

## Concept Mapping

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Concept mapping (CM) is a mixed methods research approach that integrates qualitative and quantitative data collection methods of brainstorming, card sorting, and ratings with the multivariate statistical techniques of multidimensional scaling and cluster analysis to create a data-driven visual representation of thoughts or ideas of a group (Kane & Trochim, 2007; Trochim, 1989a). Several methods share the name “concept mapping.” For example, Novak (1998) uses the term “concept mapping” to describe a qualitative method to graphically organize ideas and relationships between ideas. These other methods should not be confused with concept mapping of the type described here that relies on both qualitative and quantitative methods. CM methodology is uniquely suited to conducting research in a community within a participatory research framework (Burke et al., 2005; Rosas, 2012) for several reasons. First, the methodology enables researchers and community members to work collaboratively in the design of the study, the data collection, and the interpretation of results. Second, although CM involves members of a community, it is not a group process in the typical sense of attempting to build consensus. Rather, the unique perspectives of individuals emerge early in the data collection and remain present throughout the multiple steps of CM. Thus, the methodology is well suited for eliciting and including diverse perspectives of multiple constituencies within a community. Third, the results provide a basis for evidence-based action planning or policy development that can be cocreated with the community.

In prior work relevant to research in communities, CM methodology has been used to address issues in culturally competent intervention services (Shorkey, Windsor, & Spence,

2009), health disparities (Risisky et al., 2008), and other community-based research efforts to include cancer screening (Ahmad, Mahmood, Pietkiewicz, McDonald, & Ginsburg, 2012), strategies to increase physical activity (Kelly, Baker, Brownson, & Schootman, 2007), youth development programs (Urban, 2008), HIV/AIDS prevention (Abdul-Quader & Collins, 2011), school violence (Johnson, Burke, & Gielen, 2011), and immigrant experiences (Haque & Rosas, 2010). Methodological work has demonstrated the validity and utility of the CM approach (Jackson & Trochim, 2002; Rosas & Kane, 2012). CM addresses the challenges in community-based research of eliciting and including the multiple and diverse perspectives of all constituencies in the community throughout the research process, with the research design and resulting interventions and policies genuinely reflecting the perspectives of community members. In this chapter, we review the general CM methodology, including a summary of the typical steps, the benefits and challenges of the approach, and an application of CM focused on suicide prevention in youth.

### INTRODUCTION TO CONCEPT MAPPING

#### Steps of Concept Mapping

CM methodology involves multiple steps and interaction with the target group or community at various points in time (see Fig. 30.1). Although the methodology is flexible and can be adapted to the unique circumstances of the issue and the community, there is a core set of common steps implemented in the following sequence: preparation, idea generation, structuring, representation, interpretation, and utilization (Kane & Trochim, 2007; Trochim, 1989a).

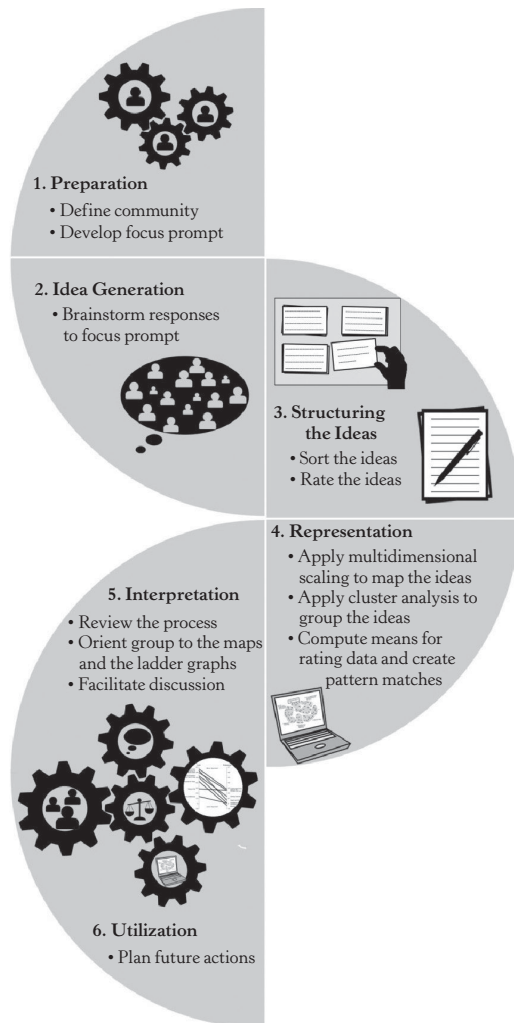


FIGURE 30.1: The steps in concept mapping.

The preparation step of CM involves defining the community, developing the research question, and determining who needs to be included. Representatives of the community work together to identify the multiple constituencies within the community and to ensure that the research process includes their participation. Representatives of the community also work together to develop a statement that enables the community to provide input to the research question. The statement is referred to as a focus prompt and is worded as an incomplete or fill-in-the-blank sentence. The intent of the focus prompt is to elicit multiple and diverse ideas from research participants who are asked to complete the statement. For example, in a study of bullying within an elementary school, teachers, parents, and students were invited to complete the following

focus prompt: “In order to address bullying at our school, I believe we need to . . .” (Vaughn, Jacquez, & McLinden, 2013). By defining the community to include multiple constituencies of school, the intent was to generate diverse ideas because individuals invited to participate had different experiences with and perspectives about the problem of bullying.

In the idea-generation step, research participants from the defined community complete the prompt and provide their individual perspectives. The key goal of data collection for this step is to obtain each participant’s independent perspective about the focus prompt. Multiple participants provide several ideas each, and the result is many diverse ideas that represent the richness of thinking in the community. Although a list of thoughtful and innovative ideas is useful, more meaning can be obtained from the community. The next step, structuring, provides an opportunity to make clear the major themes among the ideas, as well as the value of these ideas and themes. Two tasks are involved during structuring: sorting and rating. In the sorting task, each participant is provided with all of the generated ideas on a set of cards, with one idea on each card. Participants are directed to work individually to sort the cards into groups of similar ideas and create a descriptive name that captures the meaning of the ideas in each group. In the rating task, participants are asked to work independently to value the ideas through ratings on one or more Likert-type scales (e.g., importance, feasibility). Data collection for idea generation, sorting, and rating can be accomplished in a number of ways using paper formats or online tools.

Representation also involves two tasks: computing the maps and computing the summary statistics for the ratings. Computing the maps involves applying multidimensional scaling (MDS) and hierarchical cluster analysis to the input provided by the community. MDS converts the sorting data into a visual representation, with each idea represented as a point on a map. MDS computes the location of each point based on the similarity of ideas. Points on the map will be located close together when the ideas represented by those points were often sorted into the same group by participants during the sorting task. Points on this map will be further apart when the ideas represented by the points were seen as different and seldom or never sorted together. Because there are often many points (i.e., ideas), it is useful to identify patterns among the ideas by

examining how the ideas coalesce into a smaller number of key ideas or themes. Hierarchical cluster analysis uses the information from MDS to identify patterns or clusters of ideas based on the proximity of points on the map. Cluster analysis yields multiple solutions, and the number of clusters can range from 1 to  $N$ , where  $N$  is equal to the number of ideas. Choosing the appropriate number of clusters is an interpretive task that requires a decision about which cluster solution has a balance of sufficient yet manageable detail in order to have a clear understanding of the issue.

Simple descriptive statistics are used for rating data. Means of the ratings are calculated for each idea and for each cluster. This analysis illustrates the variation in value among ideas and clusters and also allows for the comparison of different dimensions of value (e.g., importance versus feasibility) and/or the analysis of the patterns of alignment and discrepancy among constituencies within a community. Pairwise comparisons (i.e., between value ratings or different constituencies) are often displayed as parallel number lines arranged vertically, with each cluster positioned on the respective number line according to the mean rating. Graphs of this type are typically referred to as *ladder graphs* and are so named because perfect alignment between the values on the left and right would resemble the parallel rungs of a ladder (Kane & Trochim, 2007). In practice, a ladder structure seldom occurs, and the graphic serves to illustrate to the community the alignment or the lack thereof among the multiple clusters on either the different value dimensions or among multiple constituencies. Referred to as *pattern matching*, the intent is to focus on the patterns of value across all of the concepts/clusters or among different constituencies as a basis for discussion and action planning rather than emphasizing individual data points (Trochim, 1989b).

The final steps of CM (interpretation and utilization) involve orienting the community to the maps, naming each cluster, and discussing how the concept map informs the original research question and project goals and how the maps can inform further action. Although individuals work independently to contribute their unique perspectives during data collection, the map and associated visuals are the result of integration of individual input to visualize a group's thinking. During the interpretation step, the researcher facilitates a session with the target group/community to qualitatively review

the concept map by discussing the cluster domains and exploring the ideas within each cluster and to assess the alignment of viewpoints on the ladder graphs. Viewing the maps and ladder graphs provides the opportunity to see the meaning and values expressed as a group, discuss further insights, and determine what actions, if any, are necessary. Actions might be to simply understand an issue and promote dialogue among the community or may include forming action teams to develop strategies that address specific issues which emerged on the map. For example, O'Campo, Burke, Peak, McDonnell, and Gielen (2005) used CM as a means to understand the relationship of neighborhood characteristics to intimate partner violence. Although no interventions were developed, their CM research provided the basis for a deeper understanding of the complexities associated with intimate partner violence, increasing the likelihood that future research and the design of interventions would take into account such nuances. In a study about influences on physical activity within an urban African American community, Kelly et al. (2007) used the concept mapping results to engage the community and identify specific actions and strategies to increase physical activity. In a third alternative to developing actions, Szaflarski, Vaughn, McLinden, Wess, and Ruffner (in press) worked with multiple community stakeholders to develop a concept map to address HIV/AIDS in a Black faith community. The results were shared with the community and served as a basis for action planning. However, unlike the previous example, the researchers did not lead the action planning phase and were not part of subsequent decision making. In this case, the community took the responsibility for considering the results and then decided what actions needed to be taken.

### Benefits of Concept Mapping

CM has numerous benefits as a community-based research methodology. Overall, CM methodology is "reflexive, flexible and iterative" (Cornwall & Jewkes, 1995, p. 1668) and can be used to answer a variety of research questions for different purposes (e.g., needs assessments, evaluation, knowledge generation). As a mixed method, CM is integrative because it combines multiple quantitative and qualitative techniques into a single integrated methodology. Although the structured data collection and the application of sophisticated analytical

techniques provide rigor, the visual representation of the data through the maps means that the results are accessible to members of the community. Aside from the research/statistician supporting the statistical analysis, understanding the results does not require comprehension of the underlying mathematics. The visual results are, with some guidance, intuitive and easily understood by community members (Burke et al., 2005).

In addition to balancing rigor with accessibility by the community, a major strength of CM is that it can be used in a participatory, community-engaged manner. CM is uniquely suited to address the inclusion of multiple participants and communities in all aspects of research from data collection to developing meaning from results (Burke et al., 2005). Depending on the goals of the project and the participants, CM can vary in levels of involvement, decision making, and communication and can be considered to occur on a continuum, from academic researchers doing outreach to the community to shared leadership between academic and community partners (Centers for Disease Control and Prevention [CDC], 2011). The steps of CM methodology allow for the possibility of participants and researchers to engage with each other and collaborate in all stages of the research process. As a result, the likelihood increases that interventions, solutions, and decisions that result from the research are contextually relevant to those most affected (Ahmad et al., 2012; Vaughn et al., 2013). Indeed, "this integration of participants throughout the process is possible since concept mapping draws on methodologies that are part of the participatory learning and action tradition, which enable participants to share, analyze and enhance their knowledge of their own lives and prioritize and act on this knowledge" (Bayer, Cabrera, Gilman, Hindin, & Tsui, 2010, p. 2087).

### Challenges of Concept Mapping

Like other research methods that have a qualitative component, CM has the same methodological limitations, such as a potentially small sample size, nonrandom sampling, and resource intensity (Burke et al., 2005). Possibly unique to CM is the response burden. The sorting task, which is central to CM methodology, can require a respondent to spend 30 or more minutes to complete the task, and this time can increase depending on the number of

cards to be sorted and the diligence with which the individual approaches the task. The time spent by a respondent in the sorting task is in addition to time spent during other steps of the methodology. Also, the task of sorting is generally not familiar to most respondents and requires some additional explanation—more than is required with tasks that may be more familiar, such as completing a questionnaire. Despite these challenges, with sufficient explanation, most groups can easily participate in the process of CM. In fact, prior research has shown that neither language (Haque & Rosas, 2010) nor age (Borden et al., 2006; Chun & Springer, 2005; Davis, Saltzburg, & Locke, 2010; Ries, Voorhees, Gittlesonhn, Roche, & Astone, 2008; Vaughn et al., 2013) is a barrier to participation when involving the community in complex issues. Pertaining to researchers, CM requires that the researchers have the resources to create the maps, such as the capability to undertake the data management and analysis steps for the multivariate analysis and access to software for the analyses. The researchers also need a working knowledge of how these multivariate statistical techniques convert individual data into a map(s) of what the community thinks. The working knowledge is required in order to explain to community members the relationship of distance on the maps to similarity of ideas and the parsing of the many ideas into clusters. When CM is used in a participatory manner, skilled facilitation is required from someone who both understands the methodology and can manage group dynamics in order to help a group understand the maps and then interpret and use the maps toward future action. There are challenges to using CM, but they are not unique to CM because other sophisticated methodologies similarly require multiple capabilities on the part of the researcher.

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### CASE STUDY

In the United States, suicide is the third leading cause of death among youth (CDC, 2014; Miller & Eckert, 2009). Youth who have had personal experiences with suicide offer unique and invaluable perspectives that can greatly impact the development and successful implementation of suicide prevention efforts. In order to promote the direct inclusion of youth in teen suicide prevention

research, we conducted a CM project focused on youth suicide prevention. Specifically, adolescents were asked to (a) identify and describe their perspectives about stopping teen suicide, (b) explore the relative importance and ease of implementation of different strategies to prevent suicide, and (c) use the concept map and the ladder graphs to guide future planning efforts.

### Step 1. Preparation

We partnered with an established youth advisory council, the Youth Council for Suicide Prevention (YCSP) at Cincinnati Children's Hospital Medical Center, to develop the focus prompt and conduct the CM study. The 2014–2015 YCSP includes 32 high school teens from the Cincinnati area. Addressing the larger goal of youth suicide prevention in Cincinnati, the focus prompt for this study was "In order to stop teen suicide, we need to . . ."

### Step 2. Idea Generation

At various community events and meetings, a total of 237 Cincinnati youth completed the generation phase of concept mapping in response to the focus prompt, and this resulted in a large set of diverse responses that were relevant to stopping teen suicide. After editing the statements to eliminate redundant ideas and deleting ideas that did not respond to the focus prompt, 77 unique statements remained.

### Step 3. Structuring the Ideas

Twenty-three of the 32 members of the YCSP worked independently via an online card-sorting program to complete an unstructured sorting of the 77 statements into groups of similar ideas that they created and named. Members of the YCSP Leadership Council ( $N = 10$ ) and health professionals who work in the area of suicide prevention ( $N = 10$ ) rated each of the 77 statements on a 1–5 Likert-type scale with respect to importance to youth suicide prevention (1 = *not important at all* and 5 = *extremely important*) and ease of implementation (1 = *very hard to do* and 5 = *very easy to do*). Respondents were informed that all ideas were important to some extent and could be accomplished; they were asked to consider the relative importance and relative difficulty of an idea among all of the other ideas and were encouraged to use all values on the rating scale.

### Step 4. Representation

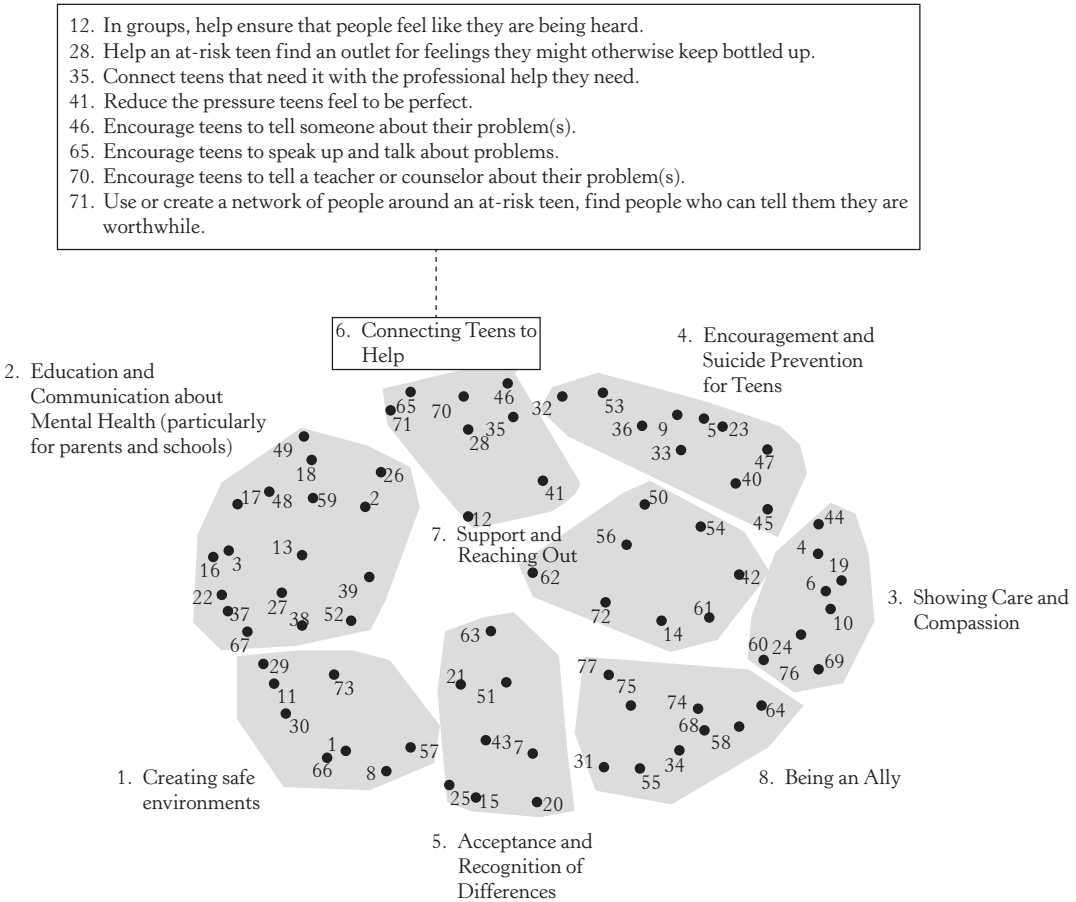
The sorting data from the respondents were analyzed using individual differences multidimensional scaling (de Leeuw & Mair, 2009). MDS created  $x,y$  coordinates and positioned the ideas as points in a two-dimensional map; hierarchical cluster analysis was applied to the  $x,y$  coordinates to compute clusters of points that identified themes or concepts among the 77 ideas. Analyses were conducted using R software (R Core Team, 2014). The multidimensional scaling results show how the 77 ideas are arranged in relation to each other (see Fig. 30.2). The eight-cluster solution was chosen and is represented by the boundaries around ideas in Figure 30.2. Mean ratings were computed for each cluster overall and then separately for youth and professionals. To visualize the values, ladder graphs were created to compare the pattern of importance and difficulty of implementation between youth and professionals (see Fig. 30.3).

### Step 5. Interpretation

At one of their regular meetings, members of the YCSP leadership council reviewed the eight-cluster solution, including the ideas in each cluster and the names that were associated with each cluster during the sorting process. Using this information, the leadership council selected names for each cluster that represented the overall theme among the ideas in that cluster (see Fig. 30.1). Although a complete review of the map is beyond the scope of this chapter, a brief tour will illustrate the variety of ideas expressed by participants (see Table 30.1 for a list of representative ideas within each cluster). Beginning at the top of the map, Cluster 6, Connecting Teens to Help, expresses the need to encourage vulnerable teens to take action to speak up, reach out, tell someone, and so on. Because distance on this map is an expression of similarity, nearby clusters can be expected to have some overlap of ideas. Moving to the left, Cluster 2, Education and Communication About Mental Health, similarly expresses a need for action, but, unlike Cluster 6, which seems directed toward vulnerable teens, Cluster 2 expresses a need for action to change the environment around vulnerable teens. Moving to the right, Cluster 4, Encouragement and Suicide Prevention for Teens, emphasizes a more personal action of listening to ensure that someone feels he or she has been heard. Likewise, Cluster 7, Support and Reaching Out,



*“In order to stop teen suicide, we need to....”*

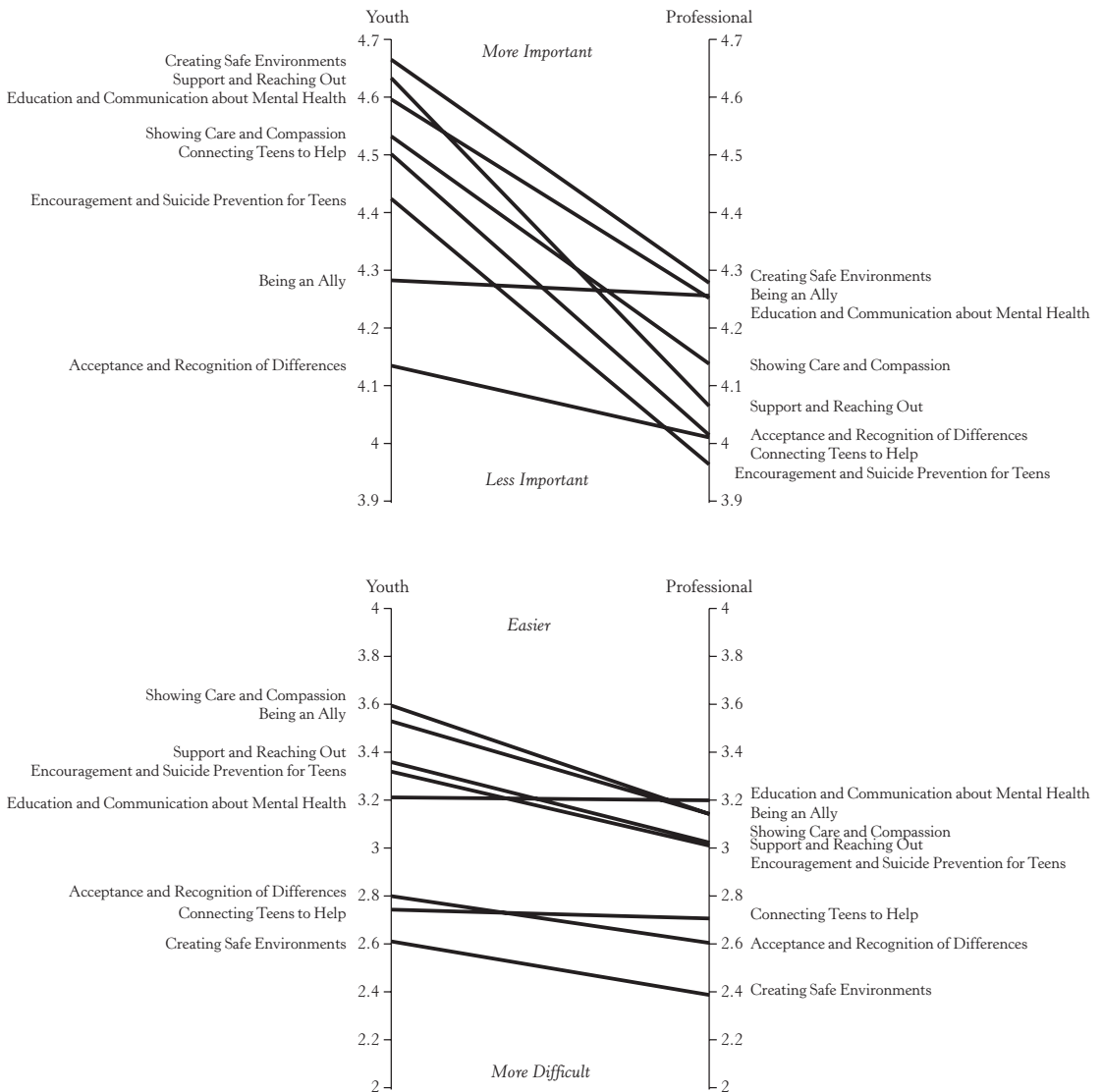


**FIGURE 30.2:** Clusters of points and the ideas that are represented on the map by the points. Typically, a session with the community would start with the point map and build to the cluster map with a review of the content within each of the clusters.

focuses on making sure that teens know that someone understands and is available to help. The sentiment of a personal concern is further expressed in Cluster 3, Showing Care and Compassion, and in Cluster 8, Being an Ally. Cluster 5, Acceptance and Recognition of Differences, continues the sentiment of care and concern but with the added nuance that other teens have a challenge and a responsibility to recognize and accept the uniqueness of others. Cluster 1, Creating Safe Environments, begins a transition back to Cluster 2 and is similarly about taking action on the environment but with a focus on personal actions.

To help inform priorities for the YCSP, the mean values of importance and difficulty were computed for all ideas within each cluster, first for all raters and then separately for the youth and the professionals

(Table 30.1). To examine the pattern of results, multiple ladder graphs were constructed. Figure 30.2 shows a comparison of youth and professionals for each of the dimensions of value, importance of the idea to suicide prevention, and the difficulty of implementation. Although the table of data suggests minor differences in the mean values, a “pattern matching approach implies a different view of data . . . [It] treats relevant data about programs, measures, participants, or outcomes as patterns or as a whole rather than just as a collection of individual measures or observations” (Trochim, 1989b, p. 358). The ladder graphs illustrate that, in general, the professionals and the youth agree on the importance and the difficulty of achieving the ideas in the eight clusters. However, the ladder graphs show that, compared to the youth, the professionals have



**FIGURE 30.3:** Ladder graphs of importance and easiness ratings that illustrate the patterns of youth perspective compared to professionals' perspective. This visual is open to interpretation by the community in a way that is often more robust than providing a table of data or more conventional graphics.

lower ratings on both graphs, indicating less importance and greater difficulty in implementing the clusters overall. This difference is interesting and a topic for further exploration with both groups. Furthermore, although both the youth and professionals are aligned on a number of clusters, there is also a noteworthy discrepancy on each of the ladder graphs. Cluster 8, Being an Ally, ranks near the bottom of importance by youth and near the top by professionals. When considering the difficulty of implementation, Cluster 2, Education and Communication About Mental Health, was seen as

the least difficult by professionals and more difficult by youth. In both instances, the discrepancies indicate areas of further exploration and discussion with both youth and professionals.

### Step 6. Utilization

The final concept map and results of the pattern matching were disseminated to all members of the YCSP to be used in future planning for the Leadership Council and each of the three working groups (i.e., Community Outreach, Social Media, and Youth Participatory Action Research).

**TABLE 30.1: REPRESENTATIVE IDEAS AND MEAN RATINGS OF IMPORTANCE AND EASINESS FOR EACH CLUSTER**

| Clusters and Representative Ideas  | Importance           |                    |                           | Easiness             |                    |                           |
|--|----------------------|--------------------|---------------------------|----------------------|--------------------|---------------------------|
|  | Overall Cluster Mean | Youth Cluster Mean | Professional Cluster Mean | Overall Cluster Mean | Youth Cluster Mean | Professional Cluster Mean |
| Cluster 1: Creating Safe Environments  | 4.47                 | 4.66               | 4.28                      | 2.50                 | 2.61               | 2.39                      |
| 1. Stop the gossiping and bullying   |                      |                    |                           |                      |                    |                           |
| 57. Never tell someone that they are “sick” or “not normal”  |                      |                    |                           |                      |                    |                           |
| Cluster 2: Education and Communication about Mental Health<br>(particularly for parents and schools) | 4.43                 | 4.60               | 4.25                      | 3.21                 | 3.22               | 3.20                      |
| 3. Bring attention to suicide prevention, especially in schools                                      |                      |                    |                           |                      |                    |                           |
| 13. Educate parents so they can help their teens, not reject them or not notice problems             |                      |                    |                           |                      |                    |                           |
| Cluster 3: Showing Care and Compassion   | 4.33                 | 4.53               | 4.13                      | 3.36                 | 3.59               | 3.13                      |
| 10. Help someone who is struggling realize that he or she is good enough and important               |                      |                    |                           |                      |                    |                           |
| 44. Let people know that they are loved and they don’t need to suffer alone                          |                      |                    |                           |                      |                    |                           |
| Cluster 4: Encouragement and Suicide Prevention for Teens  | 4.20                 | 4.43               | 3.96                      | 3.17                 | 3.32               | 3.01                      |
| 33. Empower teens in their self-identity   |                      |                    |                           |                      |                    |                           |
| 36. Listen to teens; let them be heard   |                      |                    |                           |                      |                    |                           |
| Cluster 5: Acceptance and Recognition of Differences   | 4.08                 | 4.14               | 4.02                      | 2.70                 | 2.79               | 2.61                      |
| 7. Have unique abilities accepted by more people   |                      |                    |                           |                      |                    |                           |
| 20. Respect others for their personality and opinions  |                      |                    |                           |                      |                    |                           |
| Cluster 6: Connecting Teens to Help  | 4.26                 | 4.50               | 4.01                      | 2.73                 | 2.75               | 2.70                      |
| 35. Connect teens that need it with the professional help they need                                  |                      |                    |                           |                      |                    |                           |
| 70. Encourage teens to tell a teacher or counselor about their problem(s)                            |                      |                    |                           |                      |                    |                           |
| Cluster 7: Support and Reaching Out  | 4.34                 | 4.63               | 4.06                      | 3.18                 | 3.34               | 3.01                      |
| 56. Make sure people who are struggling know that someone cares/ understands                         |                      |                    |                           |                      |                    |                           |
| 61. Let people know that there are people who can help   |                      |                    |                           |                      |                    |                           |
| Cluster 8: Being an Ally   | 4.27                 | 4.28               | 4.26                      | 3.34                 | 3.53               | 3.14                      |
| 74. Take time to listen and talk to people   |                      |                    |                           |                      |                    |                           |
| 75. Let people know that it is OK to not be OK   |                      |                    |                           |                      |                    |                           |



## CONCLUSION

CM methodology is a mixed methods research approach that directly engages community members in a structured process of conceptualizing and visualizing thoughts about complex issues. The stepwise progression of CM contributes to an in-depth exploration of issues important to communities. The initial steps in CM involving data collection (i.e., idea generation and structuring steps) are completed independently and asynchronously. The independence of community member input helps ensure that each individual's perspective is not tempered by the perceived power of others, conformity biases, pressures to reach consensus, or any of the other challenges associated with group processes. The complexity of the research issue is not simplified; diverse and sometimes even conflicting ideas coexist throughout the steps of CM. Later steps of CM (i.e., interpretation and utilization) do involve group process as an important element of the methodology but are informed with the evidence that emerged from the community. The integration of quantitative and qualitative research methods produces visual representations in the form of maps and ladder graphs that allow community members to easily see and understand the relationship between ideas and the perspectives of various constituencies within a community. When CM is conducted in a participatory manner, all relevant constituents of the community can be actively engaged in the research process from beginning to end. This ensures that all voices are included, and that there is an increased likelihood that the CM results will have greater contextual relevance. Thus, rather than conducting research on or about communities, CM offers community-based researchers the opportunity to learn what the community thinks.

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