INFORMING POLICYMAKING WITH CONCEPT MAPPING

Will Focht, Michael A. Langston, and Richard Todd DeShong

Introduction to Concept Mapping

Concept mapping[1] is a technique designed to capture a person's view or conception of an issue or problem in a diagrammatic, rather than linear, form. The map can capture the values, beliefs, and assumptions, in addition to associative relationships, that an individual has about a problem. Concept mapping owes its origins to Kelly's (1955) Theory of Personal Constructs. He asserted that "man as a scientist continually checks the sense he makes of his world by using the current understanding (construct system) to anticipate and reach out for the future." He developed a formal "repertory grid" technique as a means for identifying this construct system and the constructs' relationships to each other. Concept mapping evolved from Kelly's repertory grid as a process that, unconstrained by formal structure, follows a "natural" conversation through which additional richness could be ascertained (Brown 1992; 1998:258).

The concept map is a representation of how a participant wishes the interviewer to understand the participant's world. It shows the relationships among concepts thereby translating cognitive complexity into an operant causal or implication network of argumentation. The map acts as the "transitional object" through which the participant and interviewer can jointly understand and reflect upon the significance of the participant's knowledge and wisdom within the context of the interview. It is not unusual for the map to help the participant gather her thoughts, reflect on the map, alter her thinking based on that reflection, and find ways to illuminate knowledge previously remaining as deep assumptions (Eden and Ackerman 1998). "The experience is often cathartic" (p. 287).

The meaning of an idea consists of its context – that is, the ideas that influence it – and the ideas that flow from it as consequences or outcomes. Comparing and contrasting ideas and elaborating their connections establish a rich context that makes understanding easier (Kelly 1963; Schein 1992; Bryson 1995:258). As the interviewer and participant view the map, they explore ideas and identify possible interpretations, which leads to a more complete understanding the problem.

Aggregate Maps

Clearly, a concept map belongs to the individual producing it. However, the real utility of concept maps comes after individual maps are merged, or aggregated, to produce a device to facilitate deliberation, referred to as a "group map" or "strategy map" (Eden and Ackerman 1998:286). An aggregate map that depicts the composite view of an entire social system allows for a holistic view of the problem, which can "act as the vehicle for negotiation in groups as maps are merged to present the aggregated views of a group" (Eden and Ackerman 1998:285).

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[1] We use the term "concept mapping" throughout this paper to avoid confusion with the vague term "cognitive mapping." Cognitive mapping has many definitions and is used interchangeably with mental mapping, schema mapping, mental modeling, and other terms. We wish to focus on people's conceptualizations of policy problems and their elements, hence our preference for the term "concept mapping." However, most of the literature that we cite in this introduction uses the term "cognitive mapping."

Alternative Concept Mapping Techniques

The cognitive mapping process was developed and refined over several years by Eden and his associates (Eden, Jones, and Sims 1983; Eden and Huxham 1988; Eden, Ackerman, and Cropper 1992; Ackerman 1993; Bryson and Finn 1995). Ackerman (1993), in particular, is a key contributor to this evolution. According to these researchers, the interviewer is charged with the "mapping" responsibility (the participant's ownership of it is gained by leaving the map displayed throughout the interview). Through frequent feedback, the interviewer attempts to recreate a map of a participant's cognition.

An alternative technique – the association-driven issue display (AID) – procedure, developed by Diane Austin (1994), allows the participant to create the map. This redeploys the interviewer into a support role and permits the interviewer to focus entirely on the evolving structure of the map being revealed by the participant. AID relies on the mapping of active symbols (i.e., schema landmarks) whose identity and relationships reflect the participant's cognitive representation of the problem. In this study, we employed a slight modification of the AID technique.

Generic Concept Mapping Guidelines

The following guidelines provide general suggestions for eliciting concept maps.

1. Planning. Before the interview, identify the issues that will be explored. This may include a candidate list of concepts that the participant may choose from to integrate, at his or her discretion, into the map. Of course, the participant can also add concepts to his or her map that are not included in the master list.[2] Also, allow at least 60 minutes to perform the interview, which includes a preliminary open-ended discussion and the concept mapping exercise. More commonly, a thorough interview will require two hours. Be prepared to terminate and resume the interview at a later time if the participant is tiring, distracted, or hurrying to meet another deadline; it is better to take longer to get fewer high quality maps than to rush through interviews and end up with more low quality maps.

2. Seating. Whenever possible, sit at right angles to the participant. Sitting opposite the interviewee tends to create an atmosphere competition, whereas sitting at right angles creates cooperation (see Argyle 1988). This position also allows the map to be shared more easily between the participant and the interviewer. This will not only validate the map but also reassure the participant that his or her statements and beliefs have been captured, thus building confidence and trust. This approach helps draw the interviewee into the mapping process as the map becomes visible as "a peculiar style of note taking" (Bryson 1995). Involving the participant in the map (however crude and messy it may look) creates quick ownership of the map being created.

3. Discussion. Begin with a broad inquiry that leads the participant into a discussion. For example, the interview may start by inviting the participant to discuss some of the strategic issues facing them or to comment on some of the issues mentioned by others including those from the candidate list.[3]

4. Agenda. Resist a "tight agenda" and instead allow the emerging map itself to constitute the agenda. This agenda is formed as the map prompts the interviewer to ask questions such as "how might that be done?," "why might that be important?," "what outcomes would you expect from...?," and "so what....?" Other questions will become apparent in exploring constructs that seem unlinked to others and when the intonation in the delivery of statements suggests that some themes are more important and therefore might be elaborated further (Bryson 1995). Typically, as the map unfolds, the interviewer will discover difficulties in linking (making sense of) constructs and will need to follow up with statements such as "I noted...but I don't think I understand what you meant" or "as you can see from my network of notes, I'm not certain how it relates to other things you've told me." This process

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[2] The process of allowing participants to present their own views on selected issues provides the basis for negotiating a group view of strategic issues. As maps are aggregated, all participants are more likely to feel they have contributed to determining the meaning of the issue – a requirement to maintain procedural justice and procedural rationality (Bryson 1995).

[3] Two other important prompts are recall of "critical issues" and "laddering" (Bryson 1995). The critical issues approach focuses on soliciting emergent goals, whereas laddering aids elicitation of an emergent goal system.

lets the participant guide the mapping process rather than being forced to accommodate the interviewer's agenda.

5. Exploration. Understand what the participant means (rather than says). When appropriate, use opportunities to gain confirmation of the emergent map. For example, when a natural break occurs, seize the opportunity to playback the material using the map as the basis for the feedback. This will enable the participant to validate the structure or to change it if necessary. The "playback" is not a simple repeat of what the participant said but rather a restatement that adds value derived from visual analysis of the map in its current form. For example, stating that "there seems to be cluster or theme about...which seems central to your thinking" invites confirmation or further elaboration such as, "actually no, I said a lot about the topic, but it is not really central, I should have said more about...." Therefore, the map should be a model of what the participant means, not specifically what the participant says. It is important to recognize that a participant can state their views only in a sequential manner, sometimes jumping from one topic to another, whereas the map can hold many arguments together simultaneously. Repetition of a concept is often a sign that the interviewee is uncertain whether the interviewer understands the concept correctly and is seeking reassurance. Discussing the map may alleviate this concern and allow them to address further concerns/issues.

6. Key Issues. Watch for landmarks that serve as focusing concepts (i.e., are central in importance or serve to anchor a portion of the map) or linkages between concept clusters. They often emerge early in the discussion and may be painful and worrisome, stimulate emotional responses, or are the primary focus of attention. Landmarks may also emerge from a rough analysis of the map's structure (Bryson 1995).

7. Ownership. Maintain the participant's ownership of the map by using his or her language in defining concepts and constructs. The participant should easily recognize his or her constructs in an aggregate or a congregate map. Paraphrasing should be done by the researcher only if he or she is confident that the paraphrase will result in the participant feeling "that's exactly what I meant."

8. Feedback. Provide frequent feedback on the evolving map. Value-added feedback produces confidence and trust in the participant and demonstrates that the researcher has listened well.

9. Review. Review the map with the participant at the conclusion of the interview. Often during the review process, the participant notices the absence of a key concept and provides further elaboration and extension. Prompt "off the record" comments, especially at the end of the interview. By providing sufficient time for a general review, the participant may utter statements "off the record" that can help the researcher to better understand the meaning of the map's constructs. The review ensures that the interviewer and participant leave no areas unexplored.

10. Review Again. Following the interview, study the map again, along with your notes and other information obtained from the interview and note any statements or linkages not added to the map that were revealed during the interview. Conducting this process immediately following the interview greatly increases the accuracy of the interpretation. If too much time elapses between the interview and the map review, then much may be forgotten. To capture deep knowledge, the map must reflect all aspects of the interview, not just the notes but also images and social interaction.

11. Record and Print the Map. A printed map provides the interviewee with a concrete record of the interview and shows the structured representation of their thinking. The printed map may be used as a focus for a second interview to elicit further development, modification, and clarification.

A Comment on Random versus Purposive Sampling of Participants

Two definitions of participant representativeness are used in selecting participants in social science research: *random sampling* in which every person in a population has an equal and unbiased opportunity to participate and *purposive sampling* in which participants are selected because they are believed to possess unique perspectives. If the purpose of the study is to generalize findings to the population, then random sampling is preferred. However, if the purpose is to ensure that all unique perspectives are represented, then purposive sampling is better because uncommon perspectives may be missed in a random sample. In other words, random sampling is better suited to sampling people as units of analysis

whereas purposive sampling is better suited to sampling perspectives as units of analysis. Since concept mapping involves the sampling of perspectives, we believe that purposive sampling is most appropriate.

Concept Mapping and Policy Framing

Concept mapping can be used to help policymakers obtain a rich understanding of relevant issues from the standpoint of stakeholders (Eden and Ackerman 1998:257). By examining the context and content of stakeholders' concept maps, policymakers are able to better understand the meaning of individual elements in the constructs and how elements fit together. This is especially valuable in formulating environmental policy, which typically involves complex issues, controversy, uncertainty, and value salience. More specifically, concept mapping can be used to prepare an aggregate map that represents the composite frame used by the stakeholder population to conceptualize the policy problem, which points the way toward formulating policies that can enjoy widespread public support.

In this case study, we used concept mapping as one of several methods to discover the concerns and preferences of participants regarding the management of adverse impacts in the Illinois River watershed (Focht *et al.* 2001; Meo *et al.* 1998; 1999; 2001a; 2001b; 2002). This study[4] is designed to test a protocol to increase the legitimacy of watershed management policymaking by enhancing stakeholder participation in it.

Concept Mapping Methodology Used in this Study

We used a modification of the Diane Austin's (1994) association-driven issue display procedure to conduct concept-mapping interviews. The interviewers introduced the exercise at the end of an open-ended interview in which the participant communicated their distress over the condition of the Illinois River Basin (IRB).

Sampling

To ensure that all unique perspectives are represented in a purposive sample, we started with *reputational* sampling, that is, with interviews of (1) those persons known to possess unique perspectives, (2) those persons thought to possess unique perspectives based on variation among relevant demographic (primarily occupational) and geographic (location in the IRB) characteristics, and finally (3) those persons who were expected to be familiar with the range of perspectives that existed among stakeholders. We began with a list of stakeholder names extracted from the attendance lists from Oklahoma Scenic River Commission meetings conducted to create an Illinois River Management Plan (1998) and with references by members of the research team and its collaborators who were familiar with stakeholders having an interest in IRB impacts and their management. This initial list identified activists, community opinion leaders, governmental officials, business owners, technical experts, and other interested and affected parties whom we knew would contribute valuable problem constructs. We supplemented these key interviews with others identified by "snowballing," that is, via reference by the key interviewees. Every attempt was made to include persons who had different perspectives. We interviewed 150 stakeholders in all and are satisfied that all unique perspectives were identified based on our careful selection of key interviewees and the increasing repetition of perspectives that we found as the interviews proceeded.

The Interview Discussion

Each interview began with a face-to-face, open-ended discussion in which we engaged the participant in a dialogue about his river basin impact concerns and their causes. Though this discussion was audiotape recorded for later transcription and content analysis,[5] we were careful to take written notes of the specific

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[4] The authors wish to thank the US EPA for their funding of our research entitled "Ecological Risks, Stakeholder Values, and River Basins: Testing Management Alternatives for the Illinois River" under the EPA-NSF Partnership for Environmental Research, Water and Watershed Program, grant GAD #R825791. We also thank Medea Langdon, David Allen, and especially John Wood for their conduct of the interviews.

[5] The results of the content analysis are not included herein except as they relate to the interpretation of concept maps.

concerns and causes that the participant mentioned. We continually prompted the participant for additional concerns and causes to help ensure that all were discussed. These discussions lasted anywhere from 30-90 minutes.

The Mapping Exercise

The concept mapping exercise followed the open-ended discussion. The mapping exercise required 30 to 60 minutes to complete. Altogether, we obtained 146 usable concept maps from the 150 interviews.

Impact List Development. After the interviewer explained the concept mapping exercise, the participant was asked to recall previously discussed impacts for possible inclusion into the map. The interviewer used notes taken during the open-ended discussion to prompt the participant to add additional impacts to the growing list, which was written on a flip chart, chalkboard, or other easily viewable device. In addition, the interviewer presented a "candidate list" of impacts (developed from prior review of Illinois River basin impact reports, prior interviews of those most knowledgeable about impacts, and impacts identified by the research team) and asked if the participant would like to add any additional concerns and causes to his list. It is important to note that the participant was instructed not to add impacts from the candidate list unless the participant had forgotten to mention it during the interview; the candidate list is nothing more than a compilation of impacts gleaned from various sources.

Relative Importance Designation. Once the personalized list of impacts was obtained, the participant was asked to select from this list those impacts that should be included in the map. The participant was encouraged to combine impacts if they were sufficiently similar. For those impacts that remained, the participant was asked to write each on an index card. Three sizes of cards were available, representing the relative importance that the participant placed on the impact. Impacts judged most important were written on 5" x 8" cards, those of moderate importance on 4" x 6" cards, and those of least importance on 3" x 5" cards (those judged to be of trivial or no importance were ignored, of course).

Perceived Knowledge Judgment. The interviewer then asked the participant to indicate the level of knowledge that she believed she had about each impact by affixing a colored dot on each card. Green dots were used to indicate high knowledge, yellow dots moderate knowledge, and red dots low knowledge.

Map Assembly. Next, the interviewer asked the participant to arrange the cards on the surface of a large sheet of paper such that the arrangement would reflect how impacts were conceptualized by the participant. The participant was told that any arrangement is permissible and that the arrangement should indicate to the observer how the participant "saw" or "thought about" IRB impacts in relation to each other. We engaged the participant in a discussion while the cards were placed on the paper. Occasionally, the participant would add additional cards or even delete cards from the map as a result of this discussion. For example, we may have sought further clarification with questions such as, "do you think that animal waste [or tourist trash, etc.] causes this?" According to Eden *et al.* (1979), it is this process of reflective mapping that gives the method its special value. Through prompted elicitation, the participant can have a "cathartic experience," which provides "added value" because it clarifies thinking (Eden 1992).

Map Labeling. After the participant was satisfied with the map, she was asked to label the entire map or portions thereof by writing descriptive explanations on colored cards and placing them on the map at appropriate locations. Labels are particularly useful for the interpretation of individual maps as well as the later development of aggregate maps. The labels also stimulate further reflection on the construction and interpretation of the map.

Self Identification. The interviewer then invited the participant to include himself into the map by writing the word "self" on a colored card and placing it on the map to indicate how he saw himself in relation to the impacts recorded in the map. According to Kaplan (1973), this knowledge of "self" (where one is situated within the map) is the crucial starting point for "adaptive behavior." The placement of self was indeed valuable in helping us see how the participant felt about the impacts (e.g., as a victim, as a manager, as a distant observer, etc.), which in turn helps us understand the bases of the participant's concerns.

Map Explanation. Finally, the interviewer asked the participant to explain the map by relating a coherent story that justified the selection and identification of impacts, the level of perceived knowledge about them, their relative importance, their inter-relationships as exhibited by their arrangement in the map, and their personal relationship to them. The interviewer would frequently ask questions to clarify the explanation. This explanation was audiotaped for later transcription and use in preparing an aggregate map and in reporting these results.

Data Recording

At the conclusion of the exercise, card placement was outlined on the paper, the cards and card outlines were similarly numbered (in case the cards, which were stapled to the paper, later became detached), and the participant code and date of interview were recorded in the corner of the paper. The paper with the stapled cards attached was then carefully folded and placed into the participant's data file.

Later, the outlined paper maps with attached cards were converted to computer graphic files using Microsoft Visio©. These graphical replicates of the maps made it easier to perform subsequent display and analysis. Four of these maps are included with this paper and will be discussed later.

The identity of the cards (impacts, self, and group labels), group membership, card size (relative importance), and dot color (perceived knowledge) were abstracted from the maps and entered in Microsoft Excel© for statistical analysis.

Map Coding

Based on a review of the maps and interview transcripts, 39 codes were developed to categorize impacts (see Table 1 in Appendix A).[6] Codes for each map were entered into Microsoft Excel© for statistical analysis.[7] The corresponding relative importance and perceived knowledge judgments were also entered. Finally, the position of the "self" card was entered as its association with one or more impact category codes. The spreadsheet was used to compute frequencies, modal relative importance, modal perceived knowledge, and contact with the self-card for each impact category.[8]

Map Interpretation

Three hierarchical levels of organization are important in map interpretation. The most basic level is that of the individual impacts. The second level concerns the relationships among impacts into clusters, inferred by card proximity and labels, which suggests how impacts are cognitively related. The highest level of organization concerns the arrangement of impact clusters in the entire map. It is also important to discern the central focus or foci (key landmark(s)) of the map, both through examination of the geometric arrangement of impacts and the placement of label cards.

Aggregate Map Assembly and Interpretation

An aggregate map is a compilation of individual maps that represents the key landmark features located within the social system construct. Aggregate maps are primarily constructed qualitatively. However, we did use quantitative information such as concept frequencies, modal importance scores, modal perceived knowledge scores, and placement of self-cards to inform our assembly. The aggregate map addresses all three hierarchical discussed above.

Initially, individual maps were divided into groups based on similarity of their construction. These were then assembled into group-specific aggregate maps. These smaller aggregates were then combined into a single aggregate map representing the social system impact construct.

Group similarity was first judged based on whether the maps contained one or multiple impact clusters (a third-level hierarchy analysis). Within these two groups, maps were then grouped according to their foci

[6] Codes were created only for those impacts that were included on at least two maps.

[7] Multiple impacts included on a single card were coded separately. Multiple impacts falling under the same category code were entered only once. Group labels were excluded.

[8] Hierarchical agglomerative cluster analysis (Ward's method) was also performed on these data to determine how participants grouped categories of impacts (to reveal similarity of categorical groupings across participants and to reveal which people produced similarly grouped impact categories). These findings are not included herein.

(a second-level hierarchy analysis). Foci were frequently represented by a single card placed at the center of the map (Figure 1 in Appendix A) or, less frequently, by a single card at one end of a group of cards arranged in a linear format (Figure 2 in Appendix A). Finally, aggregate map interpretation was informed by the meaning of the individual impact categories included in the aggregate map (a first level hierarchical analysis).

Individual Map Results

In the next section, we will discuss our creation of an aggregate map based on the results of our analysis of all 146 individual maps. However, by way of example, we have selected four maps that are exemplars of many of the maps we obtained for individual analysis.

The concept map presented in Figure 1 (Appendix A), created by an environmental lawyer with experience in litigation involving the Illinois River, is typical of a water quality-focused (WQ-F) map with its radial geometry. All impacts but litter directly are viewed as directly affecting water quality (litter is grouped with human waste as a recreational impact). Three impact clusters are labeled: "point sources," "non-point sources," and "recreational." She aligns herself most closely with "water quality" and "population growth." The most important impacts to water quality are septic tanks, human waste, and agricultural runoff from both Arkansas and Oklahoma. Other impacts are judged as moderately important while none are identified as having low importance. She believes that she has low knowledge of litter, human waste, city runoff, and septic tanks and moderate knowledge about wastewater plant effluent, water quality, agricultural runoff from both states, and population growth. We may summarize her frame thus: she is most affected by threats to water quality (most important) and population growth (less important), about which she has moderate knowledge; and recognizes that pollution sources and recreational impacts threaten water quality, though she knows less about septic tanks and recreational impacts from human waste (more important) and urban runoff (less important) than about impacts caused by agricultural runoff (more important) and sewage plant discharges (less important). Litter is not seen as a direct threat to water quality and is thus judged less important, though she admits that she does not know much about litter's impact. We will return to this map in our discussion of the aggregate map.

Figure 2 (Appendix A) presents a less common construction of a WQ-F map. This map is interesting because it is linear rather than radial. This participant is the owner of a float trip business on the river. His description indicates that the linear arrangement is analogous to chapters in a book. "Well, it all pertains to the same thing. The ending of the story would be water quality. In order to get to the end of the story, you've got to read the first few chapters and take care of business." Thus, water quality is again the key focus or anchor of his frame. All impacts are judged as highly important. He believes that he is most knowledgeable about drinking and trash but less knowledgeable about technical issues such as Arkansas sewage, poultry, and nurseries. He judges that he has moderate knowledge of erosion and water quality generally based on his personal experiences with the river. He sees himself as most impacted by the trash, erosion, and water quality because as he puts it "that's what I see every day." He entitled his map, "Clean up your ACT!" suggesting that he believes that impacts can best be managed through personal responsibility.

Contrasting the interpretations of the "self" card on these two maps is instructive. On the previous map, the "self" card was placed on the parts of the map with which she most closely identified and were most important to her. In the latter case, the "self" card was associated with the issues that most directly affected him. Other participants placed the self card near impacts over which they believed they have the most control or that have the greatest effects on the river. It is important therefore to explore with the participant how they relate to the impacts.

An eighth grade teacher who is a lifelong resident of the basin constructed Figure 3 (Appendix A). This map is typical of water quality- and socially-focused (WQ&S-F) maps with its two distinct impact clusters. The cluster on the right is anchored by water quality (most important) and is partially surrounded by pollution sources about which he sees himself as fairly knowledgeable and which are judged as moderately or least important. Note here that he judges as least important those impacts that are more indirectly associated with water quality and about which he knows the least. The cluster on the left is socially focused and seems to have two themes. One theme is his concern about restriction of access to the river by the Army Corp of Engineers (Corps), which restricts his ability to fish. The second theme relates to offensive behavior, which is seen as caused crowds of canoeists and exacerbated by their

alcohol consumption. He situates himself squarely within the social impact cluster and expresses that it is his "personal preference" that these impacts be reduced first. He is frustrated by "everyone [else's] concern" about water quality, which seems to be the focus of the "county and national government."

Figure 4 (Appendix A) presents another concept map from the WQ&S-F group, which was produced by a real estate agent in Tahlequah. One impact cluster is labeled "agricultural" and includes water quality concerns. The other cluster is labeled "people" and contains social concerns. She perceives herself as more knowledgeable about social concerns than the more technical water quality concerns. Water quality, drinking alcohol, litter, and the economy of Tahlequah are highly important to her frame. Interestingly, the "economy of Tahlequah" impact appears as a bridge joining these two clusters. She gives this impact even more prominence by placing her "self" card on it, which is not surprising given her occupation as a businesswoman in Tahlequah. She believes that the degradation of the river affects her most directly through its economic ramifications. The existence of this bridge points a way to fashioning policies that can successfully relate pollution impacts to behavioral impacts.

Aggregate Map Results

As discussed previously, aggregate maps are created to represent a composite concept map of the entire social system.[9] The aggregate map created from our review of 109 of the 146 concept maps we obtained from stakeholders in the IRB is discussed next.

The two most commonly encountered impact clusters concerned water quality impacts (n=64) and social impacts (n=45). Since 75 percent of the 146 concept maps in our study contained one or both of these two clusters, we will use only these maps, for the purposes of this paper, to illustrate how an aggregate map is constructed.[10]

To aggregate impact clusters, impact codes in WQ-F and WQ&S-F maps were isolated, sorted, and ranked by frequency of mention. Table 2 (Appendix A) lists the twenty most-encountered impact category codes in WQ-F and WQ&S-F maps along with their occurrence frequencies, relative importance frequencies, perceived knowledge frequencies, and the number of associations between the impact categories and the "self" card. This analysis of which categories to include in the aggregate map, modal importance rating, modal knowledge rating, and modal "self"-cluster association address the level one hierarchical analysis.

The relationships among impacts were assessed through a qualitative review of those maps containing WQ-F or WQ&S-F clusters. Most clusters in WQ-F maps surround a central card that is almost invariably stated as "water quality." Some participants described these arrangements as "spokes in a wheel." A few of the WQ&S-F maps contain single cards that link socially-focused clusters to water quality-focused clusters. These bridges are either economic impacts (n=2) or "self" cards (n=6).[11]

Figure 5 (Appendix A) presents the aggregate map that we assembled using key concepts taken from all WQ-F and WQ&S-F maps in our sample. It is easy to see that the map consists of three parts: a water quality-focused impact cluster, a socially-focused impact cluster, and a bridge. This map is considerably more complex than the individual maps because it represents a composite problem frame.

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[9] Another procedure to generate a social system concept map is to convene a focus group meeting and allow participants to generate a map as a group. We refer to this sort of social system map as a congregate map. We did not undertake to develop a congregate map in this project. However, we have included suggestions for convening a congregate mapping exercise in Appendix B.

[10] Subsequent work will seek to enrich this preliminary aggregate map with the incorporation of information gained from the remaining maps not considered in this analysis. Nevertheless, this work is sufficient to demonstrate the utility of concept mapping to reveal a social system problem frame for use in policy analysis and formulation.

[11] The reader is cautioned not to make too much of the low frequency of "bridge" cards found in these concept maps. Recall that we did not employ random sampling of participants and therefore do not intend to extend our statistical findings to the entire IRB population. Instead, we used purposive sampling to capture as many different frames of stakeholders' view of the IRB as possible. This allows us to assemble an aggregate map that is representative in the comprehensive sense (inclusive of all frames) though not in the statistical sense (generalizable to the population with respect to frequencies, variances, measures of central tendency, and so on).

The relative importance of impacts was determined based on their frequency of importance rating and not their frequency of mention. For example, the third-most common card, "Litter and Trash from Recreation," is rated as only moderately important because it was rated this way by more participants. Obviously, impacts that are of most common concern are not necessarily judged as most important. Note also that water quality impacts are generally judged more important than social impacts, indicating that water quality impacts dominate social impacts as concerns to social system as a whole. In the social cluster, note that overpopulation is the only impact rated as highly important, which suggests that stakeholders generally attribute social problems to recent increases in population. In the water quality cluster, note that wastewater effluents, animal feeding operations, and erosion are seen as the greatest threats to water quality. These impacts are the primary causes of water turbidity – the most important marker of poor water quality to most stakeholders. This finding also confirms that the level of understanding among stakeholders about the effects on turbidity caused by nutrient loading and soil erosion are rather sophisticated. Surprising to us is the relatively low importance attached to urination and defecation in the river by tourists. This concern, though expressed by many, is judged as relatively unimportant to water quality compared to other nutrient sources; again, confirming a level of sophisticated understanding that many outsiders do not credit.

Most perceive their level of knowledge as either high or low, with few moderate knowledge self-assessments. The impacts judged most familiar are those social and water quality impacts that are most visible such as cattle access to the river, animal feeding operations in Oklahoma, and water supply; whereas lower levels were accorded to more technically complex and controversial impacts such as urban runoff, urban development, wastewater effluents, septic systems, nursery runoff, and animal feeding operations in Arkansas. The low level of perceived knowledge for urban development and urban runoff is interesting because their obvious connection.

Comparing importance and perceived knowledge, we find no obvious relationship between these two judgments. Nevertheless, we believe it is useful to stress the high importance attached to familiar impacts such as water quality, population growth, and economics: population growth anchors the social cluster, water quality anchors its own cluster, and economics forms the bridge between the two clusters. We will return to this finding in discussing policy implications in the next section. It is also interesting to note the lower perceived knowledge about Arkansas municipal wastewater versus Oklahoma wastewater; this difference is probably due to a dearth of available information rather than any technical difference in the two operations.

Most participants placed themselves on or adjacent to the water quality card (Table 2, Appendix A). They identify strongly with the quality of the river and believe that the impacts that degrade water quality also affect them. However, a few others placed their "self" cards near the economic impact, suggesting that they recognize the relationship between the regional economy and IRB impacts. Upon careful reflection, we believe that it is appropriate to place two "self" cards in the aggregate map. The first, "self as affected," is placed on water quality indicating that stakeholders believe that water quality is the primary cause of impacts to their well-being. The second, "self as affecter," is meant to suggest that stakeholders recognize that economic activities, and their involvement in them, has a significant affect on water quality. In sum, stakeholders recognize that water quality in the Illinois River is most affected by human activity and therefore its protection must be assured through personal accountability. This, we believe, is a reason to remain optimistic about the future of the Illinois River and its economy.

Concept Mapping and Problem Framing

As posited at the beginning of this paper, concept mapping can provide valuable insight into policy deliberations by revealing problem frames. In our study, we identified several such insights.

First, many participants see the relationship between water quality impacts and their causes as simple and direct. Moreover, impacts that are judged most important tend to elicit lower levels of perceived knowledge. These findings suggest that policies designed to educate stakeholders on the complex relationships between causes and effects are both needed and welcome.

Second, pollution impacts are focused on water quality whereas social impacts are focused on population growth. Also, we have noted that water quality impacts are ranked as more important than social impacts. This suggests that though policies designed to reduce pollution threats to water quality should

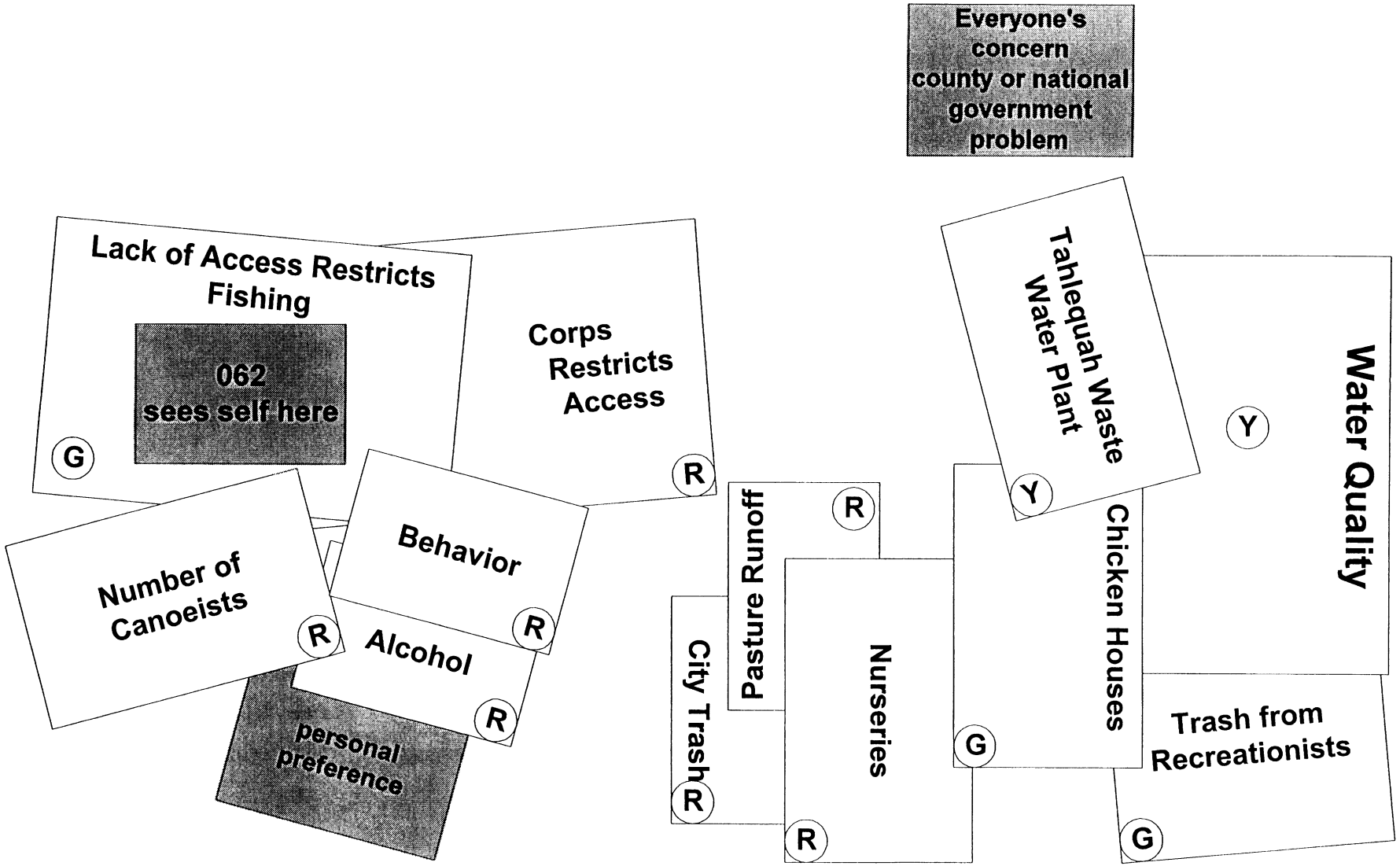

Figure 3. Typical Two-Cluster Map Focused on Water Quality and Social Concerns

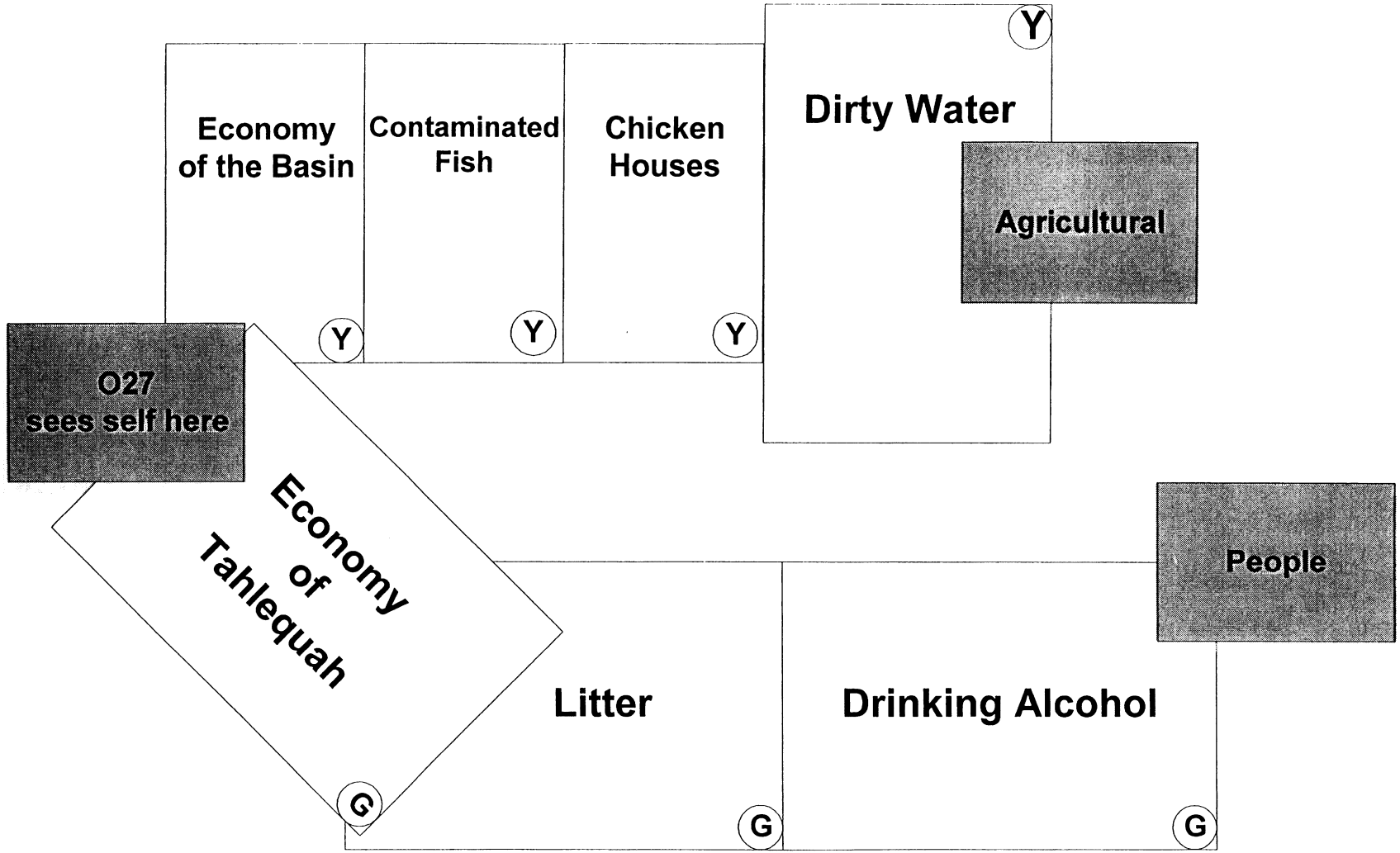

Figure 4. Two-Group Map with Economics Connecting Water Quality and Social Concerns

be pursued first, policies designed to address social impacts through better management of population and economic growth should not be ignored.

Third, the "self as affecter" card in the aggregate map reflects the notion frequently expressed in interviews that individuals must accept responsibility for impact mitigation. An increasing sense of personal responsibility may serve as a powerful impetus to reduce impacts in both clusters. An army of private individuals working to protect the river will be more effective (and politically legitimate) than will a government agency imposing its will on recalcitrant users of the resource.

Finally, and perhaps most importantly, both economic impacts and individuals are potential bridges that can link the two major impact clusters. Stakeholders recognize that the economy affects and is affected by both social and water quality impacts. Similarly, stakeholders recognize that they also affect and are affected by both social and water quality impacts. In other words, stakeholders recognize the systemic relationship among water quality, social impacts, economic growth, and their own individual welfares. Thus, the economy and self-interest not only provide potential avenues to address both social and water quality concerns, but also represent a means of balancing protection and sustainable use in an equitable manner.

Conclusions

The Utility of Concept Mapping

The concept map procedure provided significant insight into both individual and aggregated social system frames of the Illinois River degradation problem. These frames are important for understanding how stakeholders conceive threats to the Illinois River, which in turn point the way to impact management policies that are more likely to enjoy widespread stakeholder support. Purposive sampling provides perspectives that represent the full range of frames present in the social system. The construction of an aggregate concept map using a combination of qualitative and quantitative methods yields the integration of common and salient features of individual maps into a single social system frame. While other methods, such as content analysis of the open-ended interviews, might have detected the significant concerns regarding the basin, concept mapping allows graphical presentations of the relationships among these concerns. In this study, these relationships revealed the pivotal role that economics and individual responsibility can play in jointly addressing seemingly disparate concerns.

The Lesson of Concept Mapping

Participants in this study are focused primarily on protecting the river. Whether they reside inside or outside of the watershed, they share an abiding interest in protecting what they value. The Illinois River corridor is one of the most scenic areas in Oklahoma and is recognized as such by organizations such as Rand McNally (who claim that the Illinois River basin is the fourth most popular place in the United States to retire). The entire region, from northwest Arkansas to east-central Texas is experiencing a population growth rate exceeding 6% and approaching 15% in some locations. However, the basin is also experiencing the pressures of new demands for increased resources, infrastructure, and services. The results of the concept mapping study are instrumental in revealing how stakeholders conceptualize their impact concerns, which is important to formulating impact management policy that will be politically acceptable. Confronted with the complex and controversial issues of defining total maximum daily loads (TMDLs) for chemicals such as phosphorus and nitrogen, the need for municipal wastewater treatment facility upgrades, the cost to small farmers of compliance with new regulations concerning non-point source runoff and land application of animal waste, and the perceived distrust of government at all levels, policymakers need to be informed of stakeholder concerns and preferences if they wish their policies to be less vulnerable to strong opposition.

In Hindsight

Based on recent stakeholder workshops, the findings obtained from concept mapping have gained validation and credence. It appears that a consensus may already be developing within the IRB social system. The "blame game" that had found expression in the news media is being expressed by only a few today. The quiet majority believes that it is more likely that everyone is to blame and that impacts have been accumulating for a long time. Many also appreciate that it is going to take all stakeholder

groups to cooperate to solve the problems that threaten the basin; very few are under the delusion that they will be solved in the short term. Finally, given the recent downturn in the economy, many stakeholders are recognizing the reflexive relationship between the regional economy and water quality. It indeed seems to be the case that the problem frames gained from interviews in 1998 and 1999 predicted policies being deliberated in late 2001.

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Appendix A: Tables and Figures

(See next seven pages.)

Appendix B: Congregate Map Guidelines

(See page 178.)

Table 1

Impact Category Code Definitions

Impact Code	Impact Cause Category	Definition / Example
$	Economic	Concerns about impacts on business viability, jobs, costs, etc.
AE	Aesthetic Concerns	Unspecified concerns over the appearance, odor, or serenity of the basin.
AFO-A	AFO Runoff-Nutrients in AR	Runoff from animal feeding operations including poultry, dairy, beef, and hog farms in Arkansas
AFO-O	AFO Runoff-Nutrients in OK	Runoff from animal feeding operations including poultry, dairy, beef, and hog farms in Oklahoma (or not specified)
AR	Agriculture runoff	Runoff from agricultural areas; includes cattle grazing areas, but not AFOs.
BEH	Inappropriate Behavior	Any behavior problem other than alcohol & drugs, or trespassing.
BEH-A		Behavior involving alcohol or drugs
BEH-T		Unauthorized movement onto private property
CATL	Cattle	Cattle accessing and defecating directly into the river.
CONFL	Conflict	Conflicts among stakeholder groups in the basin.
CR-C	Crowding from recreationists	Crowding on the river by large numbers of recreationists.
CR-S	Over population	Over population in the basin by residents.
DEV	Development	Building, structures, and clearing
ECH	Ecological Health	Unspecified concerns over wildlife, biodiversity, habitat, etc.
ER	Erosion	Erosion from any area source land clearing, deforestation, unpaved roads, Lake Francis, gravel mining, etc.
HF	Hunting, Fishing, etc.	Sport use of the river
HHC	Human Health Concerns	Unspecified concerns over threats to human health by sickness or disease.
ID	Industrial Discharge	Effluents from industries or businesses.
LT-C	Litter & Trash from Recreationists	Discarding of small trash items in the river by recreationists.
LT-S	Litter & Trash from Residents	Discarding of small trash items near or in the river by residents.
MED	Media Stigmatization	Unjustified media sensationalism of problems contributing to negative image of basin.
NonPNT	Non-Point Source	Unspecified non-point source pollution
NR	Nursery runoff	Runoff from plant nurseries
OSRC	Oklahoma Scenic Rivers Commission	Concerns over the mismanagement of the basin by the OSRC
PNT	Point Source	Unspecified point source pollution
REG	Government Regulations	Unspecified government regulations
RPRN	Riparian Areas	Concerns involving riparian (streamside) areas.
SAF	Safety	Unspecified concerns over floating, crime, accidents, etc.
SS	Septic System Leachate	Groundwater moving from domestic septic-drain fields laden with nutrients.
UD	Urination/Defecation	Defecation and urination directly into the river and dumping of sewage from houseboats by recreationists.
UR	Urban Runoff	Runoff from urban areas, including roads, businesses, and residences.
VD-A	Vegetative Debris Accumulation	Piles of vegetative debris
VD-R	Vegetative Debris Removal	Removal of log jams and other vegetative debris for recreation
WCD	Water Craft Discharges	Oil & gas discharges from watercraft.
WQ	Water Quality	Concerns regarding the quality of the water in the river.
WS-L	Inadequate Water Supply	Lack of drinking water supply due to poor water quality
WS-N		Lack of water due to water withdrawals
WW-A	Municipal WWTP Effluents in Arkansas	Effluent from domestic wastewater treatment plants in Arkansas; includes concerns about phosphorus.
WW-O	Municipal WWTP Effluents in Oklahoma	Effluent from domestic wastewater treatment plants in Oklahoma; includes concerns about phosphorus.

Table 2

Impact Categories Found in Water Quality-Focused Concept Maps

Impact Category Code[12]	Number of Maps with This Category	Relative Importance			Perceived Knowledge			Number of Associations with "Self" Card
		High	Medium	Low	High	Medium	Low	
WQ	100	**89**	9	2	**58**	4	37	**58**
AFO-O	93	**57**	29	7	**41**	14	38	12
LT-C	90	17	**40**	33	**50**	13	26	13
NR	61	15	**27**	19	19	18	**24**	2
WW-A	57	**35**	15	7	13	14	**30**	7
UD	53	10	21	**22**	14	**20**	19	8
WW-O	51	**24**	21	6	16	15	**20**	2
SS	43	11	**19**	13	15	12	**16**	2
BEH-A	33	12	**13**	8	**22**	4	6	8
ER	31	**14**	11	6	23	7	**32**	12
BEH	27	7	**16**	4	**13**	4	10	5
CR-C	27	7	9	**11**	**13**	3	11	5
CATL	24	4	9	**11**	**10**	5	9	2
AFO-A	21	**16**	3	2	4	3	**14**	4
UR	18	2	**12**	4	4	4	**10**	1
AR	11	**5**	**5**	1	**8**	3	3	2
WS-N	11	3	3	**5**	**6**	2	3	1
CR-S	9	**5**	3	1	**5**	2	2	3
LT-S	7	**3**	2	2	**5**	0	2	1
DEV	6	2	**3**	1	0	1	**5**	0

Bold numbers indicate modal (most frequently encountered) selections.

[12] See Table 1 for code definitions.

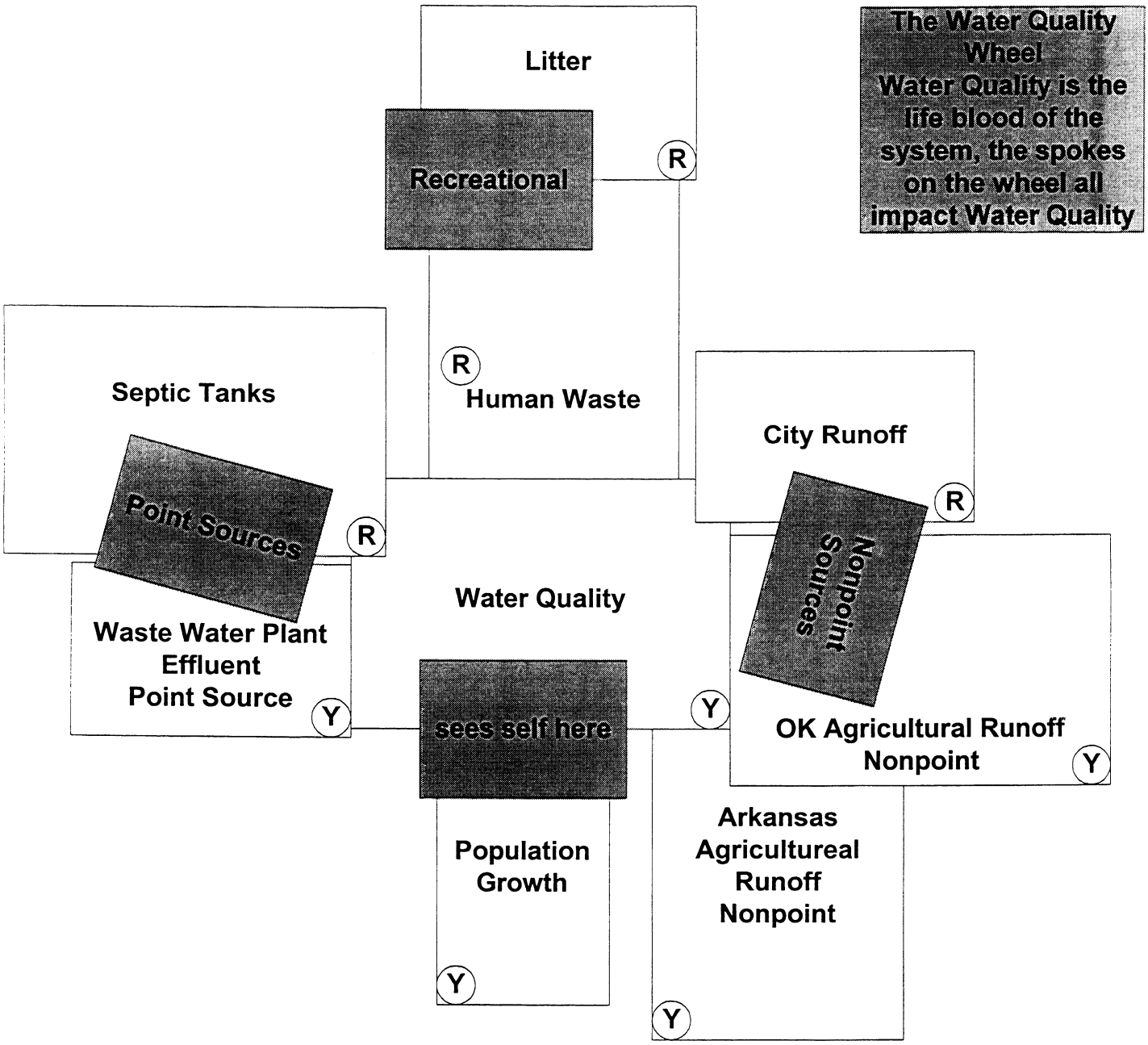

Figure 1. Typical Concept Map Showing One Group Focused on "Water Quality"

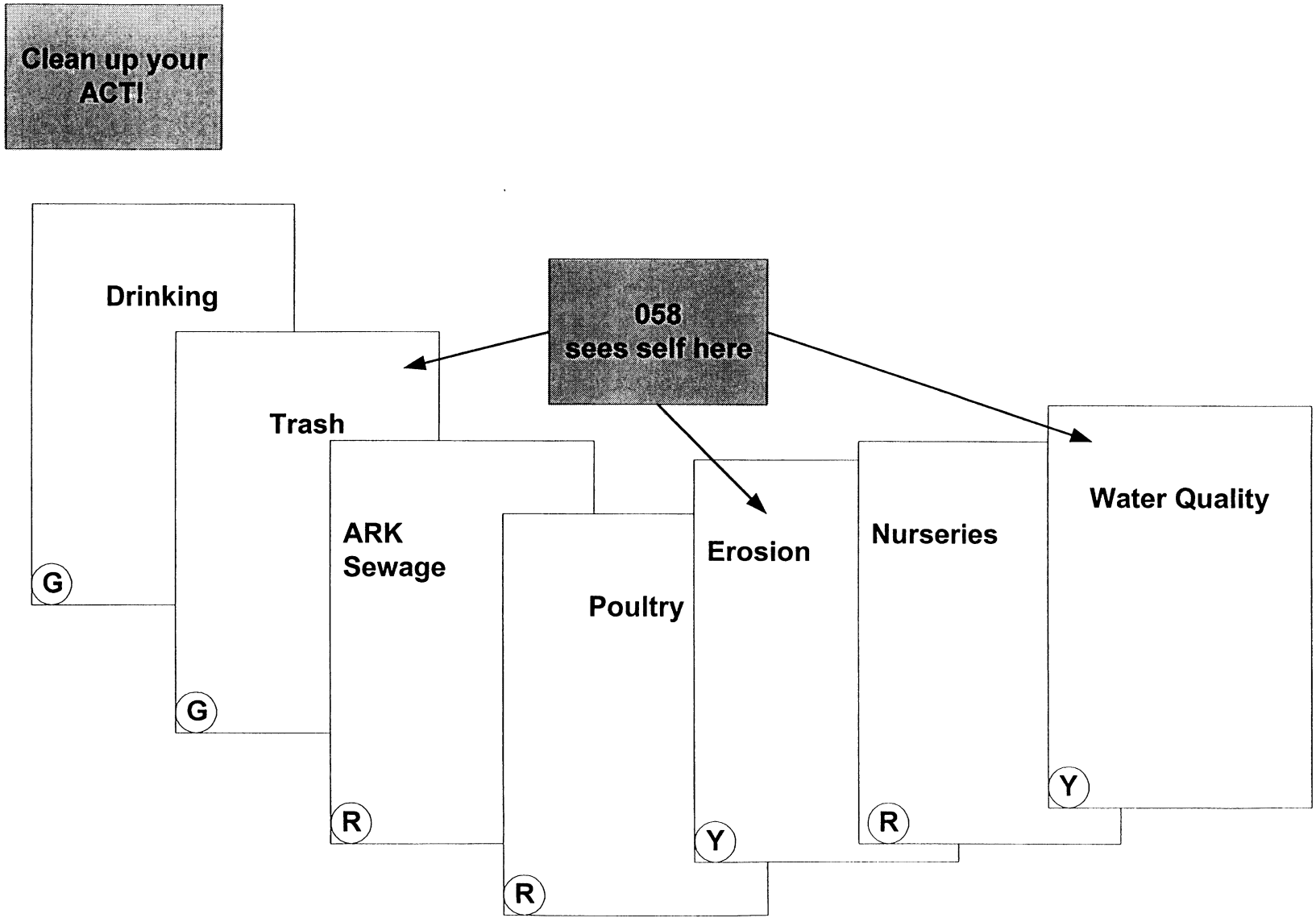

Figure 2. Typical Concept Map Showing Linear Progression from the Anchor "WQ"