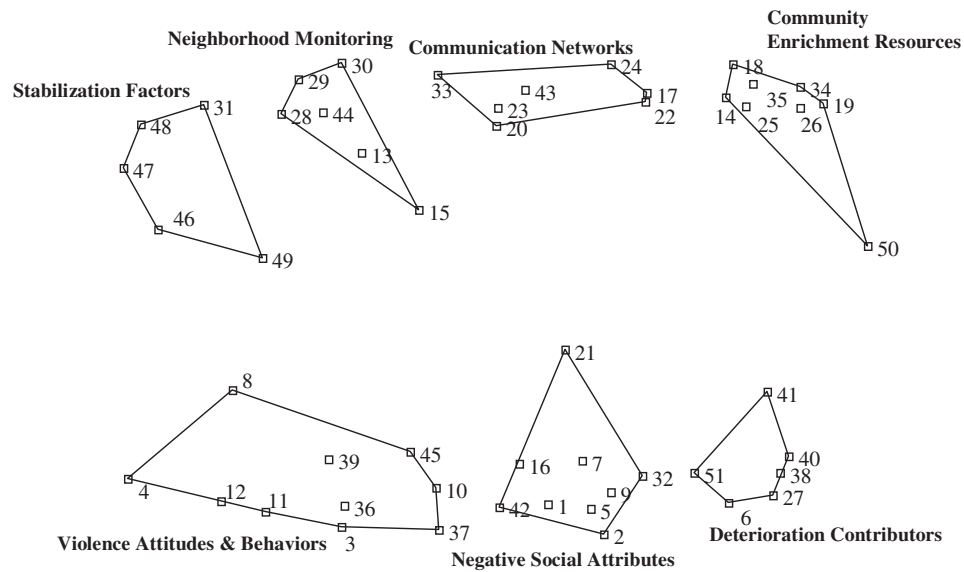


FIGURE 5: Final Seven-Cluster Map

The final cluster labels were developed based on a review of the items within a cluster and the list of pile names provided by participants. See Table 1 for a list of the seven cluster domains and their item contents. Statements bound together within a cluster were determined to share a common theme. For example, the Deterioration Contributors cluster contains statements (Items 6, 27, 38, 40, 41, and 51) generally associated with economic disadvantage and items (Items 31, 39, 46, 47, and 48) within the Neighborhood Monitoring cluster relate to having an engaged and active neighborhood environment.

The research investigators conducted additional analyses to examine the final seven-cluster solution according to the four rating scales. Table 1 also presents the average item rating for each of the four rating scales. Those items that received a higher average rating are considered to be more strongly related to the outcome. For example, whereas Item 12 from the Violence Attitudes and Behavior cluster was rated as being extremely important for prevalence (4.51), severity (4.41), and perpetration (4.47) of violence, it was not deemed as important for the cessation of violence (1.47).

Figures 6 and 7 present a visual display of and relative cluster ratings for the rating exercise related to the prevalence and cessation scales. Clusters portrayed with more layers contain items that were judged to be relatively more important than other clusters. The items within the two clusters Violence Attitudes and Behaviors, and Negative Social Attributes were determined to be strongly related to prevalence of intimate partner violence. Items within the Communication Networks and Community Enrichment Resources clusters were felt to be extremely supportive of women's ability to end intimate partner violence (cessation).

The concept-mapping analytic tool called pattern matching permits examinations of consensus between groups or categories. We used this tool to ensure that the

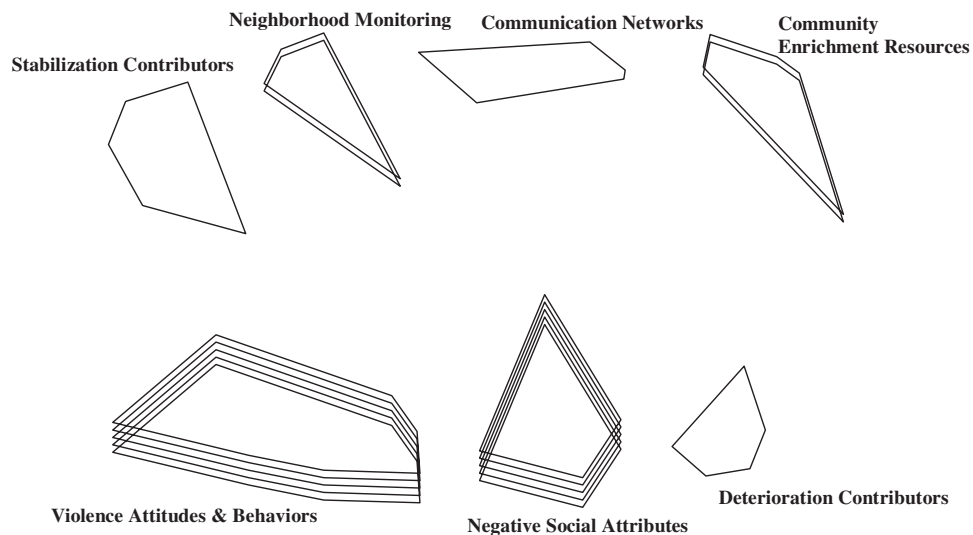


FIGURE 6: Prevalence-Rating Map

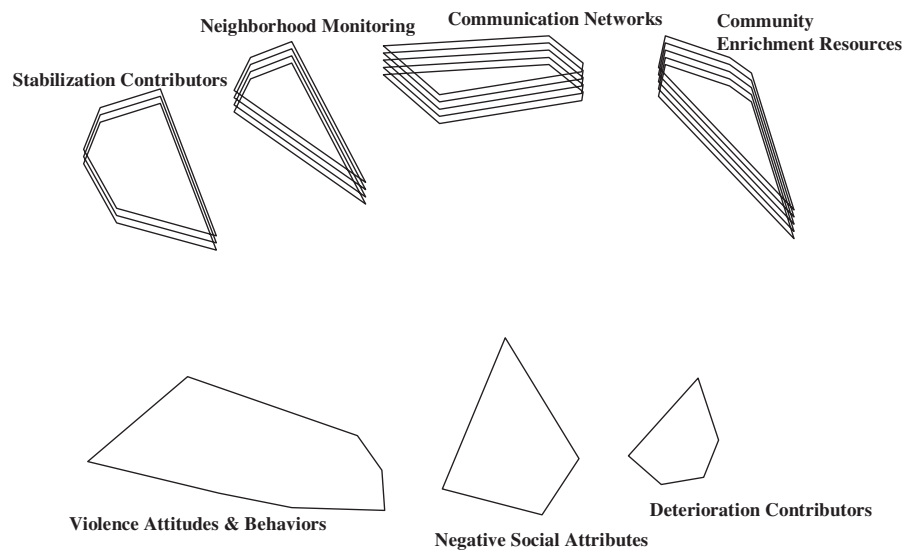


FIGURE 7: Cessation-Rating Map

rating results obtained from Groups 1 and 2 were similar. The correlation coefficients produced from the pattern-matching analysis showed a strong relationship between two groups with regard to all four rating categories ( $r > 0.90$ ). Pattern matching also showed that the relationship of cluster ratings was virtually the same for the prevalence, severity, and perpetration outcome scales (Figure 8). Additional pattern-matching analysis (not shown) also showed an inverse relationship between those three scales and the cessation scale.

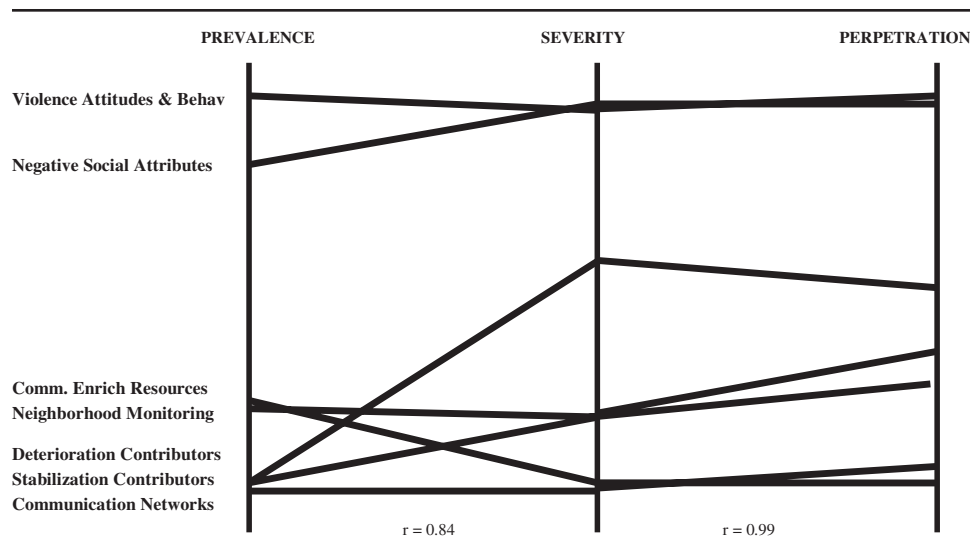


FIGURE 8: Pattern-Matching Results

### Step 5: Interpretation

In the fifth and final step, we invited the members of the sorting-and-rating sessions back to participate in two interpretation group discussions. These interpretation group discussions were designed to address our research goal of exploring the mechanistic pathways driving the relationship between neighborhood factors and intimate partner violence experiences. Twenty women returned and participated in the group discussions. Informed consent was obtained from the participants, and they received a monetary reimbursement of US\$40 for their time and thoughts.

Working in small groups (4 to 5 participants each), the participants were asked to discuss and diagram the relationship of items within clusters. They were asked to create a story that would share their ideas about how items within clusters were related to each other and to prevalence and cessation of intimate partner violence. At the end of each group discussion, participants presented and explained the visual diagrams they created to depict how the neighborhood-level characteristics are associated with one another and with intimate partner violence. For example, during discussions of the Stabilization Contributors cluster, it became apparent that the participants regarded high rates of home ownership within a neighborhood as an important indicator that people in the neighborhood would be likely to be alert, to take a stand, and to call 911 (Figure 9). A participant described the relationship depicted in Figure 9 in following way:

Basically homeownership is like the main thing. We broke it down into two parts. With homeownership, when people own their homes they take a stand and they're alert and will call 911 or alert the authorities if they hear or see something. But, you can also have areas with low homeownership and job availability or not a good job. And then at home that's going to cause stress which will contribute to violence.



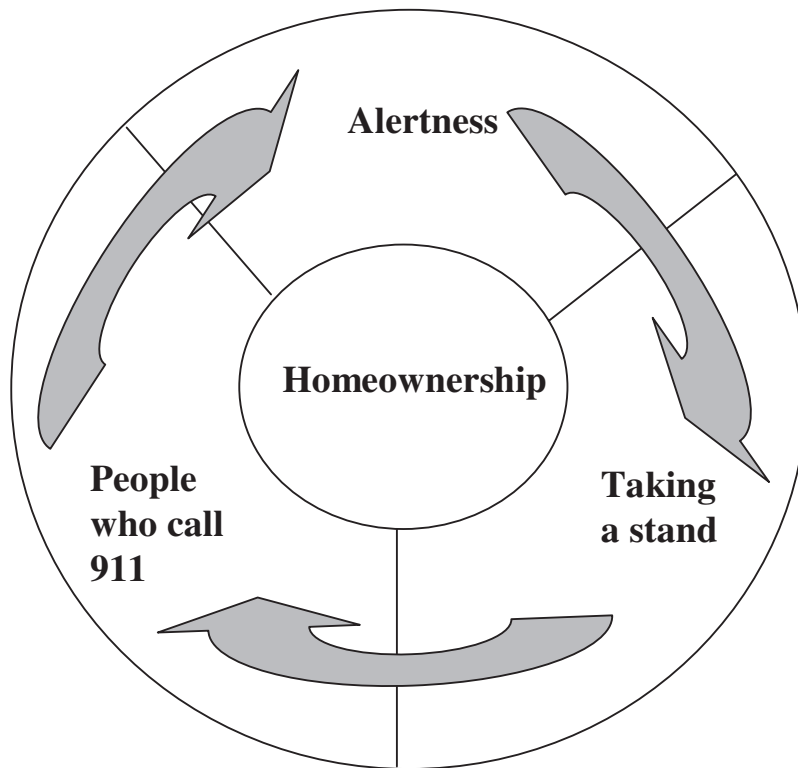


FIGURE 9: Stabilization Factors Cluster Mechanisms Diagram

### Step 6: Utilization of Findings

On the completion of data collection and analysis, the research team reconvened to discuss how the findings could be used to inform our three original research goals. A summary of that discussion is presented below. Additional, more detailed discussion of the research and practice implications is available in the manuscript focused on the results of our analyses (O'Campo et al., 2005).

Our findings support existing research on neighborhood factors and intimate partner violence as well as highlight additional factors to be considered in future studies. For example, existing intimate partner violence neighborhood effects research has heavily used readily available administrative data, such as that collected from the U.S. Census, to construct neighborhood-level indicators of income, education, and employment. Results from our research suggest that future research should consider collecting data to address the important role of the interaction between neighbors and community members. However, the collection of data on neighborhood characteristics such as intervention by neighbors in situations of intimate partner violence, alertness and vigilance of neighbors about intimate partner violence, and communication between neighbors about issues of intimate partner violence will require creative thinking about how to measure those aspects of interaction within neighborhoods. From our research, it is also clear that neighborhood characteristics differentially influence the outcomes of intimate partner violence

cessation and intimate partner violence prevalence, severity, and perpetration. Intimate partner violence perpetration and severity share very similar relationships to neighborhood characteristics, whereas intimate partner violence cessation has unique associations with neighborhood characteristics. To further our understanding of how neighborhood characteristics influence the whole spectrum of intimate partner violence experiences, future research must focus on both cessation and perpetration of intimate partner violence and do so separately. Our findings regarding the pathways of the relationships between neighborhood context and intimate partner violence experiences provide a starting point for informing the generation of specific hypotheses about how neighborhoods affect intimate partner violence.

## **STRENGTHS AND UNIQUE CONTRIBUTIONS OF CONCEPT MAPPING**

Despite sharing methodological limitations commonly associated with other qualitative modes of inquiry (e.g., nonrandom sampling, small sample size, labor-intensive process), concept mapping is a unique qualitative approach with several strengths and potential contributions to public health research.

Designed to follow a series of structured steps, concept mapping integrates several qualitative and quantitative methods into a single process. The use of different data collection and analysis methods within a structured process permits the exploration of complex ideas during a relatively short time. For example, although the concept-mapping activities conducted as part of our Community Pathways to Reducing Interpersonal Violence study focused on the abstract topic of neighborhood context and intimate partner violence, we were able to obtain rich data and generate detailed, concrete ideas about how neighborhoods affect experiences of intimate partner violence after approximately 10 hours of data collection and participant analysis.

The concept-mapping data collection process is unique and draws some of its strength from the inclusion of both individual and group-oriented activities. Drawing on data collection processes similar to the nominal group technique (Owen, 1993) and the Delphi technique (Owen, 1993), concept mapping starts by generating specific individually brainstormed items and ultimately reaches group collective consensus regarding the relationship of those items and their relative importance to one another. During the initial stages of the data collection process, participants work independently on several activities, thus avoiding typical group dynamic problems, such as a single individual's monopolizing of the discussion or the increased likelihood of conformity biases. In addition, participants are relieved of the need to process their perceptions publicly, and they are not required to share personal experiences.

Another unique feature, and one of the major strengths of concept mapping, is the inclusion of participants in the interpretation and analyses of maps constructed during the mapping groups. This is facilitated by the immediate input and analysis of the pile sort and rating data, which permits a collective group assessment and discussion of the cluster domains toward the end of the group session. Unlike other qualitative methods, such as in-depth interviews or focus group discussions, in which the data are collected and then analyzed later by the researcher, concept-

mapping participants contribute directly to data analysis, driving much of the discussion and interpretation of findings; the facilitator's role is largely to manage the process. This process ensures that the results directly reflect the thoughts and perceptions of the participants.

Using qualitative discussion data gathered in the early stages, concept mapping provides a means for quantitative analyses of the data to explore similarities of ideas and produce quantifiable information that is used to enhance qualitative interpretations. The use of multidimensional scaling to examine similarities of ideas between participants and hierarchical cluster analysis to create boundaries around items sharing strong degrees of similarity permits the generation of visual maps depicting group conceptualizations. This combination of methods provides structure and lends credibility to the data.

Concept mapping is a substantially stronger methodological approach for understanding a complex phenomenon than focus groups or in-depth interviews, and it can be used to enhance and extend such traditional techniques. Unlike methods that allow the researcher only to identify and explore themes related to a phenomenon, concept mapping also allows analysis of how these themes relate to one another. Whereas the structure of focus group discussions often results in consensus and discussion regarding a single theme, concept mapping allows for the exploration of multiple themes at the same time and for a better understanding of how those themes are related to one another. Such data can contribute directly to the development of testable research hypotheses and building of theory.

Visual displays of the associations between multiple themes and ideas are a particular strength of concept mapping. The concept maps can be understood easily and are useful for displaying the group findings. Results from the rating activities can also be displayed visually to illustrate which factors are perceived by the group to be more important or relevant to the area of interest.

## DIFFICULTIES AND CHALLENGES OF CONCEPT MAPPING

Concept mapping is a method that suffers from a couple of select limitations worth addressing. The primary difficulty in the use of this method is that it can be resource intensive. The purchase of licenses to use specialized software and the use of computers to input, run, and display the analyses can be costly. The conduct of the groups, and entry and analysis of the data require trained personnel equipped with necessary specialized skills. Ideally, the group facilitators should have experience managing group dynamics and assisting with the flow of data activities and related discussion. In addition, given the simultaneous data entry and analysis that occurs during the representation step, personnel responsible for operating the Concept Systems software must be practiced at quickly and efficiently entering and analyzing the data. The logistics of finding a suitable location and the technology necessary for projecting the visual results so that the participants can offer input is another challenge. In resource-poor settings, the use of the method might be limited.

Because concept mapping entails a stepwise process that builds on prior activities, involving the same participants in subsequent activities facilitates the exploration of complex topics, encourages the establishment of positive group dynamics,

and contributes to the collection of rich in-depth data. A downside of having participants spend so much time in such research activities is the challenge of participant burden. For example, in our research example provided above, participants spent close to 10 hours sharing their thoughts and conducting sorting-and-rating activities. However, planned breaks and provision of drinks, food, and monetary compensatory measures can ease participant burden. In fact, in our research, we found little evidence of participant burden. A majority of the participants talked about how much they enjoyed getting together to express their thoughts and even stated their interest in participating in similar future study activities.

The final challenges associated with the method have to do with the interpretation of results. Although the concept-mapping results highlight the similarities between and clustering of items, a limitation of the approach is the inability to describe or explore the relationships between clusters. Another challenge has to do with caution that researchers must heed when examining the quantitative output results. For example, when examining the average rating score assigned to each item, it is the item score relative to the other item ratings that is important, not the absolute number. Researchers less familiar with qualitative research might be tempted to assign inappropriate values to the quantitative data produced during concept mapping.

## CONCLUSIONS

Concept mapping is a participatory research tool useful for exploring and understanding complex phenomena. Its application of quantitative analytic approaches to qualitative data produces visual representations of the relationship between ideas, which provide unique insight into group thought and perspectives. Our application of concept mapping serves as a good example of how results from such explorations can be used by public health researchers to generate research hypotheses and develop theory.

## REFERENCES

- Adler, E. S., & Clark, R. (1999). *How it's done: An invitation to social research*. Belmont, CA: Wadsworth.
- Bernard, H. R. (2000). *Social research methods: Qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.
- Browning, C. R. (2002). The span of collective efficacy: Extending social disorganization theory to partner violence. *Journal of Marriage and Family*, 64, 833-850.
- Chambers, R. (1992). *Rural appraisal: Rapid, relaxed and participatory* (Institute of Development Studies, Discussion Paper 311). Brighton, UK: IDS.
- Coxon, A. P. M. (1999). *Sorting data: Collection and analysis*. Unpublished manuscript, Thousand Oaks, CA.
- Cunradi, C. B., Caetano, R., Clark, C., & Schafer J. (2000). Neighborhood poverty as a predictor of intimate partner violence among White, Black and Hispanic couples in the United States: A multi-level analysis. *Annals of Epidemiology*, 10(5), 297-308.
- Davison, M. L. (1983). *Multidimensional scaling*. New York: John Wiley.
- Everitt, B. (1980). *Cluster analysis* (2nd ed.). New York: Halsted.
- Galvin, P. F. (1989). Concept mapping for planning and evaluation of a Big Brother / Big Sister program. *Evaluation and Program Planning*, 12(1), 53-58.
- Miles, M., & Huberman, M. (1994). *Qualitative data analysis*. Thousand Oaks, CA: Sage.

- Miles-Doan, R. (1998). Violence between spouses and intimates: Does neighborhood context matter? *Social Forces*, 77, 623-645.
- O'Campo, P., Burke, J., Peak, G., McDonnell, K., & Gielen, A. (2005). Uncovering neighborhood influences on intimate partner violence using concept mapping. *Journal of Epidemiology and Community Health*, 59(7), 603-608.
- O'Campo, P., Gielen, A., Faden, R., Xue, N., Kass, N., & Wang, M. C. (1995). Violence by male partners against women during the childbearing years: A contextual analysis. *American Journal of Public Health*, 85, 1092-1097.
- Owen, J. M. (1993). *Program evaluation: Forms and approaches*. St. Leonards, Australia: Allen and Unwin.
- Power, R. (1998). The role of qualitative research in HIV / AIDS. *AIDS*, 12, 687-695.
- Rosenberg, S., & Kim, M. P. (1975). The method of sorting as a data gathering procedure in multivariate research. *Multivariate Behavioral Research*, 10, 489-502.
- Scrimshaw, S. C. (1992). Adaptation of anthropological methodologies to rapid assessment of nutrition and primary health care. In N. S. Scrimshaw & G. R. Gleason (Eds.), *RAP: Qualitative methodologies for planning and evaluation of health-related programs* (pp. 25-38). Boston: INFDC.
- Sofaer, S. (1999). Qualitative methods: What are they and why use them? *HSR: Health Services Research*, 34, 1101-1117.
- Steckler, A., McLeroy, K. R., Goodman, R. M., Bird, S. T., & McCormick, L. (1992). Toward integrating qualitative and quantitative methods: An introduction. *Health Education Quarterly*, 19, 1-8.
- Trochim, W. (1985). Pattern matching, validity, and conceptualization in program evaluation. *Evaluation Review*, 9, 575-604.
- Trochim, W. (1989). An introduction to concept mapping for program planning and evaluation. *Evaluation and Program Planning*, 12, 1-16.
- Trochim, W., Stillman, F., Clark, P., & Schmitt, C. (2003). Development of a model of the tobacco industry's interference with tobacco control programs. *Tobacco Control*, 12, 140-147.
- Trochim, W., Milstein, B., Wood, B., Jackson, S., & Pressler, V. (2004). Setting objectives for community and systems change: An application of concept mapping for planning a statewide health improvement initiative. *Health Promotion Practice*, 5(1), 8-19.
- Yampolskaya, S., Nesman, T. M., Hernandez, M., & Koch, D. (2004). Using concept mapping to develop a logic model and articulate a program theory: A case example. *American Journal of Evaluation*, 25, 191-207.

Jessica G. Burke, Ph.D., is an assistant professor in the Department of Behavioral and Community Health Sciences at the University of Pittsburgh Graduate School of Public Health.

Patricia O'Campo, Ph.D., is director of the Centre for Inner City Health Research at St. Michael's Hospital in Toronto, Canada.

Geri L. Peak, Dr.P.H., is an independent consultant with Two Gems Consulting Services in Baltimore, Maryland.

Andrea C. Gielen, Sc.D, is a professor in the Department of Health Policy and Management at the Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland.

Karen A. McDonnell, Ph.D., is an assistant professor in the Department of Prevention and Community Health at the George Washington University School of Public Health.

William M. K. Trochim, Ph.D., is a professor in the Department of Policy Analysis and Management at Cornell University in Ithaca, New York.