Sociocognitive Inquiry

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ABSTRACT

This chapter describes techniques for sociocognitive inquiry based on conceptual grid elicitation and analysis using web-based tools, such as *WebGrid*, which are designed to elicit conceptual models from those participating in a networked community. These techniques provide an interactive web-based experience with immediate payback from online graphic analysis, that provides an attractive alternative to, or component of, conventional web-based surveys. In particular, they support targeted follow-up studies based on passive data mining of the by-products of web-based community activities, allowing the phenomena modeled through data mining to be investigated in greater depth. The foundations in cognitive sociology and psychology are briefly surveyed, a case study is provided to illustrate how web-based conceptual modeling services can be customized to integrate with a social networking site and support a focused study, and the implications for future research are discussed.

INTRODUCTION

There are many significant aspects of social networks that can only be partially modeled through passive data mining techniques, partly because a high proportion of the members of the network are primarily recipients making infrequent contributions, and partly because many community beliefs and values are tacit, and implicitly embedded in its *habitus* (Bourdieu, 1989; Gaines, 2003). In order to extend the models developed through passive data mining and to address issues that may be very relevant to the community but have not been adequately covered through its normal processes, some form of *active inquiry* exploring the sociocognitive structure may be required.

Sociocognitive inquiry provokes network activity through the introduction of materials and processes that generate additional data. Asking provocative questions or initiating new topics are common techniques for provoking natural community activity used by moderators and others with social capital in the network. Questionnaires provide a more structured technique for obtaining specific data from members but can be unattractive because they require time and effort to complete, usually have no immediate payback to the individuals completing them, and do not allow the emergence of topics beyond those originally conceived in the questionnaire design.

This chapter presents computer-based *conceptual modeling* techniques (Gaines & Shaw, 1989; Gaines & Shaw, 2010) as a means of exploring the sociocognitive structure of networked communities on the Internet in a way that is socially acceptable and supportive of the communities and those studying them. It demonstrates how the modeling process is itself interesting and stimulating, and how the ongoing online analysis provides an immediate payback to individual members by reflecting back to them their personal conceptual models.

It describes and illustrates techniques for comparing models, and the graphic output presenting individual models, pairwise comparisons, and sociocognitive networks derived from them that can be analyzed by standard social network analysis techniques. It exemplifies the way in which the technology may be used to support networked communities, and discusses the issues involved in using it in this way, and the outcomes both in targeted studies and in long-term community support. It shows how active sociocognitive inquiry can enhance and complement existing social mining techniques, and be used to follow-up preliminary models from data mining with more detailed models based on, and refining, that research.

BACKGROUND

Empirical study of social networks has been based primarily on behavioral data, on observing what and how members of a community are interacting. However social action also has cognitive connotations of being interpreted as *meaningful*. For example, Weber (1968, p.4) defines *action* as human behavior to which the acting individual attaches subjective meaning, and *social action* as that whose subjective meaning takes account of the behavior of others. Weber's definition captures the cognitive aspects constitutive of all social interaction, but is not in itself sufficient to guarantee that the interaction will take place in the context of a social group or community. One person could be acting socially with respect to one or more others, without those others being aware of it, attributing similar meaning, or reciprocating.

Gilbert (1992, p.153) captured the essential cognitive nature of social interaction in a community, drawing upon Simmel's (1910, p.374) notion that members' consciousness of being a unity is what constitutes that unity, and proposing that "*We* refers to a set of people each of whom shares, with oneself, in some action, belief, attitude, or other such attribute." That is cognitive commonality is constitutive of a social group or community. Again, the commonality does not guarantee the existence of the social group—there could be commonality among people who have never met but share a culture—but is what constitutes the *meaning* of membership to those in a social group or community.

Cognitive commonality is itself a difficult notion, with connotations of collective cognition (Gaines, 1994; Resnick, Levine, & Teasley, 1991), collective rationality (Gaines, 2010; Goldberg, 2010), organizational knowledge (Gaines, 2003; Weick, 1995) and the extent to which we do actually use what we regard as shared concepts in the same way (Shaw & Gaines, 1989). Hattiangadi (1987, p.15) notes that "our understanding of language is approximate—I do not believe that we ever do understand the *same* language, but only *largely similar* ones." A miracle of human social existence is that we manage to "muddle through" despite major lack of cognitive commonality (Fortun & Bernstein, 1998). Computer tools for eliciting conceptual models intrinsically have the same issues as those of a human learner coming to calibrate their cognition against the norms of their communities, and can only lead to approximate models with which we can, hopefully, muddle through in an improved fashion.

In social network mining the behavioral data generated through social interaction provides us with structural information about the network but often what we wish to ascertain are the cognitive commonalities underlying that interaction. What is the *meaning* of that interaction for those participating, what are common underlying *beliefs* and *values*, what *roles* are people playing, perhaps in providing access to relevant *uncommon* knowledge relating to individual experience, expertise, and so on.

In some cases a textual analysis of the discourse (Berry & Castellanos, 2008; Feldman & Sanger, 2007) may provide the cognitive models of interest but, often, the basis of the social interaction is tacit, either because it is presupposed and taken for granted by the participants, or because a substantial part of the community is not taking part in the overt interaction even though they embody the cognitive foundations of that community.

Those members in moderator roles may become aware that issues are not being adequately addressed by the community, and attempt to rectify this by provoking particular discussion and engaging more of the community. They may also attempt to use more structured techniques such as surveys through questionnaires.

Web-based surveys have become widely used in recent years (Couper & Miller, 2008) but studies suggest they are not as effective as conventional techniques (Heerwegh & Loosveldt, 2008; Manfreda, Bosnjak, Berzelak, Haas, & Vehovar, 2008). However, the majority of such studies focus on market research and public opinion surveys where the data collected is primarily of interest to those collecting it, there may be little sense of community among the participants, and the survey methodologies have largely been based on the conversion of paper-based surveys to HTML. That is, the user may well find them of *slight interest*, having little of the *expected interactivity* of web-based experiences, and failing to provide the *flow experience* (Gaines, Chen, & Shaw, 1997) and *instant gratification* (Greenfield, 2008) characteristic of well-designed web services and expected by experienced web users.

Recent studies have begun to focus on issues that characterize effective web experience in social networking applications, such as *interactivity* (Bolton & Saxena-Iyer, 2009), *flow experience* (Hoffman & Novak, 2009), *peer discourse* (Dhar & Chang, 2009), *sense of community* (Scarpi, 2010), and so on, and to model the *personality factors* (Brüggen & Dholakia, 2010) of active participants. Conceptual modeling tools supporting a web-based community must enable a moderator to address topics that are core to the interests of the community in such a way as to provide rich experience that takes advantage the interactivity of the web to provide immediate paybacks for members' engagement both as individuals and as community supporters.

WebGrid (Gaines & Shaw, 2007) is a web-based conceptual modeling service based on Kelly's (1955) *conceptual grids* derived from *personal construct psychology* (Gaines & Shaw, 2010). Manual modeling techniques were computerized in the 1970s (Shaw, 1980) and ported to the web in 1994 (Gaines, 1995) as tools for knowledge modeling in expert system development (Gaines & Shaw, 1993a, 1993b). The tools readily integrate with survey methodologies and have the merit of proving instant online conceptual models in graphic form enabling participants to view their own models and compare them with those of others in the community, together with overall socionets of cognitive relations between members, and consolidated conceptual models that show the sociocognitive structure of the community.

The next section outlines the socio-psychological foundations of the method and its links with theories of social action, and the following section provides a case history illustrating their application.

PERSONAL CONSTRUCT PSYCHOLOGY

Kelly's (1955) *personal construct psychology* provides a framework for conceptual modeling based on Dewey's pragmatic instrumentalism that models the future-orientation characterizing living systems. Dewey (1910) saw our conceptual systems as forming in order to be able to anticipate a world that had sufficient coherence in time for such anticipation to be reasonably effective and provide evolutionary advantage. Hume (1888) had noted that there is no logical rationale for it to be possible to anticipate future events, and hence it is an empirical phenomenon that the world we live in often exhibits patterns that enable future experience to be anticipated from past experience. As Dewey (1911) notes: "While there is no a priori assurance that any particular instance of continuity will recur, the mind endeavors to regulate future experience by postulating recurrence. So far as the anticipation is justified by future events, the notion is confirmed. So far as it fails to work the assured continuity is dropped or corrected."

Kelly based his constructivist psychology on Dewey's insights, taking anticipation as the generative principle underlying all psychological phenomena, that "a person's processes are psychologically channelized by the ways in which he anticipates events" (Kelly, 1955, p.46), and deriving all other aspects of psychological processes as corollaries of this fundamental postulate. His first corollary is that of *construction*, that "a person anticipates events by construing their replications", where: "By construing we mean 'placing an interpretation': a person places an interpretation upon what is construed. He erects a structure, within the framework of which the substance takes shape or assumes meaning. The substance which he construes does not produce the structure; the person does" (Kelly, 1955, p.50).

Kelly uses a *templet* metaphor for our constructive processes: "Man looks at his world through transparent patterns or templets which he creates and then attempts to fit over the realities of which the world is composed. The fit is not always very good. Yet without such patterns the world appears to be such an undifferentiated homogeneity that man is unable to make any sense out of it. Even a poor fit is more helpful to him than nothing at all." (Kelly, 1955, p.8-9).

One can use the more common term, concept, in place of templet providing one notes that: fitting a templet or concept to experience may be not only a classification but also the setting of appropriate parameters in a *model* or *theory*, and the derivation of its consequences; and that fitting a templet or concept can be an *action* changing the world to induce the fit, not just a passive process of perception of whether an templet or concept fits an experience. Dewey and Kelly accommodate within the term anticipation: *prediction* of what may happen; *action* to make something happen; *imagination* of what might happen or be made to happen; and *preparation* for eventualities that may well never happen.

Kelly's (1955, p.56-64) "organization" and "dichotomy" corollaries focus on the relations between templets/concepts, that fitting one implies that some others are entailed by it and also fit, and some others are negatively entailed, or opposite to it, and do not. He saw a triple of concepts with two in opposition but entailing a common superordinate as a fundamental psychological structure that he termed a *construct*. He saw the relations of entailment and opposition as fundamental constraints upon the meanings being imposed on experience, noting that "no construct ever stands entirely alone; it makes sense only as it appears in a network" (Kelly, 1955, p.304).

The network of constructs used by an individual in a certain role is constitutive of that role and of the individual's actions in behaving in that role (Shaw, 1985). Kelly models social action in terms of two more corollaries to his fundamental postulate. His "commonality corollary: to the extent that one person employs a construction of experience which is similar to that employed by another, his psychological, processes are similar to those of the other person" (Kelly, 1955, p.90) captures the cognitive commonalities that constitute a culture. His "sociality corollary: to the extent that one person construes the construction processes of another, he may play a role in a social process involving the other person." (Kelly, 1955, p.95) captures the capability to understand another's culture within the framework one's own.

CONCEPTUAL GRIDS

Kelly developed a method for eliciting the construct system of a person in a particular role or domain that focused on the dimensions of opposition of the constructs significant to acting within that role, the distinctions critical to anticipation in that domain. His method involves the selection of a range of stereotypical elements of experience characterizing the domain, and then eliciting the constructs used to classify those experiences in terms of their similarities and differences. He terms the matrix of elements classified by the constructs a *conceptual grid*, and describes how the network of relations between the constructs can be derived from it as a conceptual model, and how grids may be compared to derive relations between the conceptual models of different people (Kelly, 1955, p.297-308). Kelly's (1955, ch.5) "Role Construct Repertory Test" is a conceptual grid in which the elements are various roles significant in the life of the person being tested, such as "your mother" or "the most interesting person whom you know personally," and his generic conceptual grid has come to be called a "repertory grid" in much of the literature.

His grid technique for eliciting conceptual models became widely used in a wide variety of disciplines such as education (Pope & Keen, 1981), clinical psychology (Kirkcaldy, Pope, & Siefen, 1993), management studies (Tan, Tung, & Xu, 2009; Wright & Cheung, 2007), consumer preferences (Earl, 1986), market research (David & Dale, 2000; Heine, 2009), knowledge modeling (Gaines & Shaw, 1993a; Shaw & Gaines, 1983), expert system development (Boose, 1986; Gaines & Shaw, 1993b) and modeling industrial and scientific communities (Gaines & Shaw, 1994; Shaw & Gaines, 1991a).

Shaw (1978, 1980) computerized conceptual grid elicitation and analysis in the mid-1970s and developed algorithms for their automatic interactive elicitation guided by online analysis, and for their comparison in such a way as to model the cognitive relationships between individuals in a sociocognitive network (Shaw, 1979; Shaw &

Gaines, 1989). In 1994, as interactive forms became available on the web, Shaw's conceptual grid tools were reprogrammed as web services (Gaines, 1995; Gaines & Shaw, 1997; Shaw & Gaines, 1996) and have been extensively used to develop conceptual models of distributed online communities.

Conceptual grid services, such as WebGrid 5 (Gaines & Shaw, 2009), now utilize CSS and Javascript to make the elicitation and analysis processes highly customizable and readily integrated with other social network services, and the servers are completely script-driven so that all aspects of the interaction, such as the vocabulary or language used, can be modified for the purposes of particular communities and applications. This enables conceptual modeling to be integrated seamlessly with other activities on social network sites, and be made an integral component of survey methodologies. Since multimedia representations of the elements being construed can be readily incorporated, ongoing analysis is used to prompt the user with suggestions related to their previous entries, and continuously updated conceptual models are available throughout the elicitation, the interactivity and instant gratification expected of the web is well supported.

Details of the psychological foundations, methodology, technology and a range of applications are available elsewhere (Gaines & Shaw, 2009) and are best illustrated for the purposes of this chapter by a brief example as presented in the next section.

WEBGRID IN ACTION

To illustrate conceptual grid elicitation and analysis we will use an example from a ballroom dance community that coordinates its activities through a web site providing it with an event calendar, bulletin board, interactive blog, photo archives, and so on. The organizing committee wished to poll all members' opinions on some controversial issues regarding the form, content and timing of events but knew from past experience that the response rate would be low and unrepresentative. The webmaster, whose nickname on the community web site was *pasoman*, decided to try and engage more members by incorporating conceptual modeling in an area of general interest in the survey.

He used a generally available WebGrid server and entered an initial grid whose elements were the ten standard international ballroom dances. He used the server's option to register a cache in order to manage the collection of grids from others based on the elements in his grid. He also used the option to customize the styling of the elicitation dialog in such a way that it appeared to be an integral part of the community's web site. He embedded the survey questions of the poll in the dialog in the same way. He then linked the community web site to a url provided by the WebGrid server with a request to all members to respond to the survey, sending the request out by email and through leaflets distributed at the dances also.

Figure 1 shows the first screen of the conceptual grid elicitation being filled in by a member whose nickname on the web site was *jazzlady*.

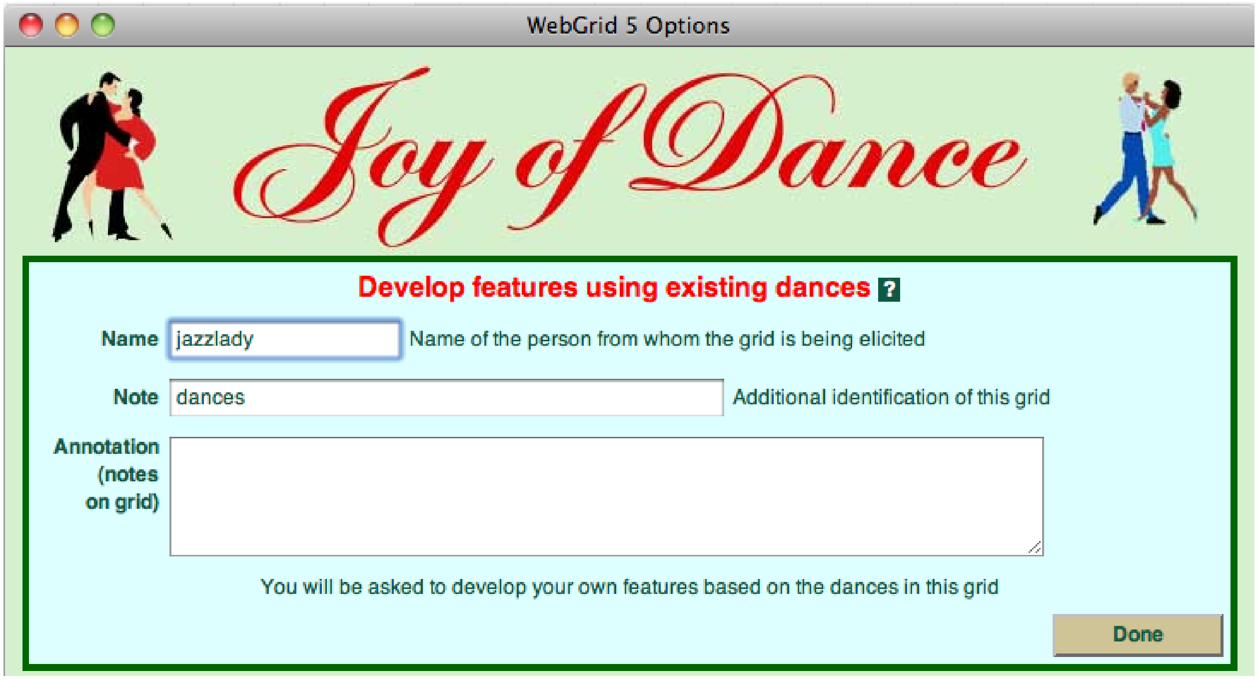

Figure 1 Initial screen of conceptual grid elicitation

When she has entered her nickname she clicks “Done” and is taken to the screen shown in Figure 2 where she is presented with three of the dances and asked to distinguish between them. She selects “slow foxtrot” as different from “cha cha” and “jive” because it is very much more difficult to learn, and enters the distinguishing terms “poor dance to learn as a beginner” and “good dance to learn as a beginner.”

Figure 2 Eliciting a distinguishing construct by comparing elements

When she clicks on the “Add feature” button she is taken to the screen shown in Figure 3 where she is presented with a list of all the dances together with popup menus allowing her to rate them on a scale whose end points are the terms she entered. A scale is normally used because most distinctions are gradable rather than black and white and it is natural to rate elements between the extremes. The number of points on the scale and the terms used for “element” (dance) and “construct” (feature) were chosen by the moderator when setting up the initial grid. The screen in Figure 3 also provides the option to edit the distinguishing terms that have been entered and to re-rate the elements distinguished in Figure 2. The “Update” button refreshes the screen if the terms are changed and also presents the element list sorted by the ratings so that the user can see if the rank order is what she intended.

Figure 3 Rating all the elements

When she clicks "Done" she is taken to a screen similar to that of Figure 2 where she is presented with a new set of elements and asked to enter another construct. After she has entered three constructs she is taken to the screen of Figure 4 which is the main feedback and analysis screen in WebGrid. The centre two sections are lists of the elements and constructs with buttons enabling selected ones to be deleted, edited, and so on. Above them is a variable number of sections generated through the ongoing analysis. For example, if two constructs are very similar the user will be prompted to enter a new element that differentiates between them. Below is a set of analysis options, and below that a set of general options.

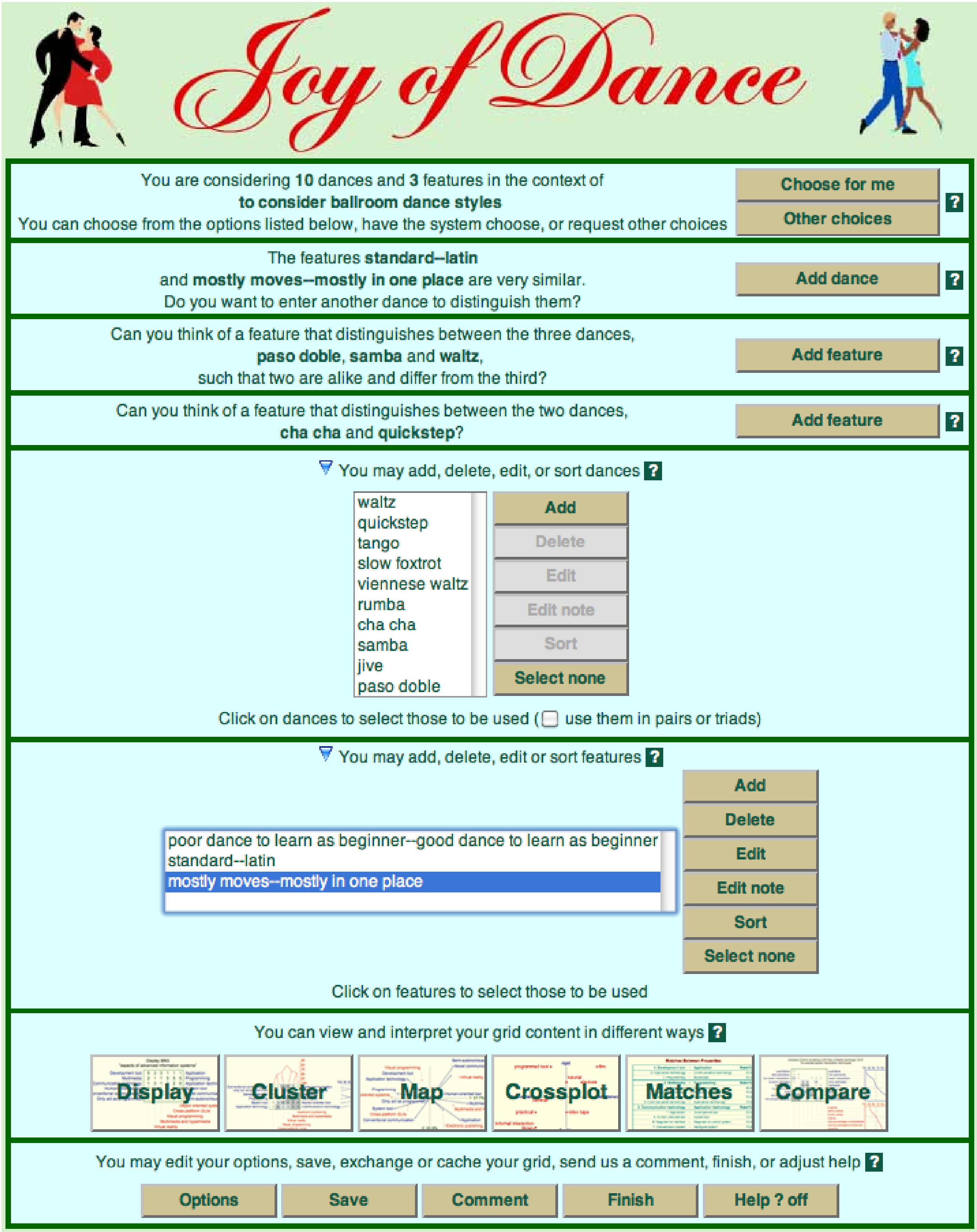

Figure 4 Main WebGrid feedback and analysis screen

To illustrate a conceptual grid, Figure 5 shows the screen when jazzlady clicks on the "Display" button to see the three constructs she has entered.

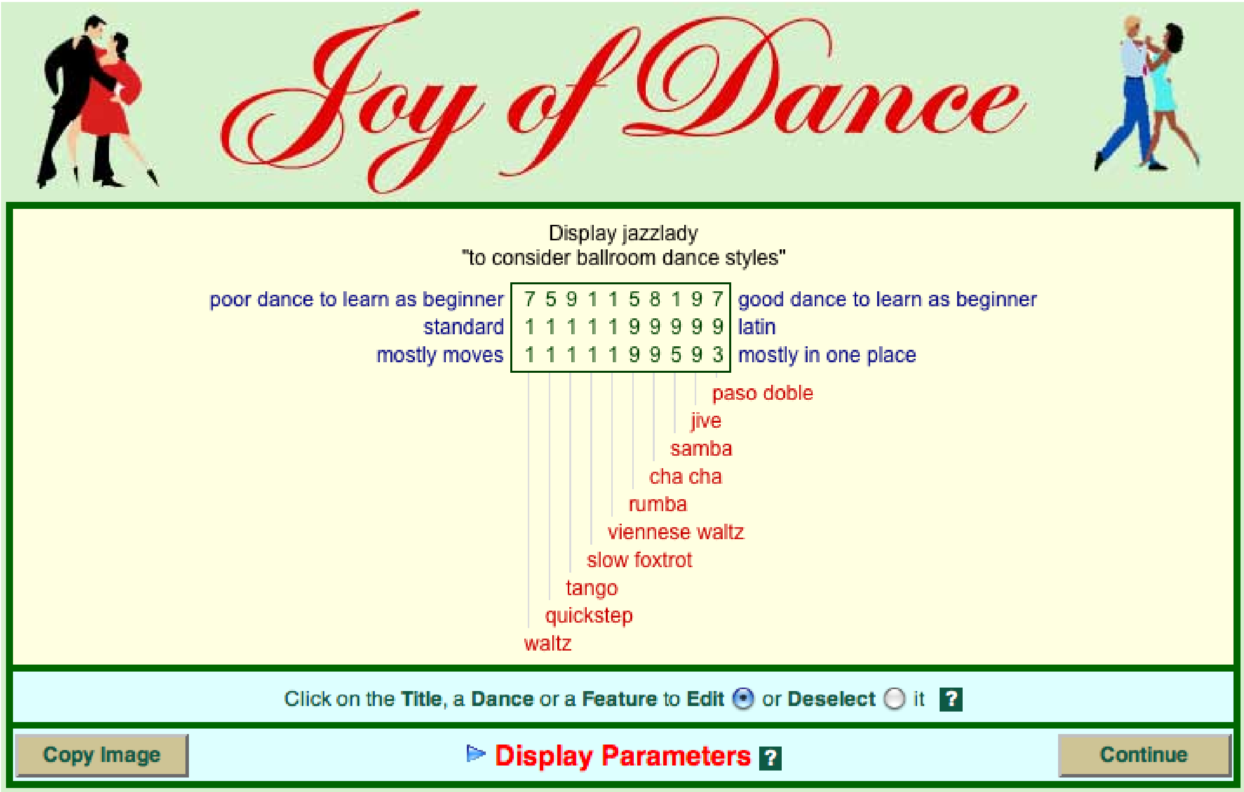

Figure 5 Display of initial grid when three constructs have been elicited

Figure 6 shows the screen when she is ready to finish after entering another seven constructs. She has also entered two more elements: “bolero” to reduce a match between the constructs “standard—latin and “keep flat—rise and fall”, and “west coast swing” because she enjoys dancing it. There are five options at the top, two of them being based on the online analysis that the elements “tango” and “paso doble”, and the constructs “standard—latin” and “mostly moves—mostly in one place”, are highly matched. Such matches prompt the entry of additional constructs and elements, respectively, and are what encourages the ongoing elicitation process as the conceptual grid is developed.

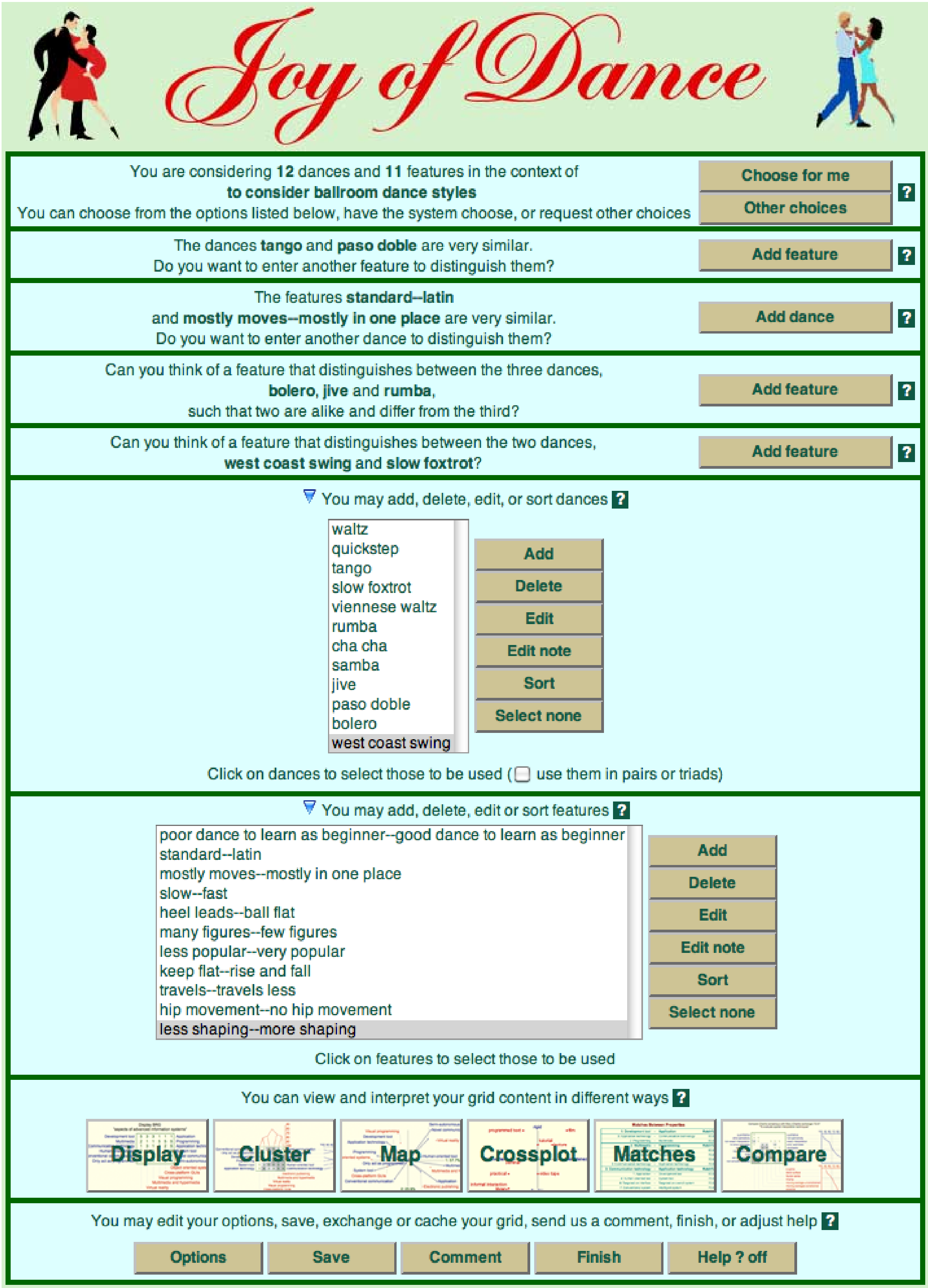

Figure 6 Main WebGrid screen after eleven constructs have been elicited

At any time during the elicitation process the user can click on one of the analysis buttons and see the conceptual model resulting from the grid that has been entered so far. Figure 7 shows a hierarchical cluster model of jazzlady's construct system generated when she clicks on the "Cluster" button.

Figure 7 Hierarchical cluster model of the construct system

In her construct clusters at the top she can see that she uses the constructs, "standard—latin", "heel leads—ball flat", "mostly moves—mostly in one place" and "travels—travels less" to make similar distinctions. In general her constructs are different significant dimensions of the way she construes similarities and differences in the dances of her community.

In her element clusters at the bottom she can see that the standard and latin dances form separate clusters, except that paso doble is in the standard cluster which makes sense because it is more similar in many respects to tango (which is classed as “standard”) than to the other “latin” dances. In general her element clusters represent those she would expect in her community.

The graphic output is interactive and she can click on an element or construct to adjust the ratings if she feels they are leading to meaningless matches. She can also break matches by entering new elements or constructs, for example, as she did when recollecting that the bolero is a latin dance that has rise and fall,

Figure 8 shows an alternative conceptual model of jazzlady’s construct system generated when she clicks on the “Map” button.

Figure 8 Principal components model of the construct system

There appear to be three major dimensions differentiating the dances: horizontally, the latin versus standard distinction; vertically one of ease of learning and popularity; and from bottom left to top right one of shaping and rise and fall. These are ones that would all be recognized by other dancers in her community, and the dances are located in a meaningful way in relation to these dimensions.

Figure 9 shows a comparison of jazzlady's construct system with that of pasoman generated when she clicks on the "Compare" button.

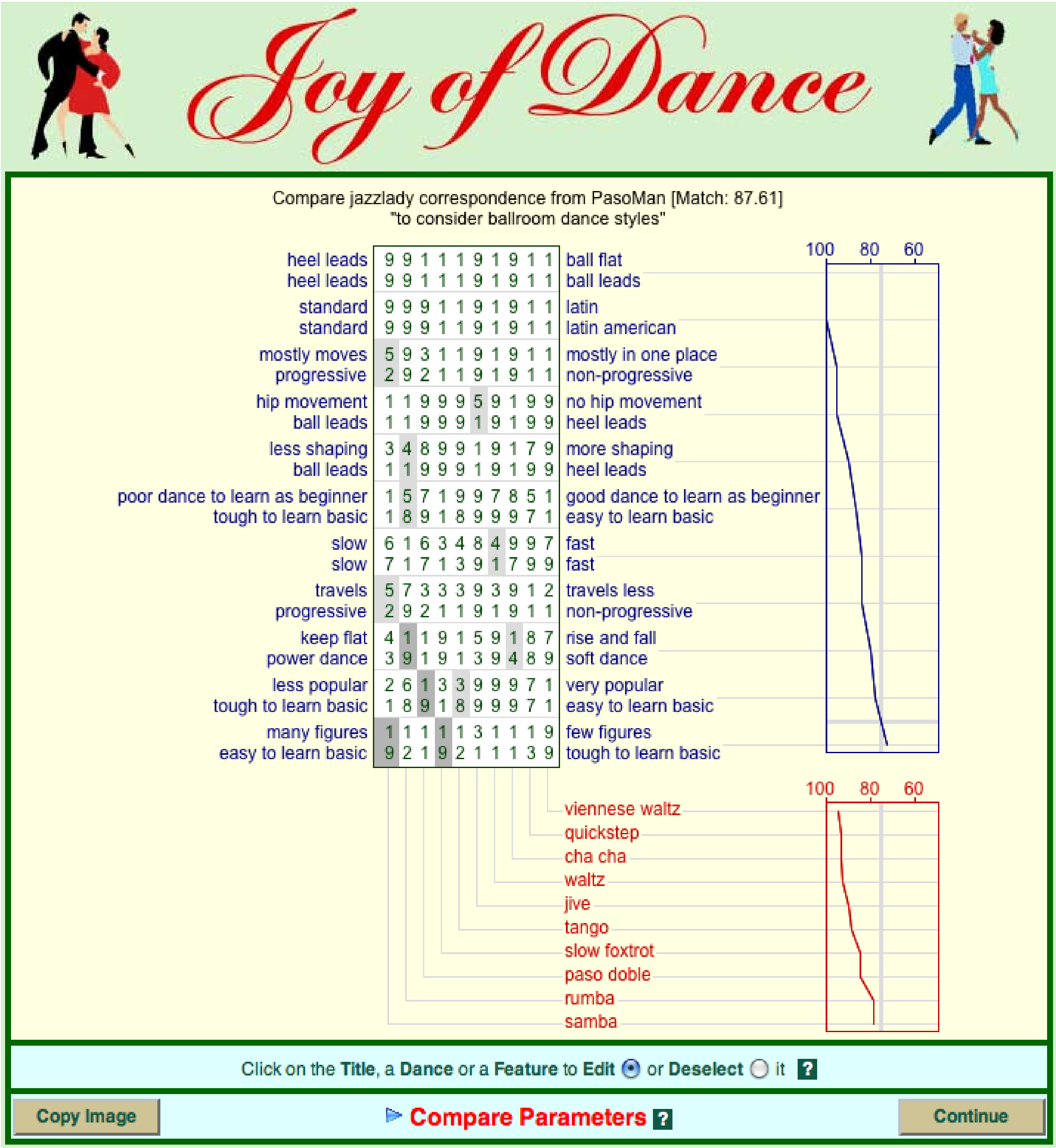

Figure 9 Comparison of two construct systems

WebGrid has taken each construct in jazzlady's system, found the closest match in that of pasoman, and sorted the grids in order of declining matches. At the top right she can see that she and pasoman use the top eight dance constructs "heel leads—ball leads", “standard—latin”, and so on, in much the same way, and that what she construes as a “poor dance to learn as a beginner” he construes as “tough to learn basic”, and “travels” as “progressive”. It seems reasonable that rise and fall is associated with soft dances, and that very popular dances are easy to learn, but pasoman appears to have no construct matching jazzlady’s “many figures—few figures” which contrasts the Viennese waltz with all the other dances.

Jazzlady has enjoyed thinking about the dances that she enjoys in her ballroom dancing, has developed models to explore how she construes them, and has identified the relations between the distinctions she makes in her conceptual framework and those of others. Her experience in doing so has had the usual rich interaction and immediate gratification she expects from the web. She has incidentally learnt to use the WebGrid functionality and would be happy to undertake another grid elicitation on the more controversial topics and choices about which the organizing committee would like to survey members, or to answer those questions directly as part of her WebGrid interaction.

PAYBACKS TO INDIVIDUALS AND THE COMMUNITY

The paybacks to individuals in the WebGrid elicitation process come through the ongoing feedback suggesting relations between their constructs and elements using their own terminology, the instant conceptual analysis in graphic form, and the comparisons with others in graphic form. There is also a payback to the community as a whole through the promotion of discussion on the web and the analysis of the entire collection of grids that have been elicited.

Rep 5 (Gaines & Shaw, 2009), the suite of conceptual modeling tools of which WebGrid is part, also contains RepSocio, a tool for analyzing multiple grids. Figure 10 shows a sociocognitive network derived by comparing ten conceptual grids elicited by WebGrid in the same way as that of jazzlady. The measure of overall match between conceptual models shown at the top right of the comparison in Figure 9 is asymmetric since one person may have constructs that correspond to all those of another but not vice versa. Hence pairwise comparison of a set of grids results in a weighted directed graph.

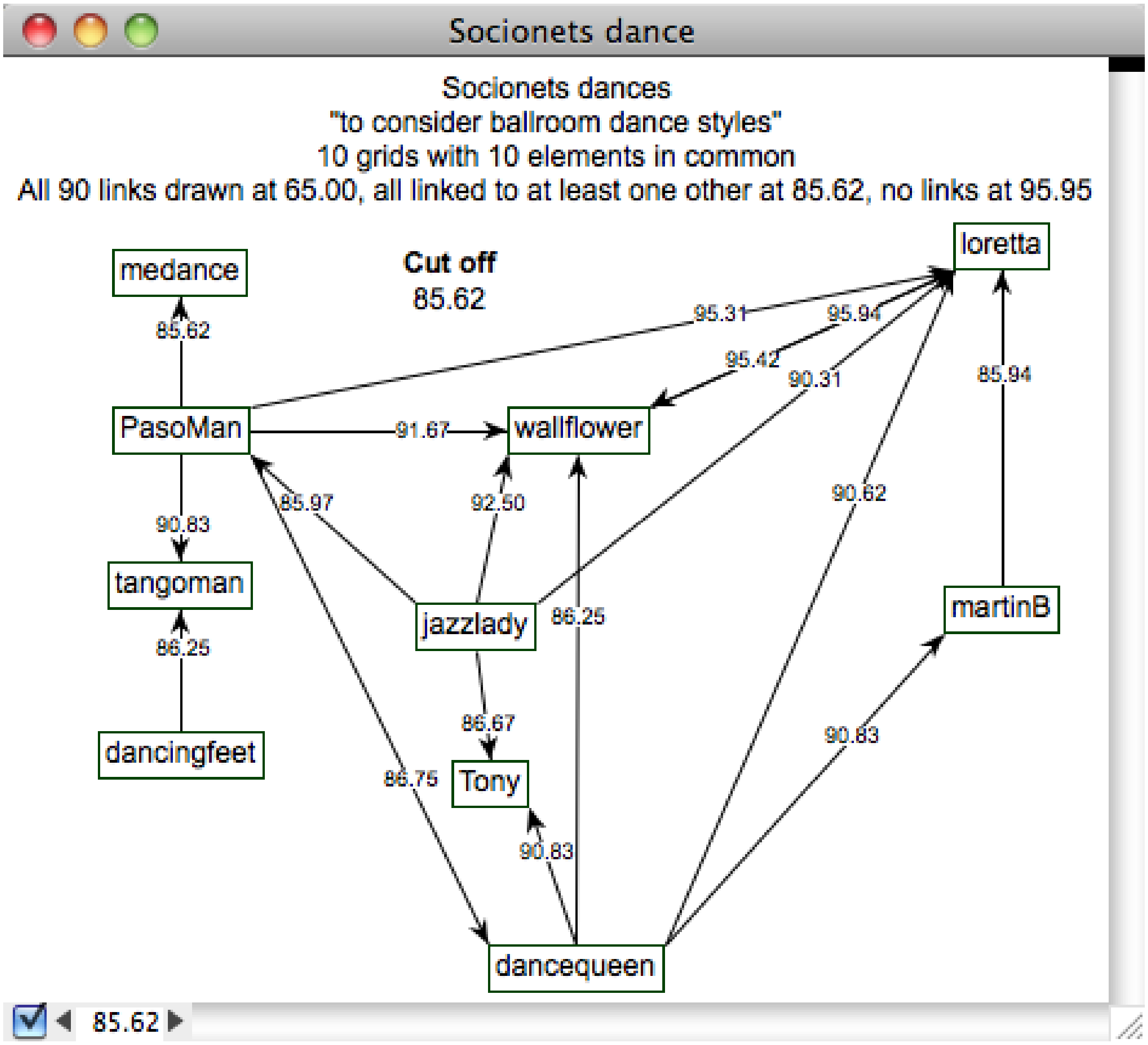

Figure 10 Sociocognitive network based on comparisons of conceptual grids

The socionets tool displays this weighted directed graph, allowing a threshold to be specified such that an edge will only be displayed if the match it represents is at or above that threshold. In Figure 10 the threshold control is at the bottom left and enables a minimum match to be typed in, or the match adjusted by clicking on the arrows to left and right of it to lower the threshold and increase the number of edges shown, or raise it and reduce them. The check box specifies whether the edge weights will be shown on the graph. The graph shown has the threshold set at the highest level at which all nodes are connected.

We term the graph a sociocognitive network rather than a social network because it represents the shared meanings (Batchelder, 2002; Fuhse, 2009) between participants in a social network rather than their behavioral interactions. Sociocognitive network models provides additional information to behavioral studies and, together, the two types of structure provide a multi-dimensional model (Chopra & Wallace, 2000;

Krackhardt, 1987) of the social network. For example, the strong mutual linkage of loretta and wallflower in Figure 10 does not indicate they are interacting strongly, but that, if they did so, they would understand one another, at least on the topic of the relations between different dances. The links in a sociocognitive network may correspond to the shared meanings of those who are already interacting, or the potential or power to interact of those who have not so far done so. Shaw and Gaines (1991b) demonstrated a pre-web system of networked personal computers, *RepGrid-Net*, at CHI'91 designed to allow participants at a conference to discover like-minded participants with whom they were not acquainted based on the elicitation of a sociocognitive network.

RepSocio can also provide a consensual conceptual model for the entire community using a Procrustes analysis technique (Gower & Dijksterhuis, 2004) where everyone's constructs are ranked in terms of the average best match in all other grids. The top ranked constructs are then combined in a conceptual grid that models the distinctions common across the community, termed a *mode* or *consensus grid* (Shaw, 1980). Figure 11 shows a principal components analysis of such a consensus grid derived from ten participants in the dance community study.

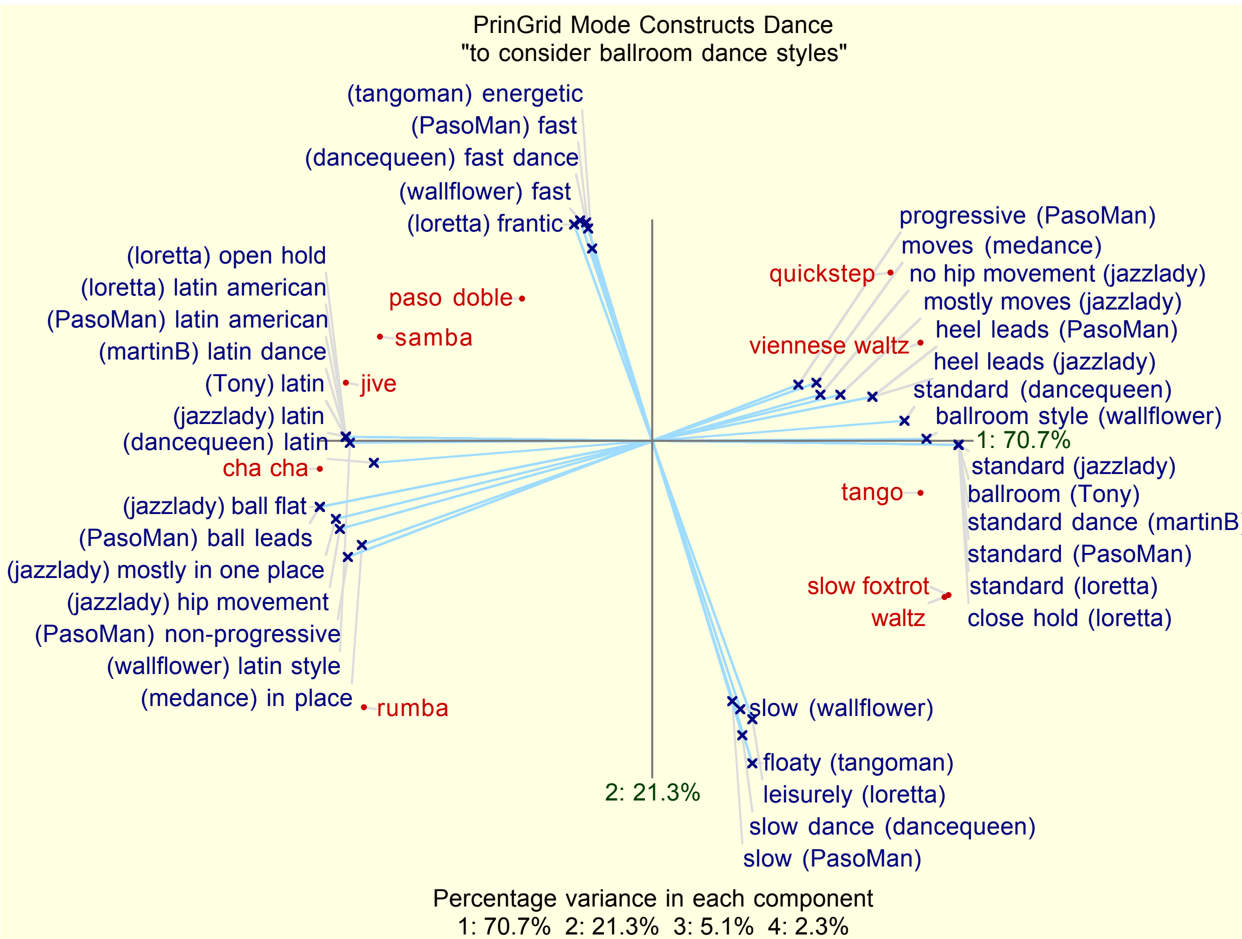

Figure 11 A consensus conceptual model based Procustes analysis of multiple conceptual grids

It can be seen that there are two major dimensions agreed across the community: one representing the “standard—latin” distinction; and the other the “fast—slow” distinction. These are the primary parameters that a ballroom dance DJ uses in putting a program of dances together, providing a balanced mixture of standard and latin dances, and ensuring that fast and slow dances are interlaced so that not too many of the same type occur closely in sequence. The way the dances themselves cluster in Figure 11 would also make sense to any member of the community.

What is missing from a consensual picture is the idiosyncratic conceptual structures of those individuals or special-interest groups that go beyond the normal consensus, for example, in the dance community of those concerned with the techniques necessary to pass medal tests, or the flair necessary to win competitions. Such sub-cultures can also be derived through use of the RepSocio analyses.

FUTURE RESEARCH DIRECTIONS

Since the commercialization of the World Wide Web in 1995 the growth of the web and Internet has followed an exponential trajectory and become an integral part of everyday life in western society (Gaines, 2006). There are special interest communities on the web nowadays that did not previously exist, and they operate through new modes of social interaction that are difficult to model within our existing human sciences. These communities create by-products that are generally publically available to those who are not part of the community and may be unaware that it exists, and these artifacts are readily accessible as knowledge sources through the powerful search technologies that have co-evolved with the web.

The success of Google’s search engine is based on its use of social linkages between web materials to enhance keyword search, and its PageRank (Langville & Meyer, 2006) web mining techniques are analogous to human information retrieval techniques (Griffiths, Steyvers, & Firl, 2007). However, the socio-cognitive foundations of web mining techniques are currently very weak. We do not have adequate theories of communities, their meaning formation processes, and the way that these generate and constrain social action. There is a wealth of relevant material, such as that of Simmel, Dewey, Weber, Kelly, Bourdieu, Gilbert, Weick, Hattiangadi and Goldberg, already cited, and others such as Mead (1934), Schutz (1943), Wolff (1976) and Tuomela (2007), whose collective works provide a rich framework integrating human meaning, culture and society, but there is, as yet, no comprehensive account that draws on these to provide theoretical foundations on which to base models of web-based communities and associated data mining and modeling techniques.

Thus, one very important future direction for the research area reported in this chapter is to encourage the development of stronger theoretical foundations for human socio-cognitive activities, for example, by making web data mining tools readily accessible to empirical social scientists. Web-based communities provide a rich, instrumented resource of, often post-modern, socio-cognitive phenomena, and collaboration between tool developers, empirical researchers in the human sciences, and theorists developing accounts of human social action could advance the differing research agendas of all those involved.

At a technical level, the integration of conceptual modeling tools with social networking technologies is already beginning to take place, as illustrated in this chapter, but web technology cannot, as yet, support all the functionality that is required for some of the major tools. For example, Rep 5 includes the RepNet conceptual network modeling tools that support *concept mapping* (Gaines & Shaw, 1995) and *semantic network* development and inference (Gaines, 2009), integrated with and complementing the conceptual grid tools. These network modeling tools require interactive graphics similar to those of computer-based drawing applications, but support for interactive drawing in web clients is still primitive and unreliable. When interactive scalable vector graphics (SVG, Campesato, 2004) are fully supported by the mainstream browsers it will be possible to port conceptual network modeling tools to the web, integrate them with the conceptual grid elicitation, and text analysis tools, and provide an even richer environment for sociocognitive inquiry.

Thus, another important future direction for the research area reported in this chapter is to encourage the development of increasingly more effective web-based conceptual modeling tools, to make them an integral component of social networking technology, and to promote standards for the interchange and reuse of the resulting conceptual models.

CONCLUSIONS

Sociocognitive inquiry is a framework for targeted studies of the cognitive structures underlying social network activity. It is based on a family of techniques for eliciting conceptual models from web communities through their direct participation in an interactive web-based experience that has immediate payback to those individuals participating. It complements techniques for passive data mining of the by-products of web-based community activities, allowing the phenomena modeled through data mining to be investigated in greater depth, and provides an attractive alternative to, or component of, conventional web-based surveys. This chapter has outlined the relevant background in cognitive sociology and psychology, provided a case study to illustrate how web-based conceptual modeling services can be customized to integrate with social networking sites, and highlighted some significant directions for future research.

ADDITIONAL READING AND ACCESS TO TOOLS

A good entry point for the background sociological literature is Gilbert's (1992) book *On Social Facts* which, while primarily targeted on her arguments for treating collectives as individuals, also surveys the relevant sociological literature. The collective stance she advocates is a useful framework for data mining in social networks and the extended web version of (Gaines, 1994) illustrates its applicability to many aspects of information technology. Good introductions to collective sense-making and knowledge processes in organization are provided in (Weick, 1995) and (Gaines, 2003).

For those primarily interested in using the tools described, or implementing similar ones:

The software manuals and tutorials for Rep 5 and WebGrid are accessible at http://repgrid.com

A open access WebGrid 5 service is accessible at http://gigi.cpsc.ucalgary.ca:2000

Relevant papers and reports are available http://cpsc.ucalgary.ca/~gaines/reports/

The psychological background is still best provided by Kelly's (1955) book on *Personal Construct Psychology*. A concise introduction with a computational slant is provided in (Gaines & Shaw, 2010). WebGrid development is described in (Gaines & Shaw, 2007). The algorithms for conceptual grid elicitation, clustering, matching, sociocognitive network production and consensus mode grids are in (Shaw, 1980), and those for principal components analysis in (Gower, 1966; Slater, 1976, 1977).

KEY TERMS AND DEFINITIONS

Concept: a templet that an agents fits to a new experience in order to be able to match it to past experiences and hence anticipate unknown aspects of the new experience from known aspects of the old.

Concept network: concepts do not stand alone but are embedded in a network of logical relations with other concepts: *entailment*, that fitting one concept implies that others also fit; and *opposition*, that fitting one concept implies that others do not fit.

Construct: a minimal concept network that Kelly saw as the basic psychological structure with which we classify experience in which two concepts in opposition both entail a third constituting their range of applicability or *relevance*.

Meaning: the conceptual structure that an agent fits to an experience and interprets as making that experience meaningful.

Construe: the constructive process of making experience meaningful, often termed *cognition*.

Community: a collection of agents each of whom construes themselves as a member of the community, and usually manifesting other common construing constituting the *culture* of the community.

Conceptual grid: a matrix for an individual or community of the concepts that they have fitted to a set of elements of experience, often termed a *repertory grid*.

Sociocognitive: pertaining to the construing of a community, its sub-communities and its members.

Sociocognitive network: a weighted directed graph with agents as nodes that models the commonality of construing between them.

Rep 5: a suite of conceptual modeling tools based on personal construct psychology.

WebGrid: a component of Rep 5 that provides a user interface to many of the tools through a web client, allowing them to be used both locally and over an intranet or the Internet.

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