Publication II

Mikko Berg, Topias Marttila, Mauri Kaipainen, and Ilpo Kojo. 2006. Exploring political agendas with advanced visualizations and interface tools. e-Service Journal, volume 4, number 2, pages 47-63.

# Exploring Political Agendas with Advanced Visualizations and Interface Tools

**Mikko Berg**
Helsinki School of Economics

**Topias Marttila**
University of Art and Design Helsinki

**Mauri Kaipainen**
Helsinki School of Economics

**Ilpo Kojo**
Helsinki School of Economics

## ABSTRACT

*With Web-based e-services called "election engines," citizens can search for and compare candidates in local and national elections using issue-based questionnaires. The results of such services are generally in the form of search engine lists. However, data on political issues and agendas is very complex, i.e., highly multidimensional. Hence, we argue that relevant voting decisions should not be based on simple search engine results, but on more encompassing cognitive operations. In our project, the service was redesigned to extend the function from a mere search engine to a navigation toolset with real-time feedback. Two types of visualization components, a similarity map and sector diagrams, help citizens to make sense of multidimensional political spaces by facilitating exploration at will. As the result of an extended research project, our redesigned service was published by a major commercial broadcasting company for the Finnish EU elections in June 2004 and in local elections in October 2004.*

**Keywords:** *Election engines, Issue-based questionnaires, Visualization, Similarity map, Sector diagram.*

## INTRODUCTION

In democratic elections, citizens are repeatedly given the difficult task of choosing from many candidates the one that best represents them based on the desired set of goals, means, values, and skills. This is not a straightforward decision, because using one criterion results in a certain order of preference, while using another may result in a completely different order. In other words, the task involves satisfying multiple criteria at the same time. This is too difficult to be solved intuitively, and as a consequence, irrelevant arguments tend to govern voting decisions.

To facilitate this task, a Web service genre of election engines has been in place in every political election in Finland since 1996. Election engines are Web-based search services with which citizens compare the candidates running for elected office and find the right one, using issue-based questionnaires. They have gained immense popularity since their first launch, and by now every major Finnish media company runs an election engine for every election. Because of the great media value of the election engine services, it is virtually compulsory for the candidates to participate. For example, in the Finnish parliamentary elections of 2002, only two out of the 200 candidates elected did not participate in any election engine. Young voters in particular found the information from these services valuable in making their voting decision (Carlson and Strandberg, 2005). They even considered the information to be more valuable than that obtained from conventional news media. In the local elections of 2004, the election engines were also a more significant source of information for the older age groups than the Internet sites dedicated to specific parties and candidates (Moring and Mykkänen, 2005). To our knowledge, only in Finland has this kind of service become such an established part of the political media.

This article discusses the future of this type of public service. First, given that election engine services are popular in the Finnish political system, we decided to find out how they could be used to stimulate citizen participation. Second, election engines have the potential to become a more objective channel of information than the conventional election advertising. We are looking for the most supported inferences from the questionnaire data, while not limiting ourselves to only one interpretation. Third, it is not enough to find a good interpretation. In addition, we need to be able to convey the interpretation with the implementation. Theoretically valid information processing is wasted if the public is not able or willing to use the service. The requirements for cognitive and perceptual accessibility cannot be overemphasized. The major part of this article is used to present the visualization of the results from a computational model~~no~~rmally used by experts in data analysis~~to~~ ordinary voters. In short, the fundamental question is how to make the alternatives seem simple to the user without trading off the accuracy of the information. This approach would satisfy the demands of both design science and behavioral science (Hefner et al., 2004) as opposed, for instance, to political propaganda where the former is satisfied but not the latter.

We address the above questions in the following steps: (1) describing conventional election engines as the starting point and reference; (2) presenting their shortcomings as an aid for voting decisions; (3) describing our alternative implementation, namely the Election Star; (4) analyzing the underlying explorative approach for the voting decision; and (5) summarizing feedback from the users of the Election Star.

## CONVENTIONAL ELECTION ENGINE SERVICES

Technically, election engines are Web-based search engines that perform searches from a database of political agenda profiles. The profiles are collected from questionnaires filled in by candidates campaigning in a given election. The form of the questionnaire varies between election engine services. In our case, the questionnaire presented a list of claims to which the candidate can take a position by choosing a degree of agreement/disagreement. In some cases the questionnaire poses questions and provides a set of alternative answers. The users interviewed (Berg et al., 2004) feel that selection using the degree of agreement guides the user less than choosing from predefined alternatives. The questions were designed by the political journalists of Alma Media, commented on and edited by several political party offices, and finally adjusted to fit the ordinal agreement scale for the questionnaire. The questionnaire presents roughly 20 claims, related to a number of topical issues and thereby constitutes a 20-dimensional conceptual space (Gärdenfors, 2000).

As a comparison and reference point, the conventional election engine interface is depicted schematically in Figure 1. It consists of a questionnaire with a written claim or a question and the interface elements for making a choice. Voters express their attitudes using radio buttons or a slider and select the degree of agreement/disagreement. Before opening the service, candidates fill in the questionnaire, thereby contributing their political agenda profile to the service.

The same questionnaire also serves as the means to enter the citizen's preference profile, i.e., an interface for setting the search key. The output of a typical election engine search is a list of best matches, usually with an opportunity to view the questionnaire contents for each candidate (Figure 1).

The lack of visual-cognitive tools to compare candidates motivated the elaboration of this concept. More precisely, what are the shortcomings of the cognitive ergonomy? First, comparing the answers of different candidates required tedious browsing of several lists or Web pages and a lot of working memory capacity. Second, the list output provided little information about the similarity/difference relations and clustering of the candidates. The service user could not compare loosely fitting candidates, which is essential for the voting decision. Third, user actions in standard services were not reflected by the online feedback and there was a danger that the effect of the choices made would

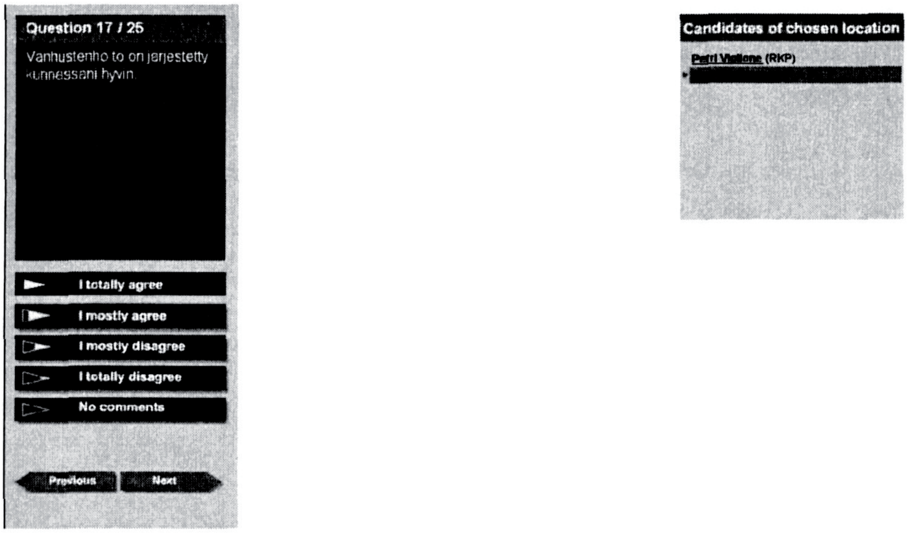


**Figure 1.** Schematic Example of a Standard Election Engine Interface. The left panel (up) presents the questionnaire claim and the corresponding degree of agreement/ disagreement (left, below). The right panel consists of two parts: the list of best matching candidates (right, up). By selecting a candidate on the list, a user can see how she/he has responded to a particular claim.

remain obscure. That is, the updated search result appeared only after submitting the completed questionnaire. Merely seeing the end result did not help citizens to understand the effect of changing their preference with respect to a single issue. There is no information to motivate users to trust the resulting list and vote for the strongest candidate suggested. There is a danger that the users will not see causal relations between the key conditions and the results, which is crucial for their trust in the service. It has been shown that Internet users are in general not very tolerant of such difficulties and seldom continue to use the services (Nielsen, 1993).

Because of these shortcomings, it is possible that users perceived conventional voting aids only as entertainment and not as a trustworthy source of information. We attempted to increase the user's trust in the service by adding transparency and immediacy. This would further increase the potential for supporting citizens in making their voting decisions and thereby have an activating impact on the democratic process. We argue that with improved data layout and visualization and immediate feedback, we can both ease the working memory constraint and structure the interaction with the complex data as exploratory navigation in dynamic knowledge ecology.

## ELECTION STAR APPROACH

### Election Engines with Enhanced Visualization

This article reports the redesign of the original concept of election engines with the objective of equipping citizens with a better cognitive toolset to tackle the problem of satisfying multiple constraints. We used Cognitive Walkthrough design principles (Lewis et al., 1990), standard usability heuristics (Nielsen, 1993), and a small sample of in-depth interviews (e.g., Taylor and Bogdan, 1984; Marshall and Rossman, 1995) on both a standard election engine and our prototype (Berg et al., 2004). The implications on the cognitive level differences were analyzed in Kerminen et al. (2000) and Kaipainen et al. (2001). Here, we present only the results concerning the overall structure and visualizations and not the particular usability details of our design.

In our project, the redesign of the election engine started from a pilot experiment using data from the Finnish local elections of 2000 (Kerminen et al., 2000; Kaipainen et al., 2001). Already in the pilot version, the original text list output was complemented with a visual interface based on the self-organizing map (SOM, an Artificial Neural Network, ANN, algorithm introduced by Kohonen, 1982) resulting in a two-dimensional similarity map of the political agendas. The present article reports the results of the first public applications of the enhanced service in the Finnish elections for the European Parliament in June 2004.

The design process involved usability tests with a prototype interface (Berg et al., 2004). A further improved version, taking advantage of feedback from the public, was published for the Finnish local elections in October 2004.

Recently, another election engine service with what we regard as an explorative approach has been introduced.[1] It utilizes the computational methods of Kontkanen et al. (2000) and differs from ours in implementation. In general, the project can be seen to support similar goals.

Figure 2 depicts the redesigned election engine service, called Election Star, with its additional interface elements and functionalities. Extending the conventional election engines, our approach is designed to support more active exploration of the space of agenda profiles. For this purpose, a holistic means of representation is needed to make sense of one candidate's point of view compared with those of other candidates and the total set of political issues. While the questionnaire and the search outcome list remain similar to typical election engines, two essential interface elements (Figure 2) are added: a similarity map for the overall holistic clustering of the candidates, and a sector diagram to visualize the profiles of the user and the closest political candidates in a manner allowing with-a-glance comparison.

1. *Helsingin Sanomat* (daily newspaper), December 29, 2003 and May 25, 2004

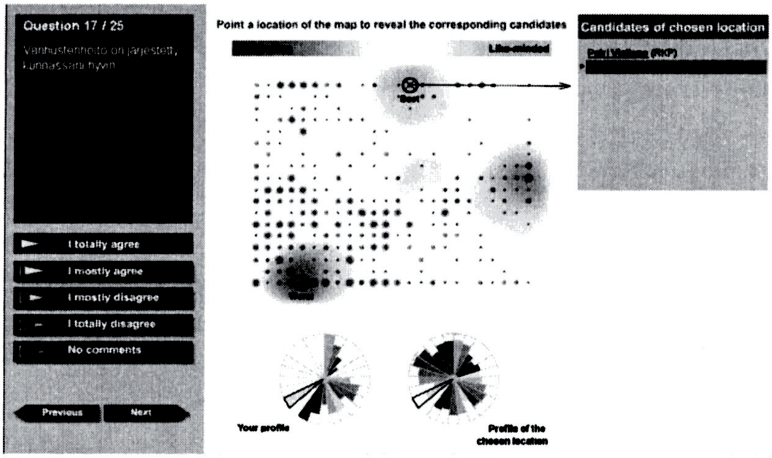


**Figure 2.** Election Star Interface with the Additional Elements. A similarity map with graded color codes, green corresponding to the strongest match and red to the weakest (middle panel, upper). In the gray-shaded figure above, there is a "green" cloud around the best-fit (top middle), and "red" clouds on the right and around the worst-fit (bottom-left). The sector diagrams depict the user's political profiles and the candidate group profiles (middle panel, below). (Translated for this article.)

The information flow diagram (Figure 3) shows how the Election Star approach departs from the more conventional election engines. They gather the input in a similar manner (steps 1 and 2), ask the user to fill in the entire questionnaire, and print the list of suggested candidates. In the Election Star approach, the corresponding similarity map (step 3, details in next section) is computed. The map is related to the questionnaire answers of the user with color-coding (step 4). Graded green and red colored "clouds" overlaid on the similarity map indicate the strongest and weakest matches, while the darkest colors correspond to the polarities. The essential improvement is that the similarity of candidates and user (colors) is updated in real time after users respond to any of the claims (step 5). Between the responses (not after the questionnaire), users are allowed to navigate and discover reasons for the changes. Users can compare their preference profile (their answers) with those of individual candidates or candidate groups in more detail by using sector diagram visualization.

In addition to visualization, these elements have several navigation functions. It is possible to search for candidates by name or political party. The number of hits per map position (a prototype) is indicated by the dot size, which mimics the convention of indicating the number of inhabitants of cities in geographical maps. In addition, the conventional search-engine-type list of the best matching candidates is displayed. As with conventional election engines, we allowed the user to see the questionnaire data of each candidate. This was further enhanced by a database access feature that allowed users to

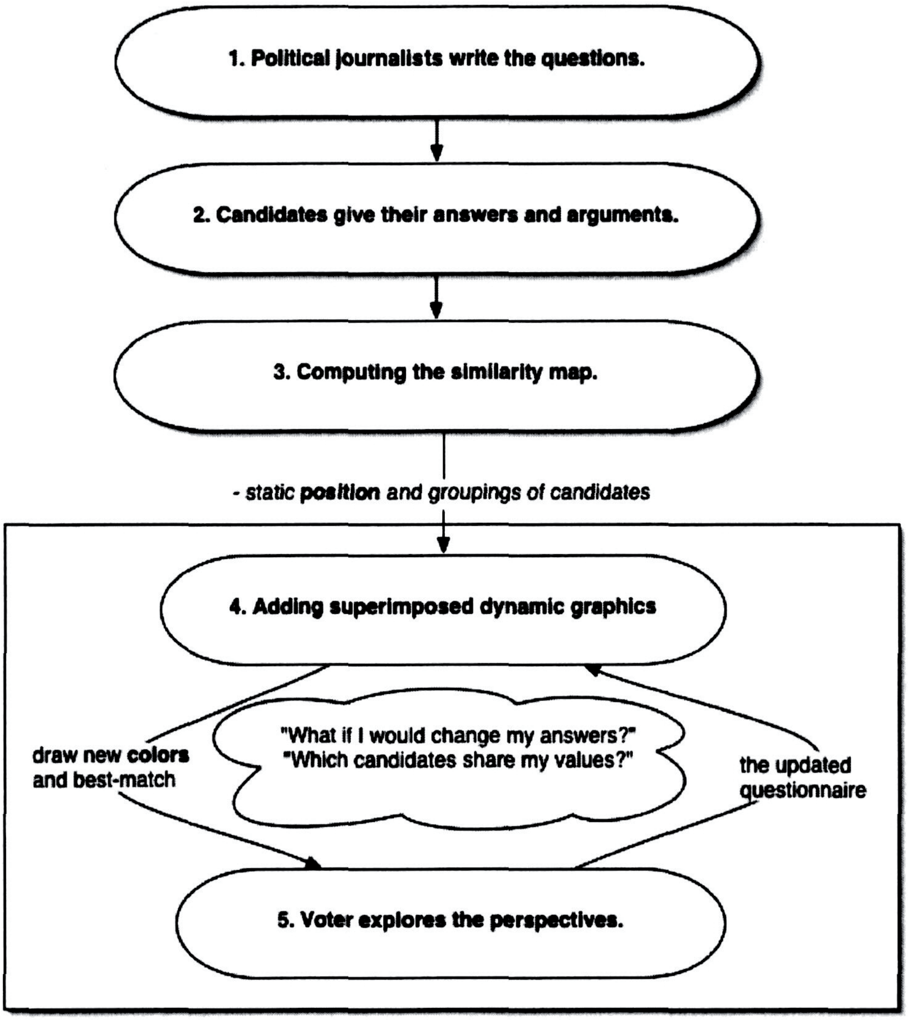


**Figure 3.** Flow Chart of the Election Star Approach. Steps 1-3 create a context using political data before user input. This information does not change during use. Steps 4 and 5 provide interaction according to user responses and allow exploring their effects. The arrow from step 5 to 4 points out the possibility that these representations make users reconsider their choices. This would change the computed similarity to candidates and the color representation, i.e., the arrow from step 4 to 5.

click a name to see a candidate's detail page, including a freely worded justification for the chosen degree of agreement/disagreement. The commercially published Election Star (Figure 4) has a few elements in addition to these: title, brand, and copyright information, space for entertainment or advertisement elements, and buttons for navigation within the service site.

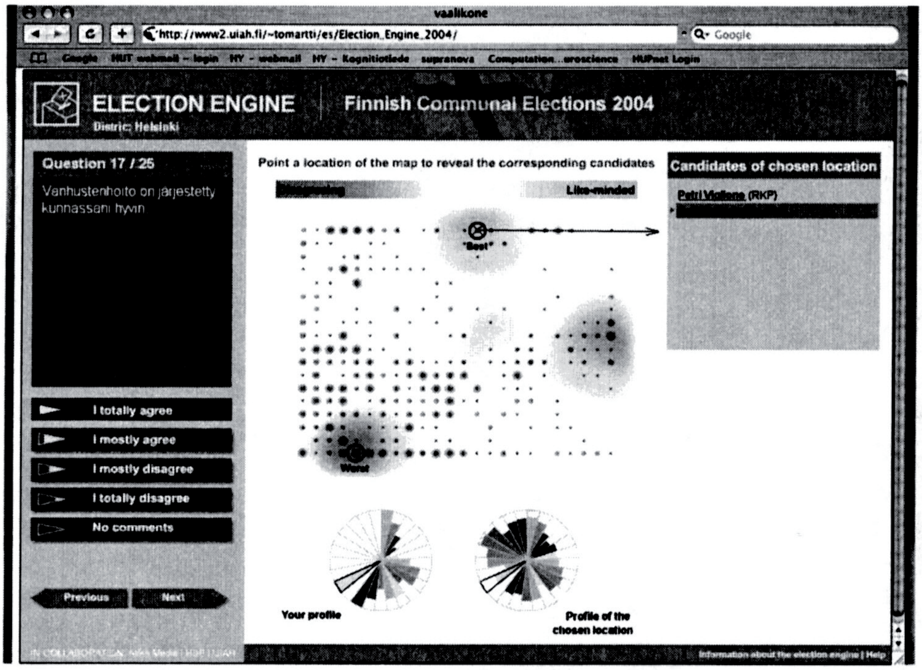


**Figure 4.** Complete Election Star interface. The upper bar with brand and title were included. The bar below includes copyright information and links with the service. The white space on the lower right is reserved for commercial use (advertisements, etc.). In the gray-shaded figure above, there is a "green" cloud around the best-fit (top middle), and "red" clouds on the right and around the worst-fit (bottom-left).

Our approach also differs from the conventional one with respect to the candidates' input. Unlike the conventional election engines, in our implementations for the Finnish European Parliamentary elections and the local elections in 2004, editing of the agenda profile was allowed throughout the campaign. The dynamically changing political map motivated the voters to keep following the changes beyond just one visit.

## Similarity Map

One of the well-known cognitive principles of organizing is similarity, apparently the basis of categorization, comparison, and decision-making (e.g., Tversky and Gati, 1978; Gärdenfors, 2000). The similarity map (Figure 5) belongs to the information-processing methods of geometric projections and is similar to the more general idea of multi-dimensional scaling (MDS, Shepard, 1962).

In our interface, the similarity map forms the static background of the interface and clusters the candidates in a manner in which holistically similar candidates are placed near each other (step 3 in Figure 3). According to our argument, this kind of visualization

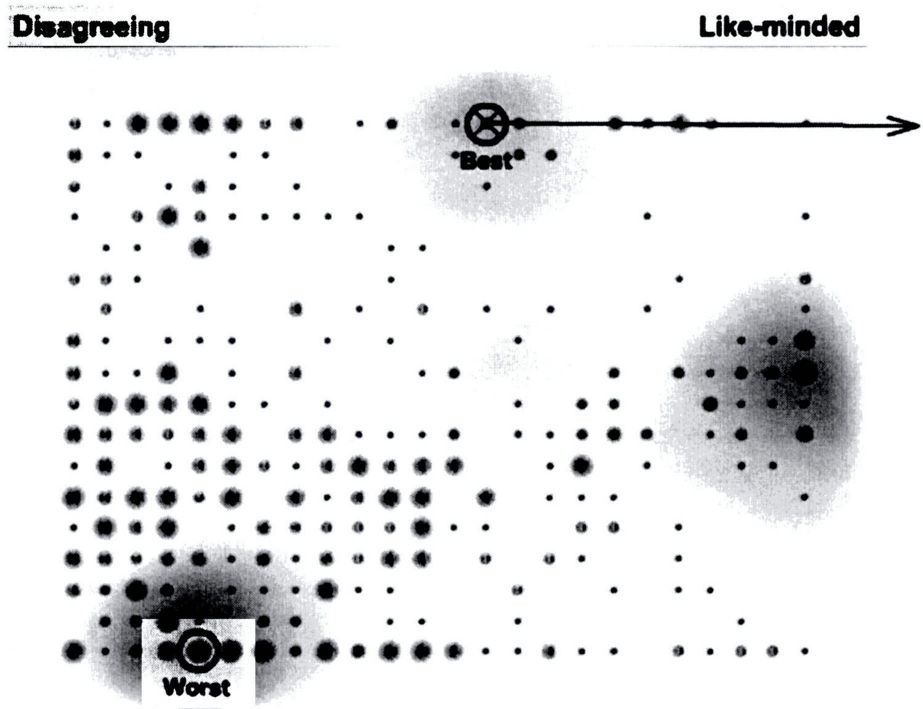


**Figure 5.** Similarity Map. This example of the designed similarity map represents all the candidates (about one thousand) in the district of Helsinki in the Finnish Municipal Elections of 2004. The size of the dots corresponds to the number of candidates in the particular location. The green cloud shade reflects the degree of similarity of the answers compared with those provided by the user, and the redness reflects the dissimilarity. In addition, it is possible to navigate between the locations in the map as described in the text. In the gray-shaded figure above, there is a "green" cloud around the best-fit (top middle), and "red" clouds on the right and around the worst-fit (bottom-left).

of similarity essentially facilitates the comparison of items defined by distance in a multidimensional space. Another advantage of the spatial similarity mapping is the inverse, i.e., displaying the most different and unlikely candidates. From the perceptual point of view, we rely here on the empirically established advantages of the parallel processing capabilities of the brain better than text based lists, while the latter are more like sequential processing and thereby less effective (Näsänen et al., 2001; Ojanpää et al., 2002). This approach is also compatible with Gärdenfors' theory of conceptual spaces as an overall framework for understanding the mind (Gärdenfors, 2000).

We chose the self-organizing map (SOM, Kohonen, 1982) as our implementation of the similarity map. As described by Kohonen, the purpose of self-organizing maps is a "visualization of complex data in a two-dimensional display and creation of abstrac-

**Table 1.** Coding the Responses. Choices for questionnaire answer and corresponding vector component values are contrasted within one dimension. In other words, it is assumed that the answer choices form a continuum of one "quality" and vary only in terms of degree. The case of "No comments" was treated as a missing data point in computing the similarity map.

| Answer | Vector value |
|---|---|
| "I totally agree" | 1.00 |
| "I mostly agree" | .66 |
| "I mostly disagree" | .33 |
| "I totally disagree" | 0 |
| "No comments" | x |

tions," presented as a "similarity graph of input data" (2001, 86). The SOM has two basic functions: (1) clustering, finding the groupings, and (2) projecting, mapping onto lower dimensions (ibid, 106). Unlike standard MDS implementations with direct metric comparison, the SOM is based on an artificial neural network model architecture, with collective interaction of local neural-like units and their adaptation in terms of competitive learning. The iterative algorithm acts on the local level by finding the best matching unit (BMU) and subsequently updating it and its neighboring units in an order-preserving grid towards the input vector. After a sufficient number of iterations, a global order emerges, reminiscent of the topological ordering in the human brain (Kohonen, 1984).

In our application, the input to the model is a set of political profiles retrieved from the questionnaires, expressed as vectors (Table 1), and the outcome is a similarity map with "prototype" nodes potentially representing more than one candidate, thereby effectively compressing information. The resulting similarity map functions as the static ground of the interface on which candidates are represented as fixed positions, while display and interface elements (b, c, d, e) point at these positions.

## Sector Diagrams

Sector diagrams help the user to draw the link between the position (of groups) in the similarity map and actual questionnaire contents (step 5 in Fig. 3.). Seldom used sector diagrams are bar charts turned around the center (Figure 6). They were first used by Florence Nightingale 1858 (rose charts in Harris, 1999). Unlike bar charts, they provide an easy-to-perceive overall view. According to our pilot studies, this visualization significantly speeds up the visual search task. This might be due to the Gestalt laws, i.e., sectors are perceived as a whole more often than a set of bars.

Sector diagrams can be used to explore concrete issues associated with the abstractions from the similarity map. A prominent sector represents an opinion shared by the candidates in that part of the similarity map. Furthermore, the sector diagram serves as a

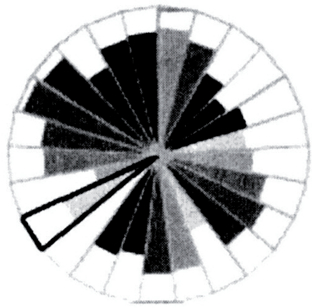

**Fig. 6.** Sector diagram. Each of the sector-diagram sectors represents the vector value of an answer (according to Table 1) to one of the 25 questions. The sector colors reflect the meaningful groupings of the questions such as questions related to economic issues. The black framing indicates the currently active question, which can be changed by clicking another sector by mouse. The case of "No comments" is displayed as an empty sector.

navigation aid, allowing the user to navigate between the questions by clicking the corresponding sector. The colors of the sectors were chosen so as to support the predefined groups of more similar questions. The idea follows the information visualization principle of Ware (2000), which suggests that sets of data dimensions be tied visually with the same hue value and separated from other sets with a visible hue contrast. In our case, the same hue value was used for mutually dependent (integral) dimensions within a group of similar questions. In general, we followed the suggestion of using multiple visualization hybrids (here, similarity map and sector diagram) when dealing with dynamics and interaction (de Oliveira and Levkowitz, 2003).

## EXPLORATION OF CONCEPTUAL SPACES

Our map-based election engine differs from the previous solutions in that the user can easily navigate through complex data with it, i.e., explore different views in the space of political agendas. Exploration as an essential aspect of perception was originally established by Neisser (1967; 1976), who referred to the freedom of perceivers to actively choose their perspectives on environmental objects, or in our case, on the data of political agendas. In the domain of data mining (DM), the explorative approach to understanding complex data has been studied within the Knowledge Discovery in Databases (KDD) community (see also Emergent Knowledge Production, EKP, systems in Markus et al. 2004). This is natural with the emphasis on processes involving experimentation, iteration, user interaction, or expert help in feature extraction (Fayyad, 1996). The visual KDD and DM have emerged very recently, while visualization and user intervention have not really changed the DM process itself (de Oliveira and Levkowitz, 2003), as we contend is the case here. Accordingly, despite the increased interest in human factor issues specific to visualizations, the actual studies are confined to Human Computer Interaction, or HCI (Tory and Möller, 2004).

Explorative interfaces have also been the goal of video game and virtual reality research for a long time. This can be interpreted as another piece of evidence for the psychological validity of the exploration approach. Even though the contexts of games and elections might differ radically, they share the challenge of making sense of complex environments. We argue that interest (positive feeling) is, at least partly, derived from the possibilities for natural interaction (e.g., sense of presence) with the explored world (Ravaja et al., 2004).

Distinctive to our approach is also the principle of economy of perception, i.e., the interface always gives users just enough information without overwhelming them with it (Schneiderman, 1996). It is easy to find suitable candidates from the map, compare them with the sector diagrams, and finally after interesting candidates are found, investigate their opinions more thoroughly.

## RESULTS AND DISCUSSION

The resulting service, called Election Star, was accessible to voters during two subsequent elections: the EU parliament elections in June 2004, and Finnish local elections in October 2004. According to the commercial media company that published the service (Alma Media), it attracted a lot of attention in the first elections and this publicity was to a great extent transferred to the latter elections. The service had almost 100,000 visitors in the local elections. We took the positive comments from the built-in feedback channel as an indicator of usefulness, but we also received some criticism and ideas for further development.

After extensive pilot studies and prototypes, the user tests conducted pointed out only minor weaknesses in some small functionalities. Several major usability problems had been corrected before the public version (see Berg et al., 2004) using an iterative design methodology (e.g., Gould and Lewis, 1985; Bailey, 1993; Markus et al. 2004). In these tests, users were unobtrusively observed when asked to use the program and encouraged to think out loud. In general, this approach followed the guidelines of both expert and novice interviews in Nielsen (1993). Most of the comments and new ideas focused on the details of usability, and exhaustive analysis of them is outside the scope of this paper. Several comments and observations supported the usefulness of the additional information on how candidates explained their choices. The explanations provided new perspectives on how to interpret the questions. In addition, some users explicitly stated that the immediate visualization feedback made them reconsider their choices, implying that there is a real need for such feedback (Figure 3). In other words, the users interpret the possible questionnaire choices as the answers of the candidates. Therefore, the similarity assessments and the navigation should not be interpreted simply in terms of an absolute number of matching choices, but rather in terms of similarity relative to other candidates.

Before opening the service, a community of new media experts was asked to give their comments on the service. Five of them answered with from one to three paragraphs. All the answers pointed in the same direction, i.e., that the new way of presenting the questions was more appealing and interesting. One of them actively concluded that the map was an efficient way of getting an overview. All of them were concerned about the consequences of the manipulative power implied by the choice of the questionnaire contents, which is a political issue that is beyond our work and the scope of this article.

In both election engine implementations, the starting page offered a link for user feedback. In online services, these possibilities have mostly been used to report problems. However, we received only a small amount of feedback related to the election engine (18 messages in the EU Parliament elections, and 0 in the local elections). The lack of feedback cannot be explained simply by saying that people had not recognized the possibility, because during the second elections the same channel was used to report even more problems than during the first elections. These problems were irrelevant to the election engine and discussed the authentication procedures and other local issues. We can only conclude that the information received through the feedback channel did not point out any major problems. Furthermore, a major difficulty that became apparent in the local elections was that the similarity map, in general, works best with a large number of candidates and is not meaningful when there are not enough candidates to compare with each other. This was relevant for very small districts.

Evaluating a design process is a complex task in itself, and there is no one measure which alone could fully evaluate the goodness of our model. For the moment, there are not enough alternative models to make any comparative surveys. Privacy constraints prevented us from using the behavior of the actual users or, better yet, the resulting voting decisions to measure our model. The electoral panel surveys provide a profile for election engine use in general and support the notion that election engines are perceived as a good source of information by the voters (Moring and Mykkänen, 2005).

We focused here on giving theoretical and functional grounds for our design decisions. We have given a more detailed description of the iterative design process elsewhere (see the earlier references) and believe that a more functional analysis of our design could be helpful for the projects working on other Emergent Knowledge Processing systems. In the near future, we will continue to investigate these issues with more extensive behavioral laboratory testing. We hope to obtain more quantitative information of the perceptual characteristic of simplified versions of these information representations.

## ELECTION ENGINES AND POLITICAL SYSTEMS

The generic election engine concept has become an established form of interactive Web-based political media in Finland and has proved its value both as a support for the democratic system and as a part of profitable media business. It allows citizens to make searches and to familiarize themselves with candidates running for elected office through a Web-based service. Election engines in general serve democratic goals in many important ways. With their help, citizens are not restricted to someone else's information about abstract party programs, entertainment-oriented publicity, or vague slogans, but can make searches of the political agenda information on demand.

Unlike most kinds of conventional media, election engines give all candidates an equal chance to reach their potential voters. Nevertheless, they serve to focus political campaigns on actual political issues instead of conventional dividers, such as parties or left-right polarities, regardless of sex appeal and the amount of media coverage. Furthermore, we propose that this kind of service be included as part of e-government and e-democracy missions that aim to serve citizens beyond entertainment. However, this does not exclude the possibility that such services may be integrated with the policies of commercial media, as the Election Star shows. It is also worth noting that at least in Finland, the concept is already driven by public and commercial demand rather than by some foreign factor (Gustafsson, 2002), such as the mere need for an information technology research and development community to find new applications.

However, we recognize the power aspect of the election engine concept, i.e., the fact that the choice of issues included and how they are presented is totally moderated by the media industry (Moring and Mykkänen, 2005). As an alternative or extension, we are considering future service implementations in which the edited questionnaire could be replaced with some kind of a citizen-driven initiative or issue list. Recently, some local governments have also set up their own election engines, e.g., the cities of Turku and Vantaa. Hence, public institutions can also raise the issues, important for their functioning to the public debate.

The Web-based services assume that the Internet is accessible to an essential proportion of citizens, which is the case in Finland. However, we are aware of the fact that on the other side of the digital divide this is not the case. Furthermore, it has been recognized that for example the Japanese have a cultural tendency to avoid the use of the decision aids and compensatory processes (Chu and Spires, 1999) suggested here. Similar cross-cultural studies (Ji et al., 2000; Morris and Peng, 1994) explain the results by the cultural bias characteristic of the collectivistic East, typically aiming at avoiding trade-offs and conflicts. There is no reason to assume that the use of election engines would suffer from this effect in other European or North American countries. In fact, the same study suggests just the opposite, claiming that Americans are willing and able to use decision aids.

Web-based voting aid services, such as the election engine, may support democracy on the level of the ordinary citizen, and with proper support in young democracies in which the tradition would emphasize party lines and long-term knowledge of the candidates (retrospective voting). In fact, the Finnish electoral system emphasizes candidate-driven campaigning, and voters typically do not want to emphasize either the party preferences or the electoral alliances (Carlson and Strandberg, 2005). This has been interpreted to be part of a more general dealigned phenomenon, where parties are not based on social cleavages, but on a "catch-all-party" idea (Moring and Mykkänen, 2005). We present election engines here only as aids for making voting decisions and as an alternative information channel that can support criticism of the weak points of democracy by offering an opportunity for new candidates with less campaign funding (Carlson and Strandberg, 2005).

## CONCLUSIONS

In our project, exploiting the experiences of two elections in Finland, we have made an extended effort to make election engines service more than a pure search engine, i.e., a tool for the citizen to explore the spaces of political agendas. As an answer to "truthfulness," we introduced a computational model for that purpose, which better reflects the similarity structures of candidates and makes more valid inferences from the questionnaire data. We take the popularity of the service as evidence that through understandable visualizations we were able to assist ordinary voters with the computation content. We also think that based on the popularity of the service, we can say that people appreciate the contribution of visualizations. To conclude this case study, we argue that the true complexity of the political domain should be acknowledged. The interaction and interface design of future election engines should facilitate making sense of complex political issues.

## REFERENCES

Bailey, G. "Iterative Methodology and Designer Training in Human-Computer Interface Design," *Proceedings of INTERCHI'93*, New York, 1993.

Berg, M., Kaipainen, M., and Kojo, I. "Enhancing Usability of the Similarity for More Accessible Politics," *Proceedings in 8th ERCIM Workshop, User Interfaces For All*, Vienna, Austria, 2004.

Carlson, T. and Strandberg, K. "The European Parliament Election on the Web: Finnish Candidates Online: Supply and Demand," *17th Nordic Conference on Media and Communication Research*, Aalborg, Denmark, 2005.

Chu, P. and Spires, E. "Cross-Cultural Differences in Choice Behavior and Use of Decision Aids: A Comparison of Japan and the United States," *Organizational Behavior and Human Decision Processes* (77:2), 1999, pp. 147–170.

de Oliveira, M.F. and Levkowitz, H. "From Visual Data Exploration to Visual Data Mining: A Survey," *IEEE Transactions on Visualization and Computer Graphics* (9:3), 2003, pp. 378–394.

Fayyad, U. "Data Mining and Knowledge Discovery: Making Sense Out of Data," *IEEE Expert*, October 1996, pp. 20–25.

Gärdenfors, P. *Conceptual Spaces: The Geometry of Thought*, MIT Press, Boston, Massachusetts, 2000.

Gould, J. and Lewis, C. "Designing for Usability: Key Principles and What Designers Think," *Communications of the ACM* (28:3), 1985, pp. 300–311.

Gustafsson, P. "The Order of E-Democracy: Internet and Democracy in Swedish Local Governments," *e-Service Journal* (2:1), 2002, pp. 114–132.

Harris, R. *Information Graphics: A Comprehensive Illustrated Reference*, Oxford University Press, Oxford, 1999.

Hevner, A., March, S., Park, J., and Ram, S. "Design Science in Information Systems Research," *MIS Quarterly* (28: 1), 2004, pp. 75–105.

Kaipainen, M., Koskenniemi, T., Kerminen, A., Raike, A., and Ellonen, A. "Presenting Data as Similarity Clusters Instead of List: Data from Local Politics as an Example," in *Universal Access in HCI Towards an Information Society for All*, C. Stephanidis, Lawrence Erlbaum, London, 2001.

Kaski, S. "Data Exploration Using Self-Organizing Maps," *Acta Polytechnica Scandinavica, Mathematics, Computing and Management in Engineering* (82:57), 1997.

Kerminen, A., Raike, A., and Kaipainen, M. "Self-Organizing Map Browser for Database Retrieval," *Proceedings of 6th ERCIM Workshop*, Florence, Italy, 2000.

Kohonen, T. "Self-Organized Formation of Topologically Correct Feature Maps," *Biological Cybernetics* (43), 1982, pp. 59–69.

Kohonen, T. "Self-Organization and Associative Memory," Chapter 5: *Self-Organizing Feature Maps*, Springer-Verlag, Berlin, 1984.

Kohonen, T. *Self-Organizing Maps*, Third Edition, Springer-Verlag, New York, 2001.

Kontkanen, P., Lahtinen, J., Myllymäki, P., Silander, T., and Tirri, H. "Supervised Model-Based Visualization of High-Dimensional Data," *Intelligent Data Analysis* (4:3), 2000, pp. 213–227.

Lewis, C., Polson, P., Wharton, C., and Rieman, J. "Testing a Walkthrough Methodology for Theory-Based Design of Walk-Up-And-Use Interfaces," *Proceedings of the ACM Conference on Human Factors in Computing Systems*, 1990, pp. 235–242.

Markus, L., Majchrzak, A., and Gasser, L. "A Design Theory for Systems That Support Emergent Knowledge Processes," *MIS Quarterly* (26:3), 2002, pp. 179–212.

Moring, T. and Mykkänen, J. "Voter Choice and Political Mediation: Net-Based Candidate Selectors in Finnish Elections," *The 55th Annual Conference of the International Communication Association*, New York, 2005.

Morris, M. and Peng, K. "Culture and Cause: American and Chinese Attributions for Social and Physical Events," *Journal of Personality and Social Psychology* (67:6), 1994, pp. 949–971.

Näsänen, R., Ojanpää, H., and Kojo, I. "Effects of Stimulus Contrast on Performance and Eye Movements in Visual Search," *Vision Research* (41), 2001, pp. 1817–1824.

Neisser, U. *Cognition and Reality: Principles and Implications of Cognitive Psychology*, W. H. Freeman and Company, San Francisco, California, 1976.

Neisser, U. *Cognitive Psychology*, Appleton, New York, 1967.

Nielsen, J. *Usability Engineering*, AP Professional, Boston, Massachusetts, 1993.

Nisbett, R., Peng, K., Choi, I., and Norenzayan, A. "Culture and Systems of Thought: Holistic Versus Analytic Cognition," *Psychological Review* (108: 2), 2001, pp. 291–310.

Ohlin, T. and Hällgren, U. "Internet Voting in Practice," *e-Service Journal* (2:1), 2002, pp. 35–61.

Ojanpää, H., Näsänen, R., and Kojo, I. "Eye Movements in the Visual Search of Word Lists," *Vision Research* (42:12), 2002, pp. 1499–1512.

Ravaja, N., Laarni, J., Saari, T., Kallinen, K., Salminen, M., Holopainen, J., et al. "Spatial Presence and Emotional Responses to Success in a Video Game: A Psychophysiological Study," *Proceedings of the PRESENCE 2004*, Valencia, Spain, 2004, pp. 112–116.

Schneiderman, B. "The Eyes Have It: A Task by Data Type Taxonomy for Information Visualization," *IEEE Visual Languages*, 1996, pp. 336–343.

Shepard, R. "Analysis of Proximities: Multidimensional Scaling with an Unknown Distance Function I & II," *Psychometrika* (27), 1962, pp. 125–139; 219–246.

Tory, M. and Möller, T. "Human Factors in Visualization Research," *IEEE Transactions on Visualization and Computer Graphics* (10: 1), 2004, pp. 72–84.

Tversky, A. and Gati, I. "Studies of Similarity," in *Cognition and Categorization*, E. Rosch, and B. Lloyd, Hillsdale, Lawrence Erlbaum, New Jersey, 1978.

Ware, C. *Information Visualization: Perception for Design*, Academic Press, San Diego, California, 2000.

## Acknowledgements

This article is a part of (1) a broader research project (Fenix program) funded by the National Technology Agency of Finland TEKES, coordinated by Alma Media and Crucible Studio, University of Art and Design Helsinki, and (2) two projects funded by the Academy of Finland, PRIMA (number 202211) and CIVI (number 210676). We would like to thank all the contributors.