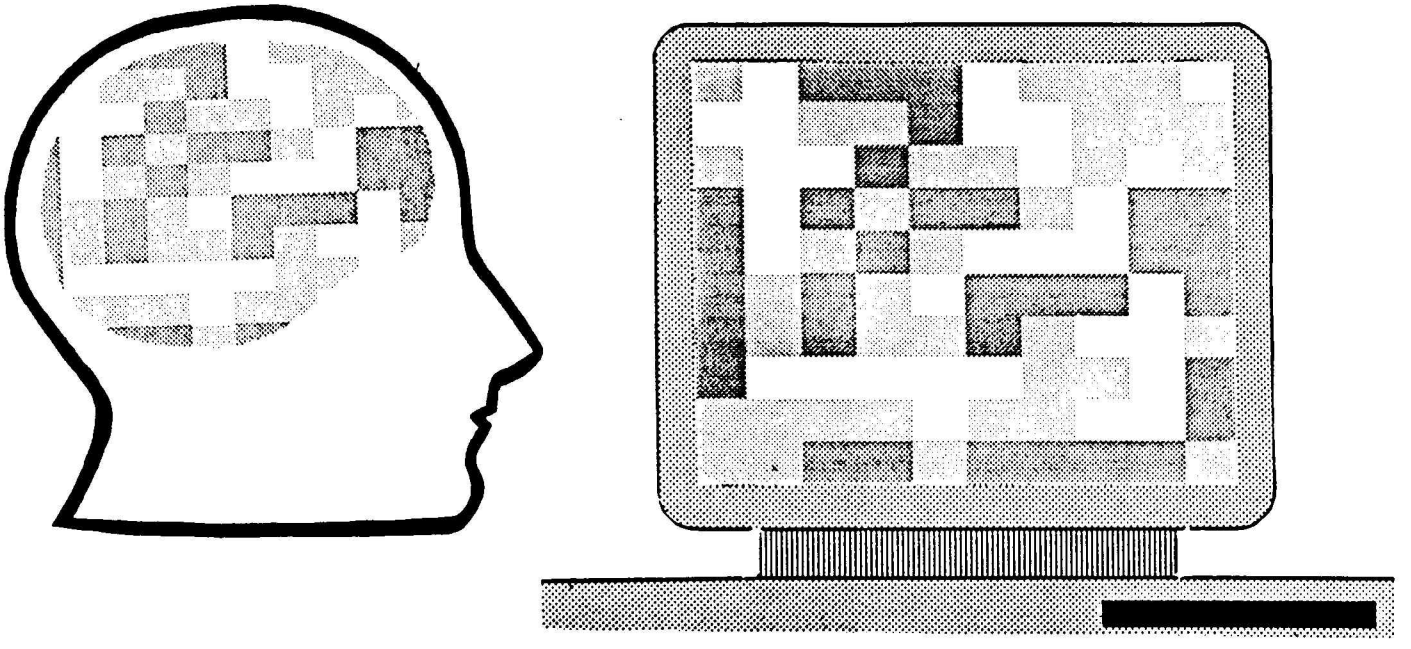
KNOWLEDGE

SUPPORT

SYSTEM

ZER0



Knowledge Acquisition Program Reference Guide

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Overview

The development of expert systems has created a new outlook on the way we perform tasks and solve everyday problems. These systems are used to assimilate the behavior and thinking process of an individual knowledgeable in a particular field (domain).

The rapid pace and complexity of applications in the expert system area has resulted in the requirement of computer programs to aide the developers in obtaining the knowledge from these people (experts).

These "knowledge support systems", as they are called, are knowledge acquisition programs that interact with the expert to gather and structure the knowledge. Then, the program generates the patterns of logic to imply new rules on how the person would solve a problem. Knowledge support systems can be thought of as expert systems in their own right since they create these implied rules to mimic the reactions an individual has to any given situation.

The rules are then transferred to an expert system shell. This shell is a software program that contains the framework and working mechanism to generate the implied logic but is empty of any specific rules. The generated rules from the knowledge support system placed onto the expert system shell forms the complete expert system. This complete system connects the rules together to infer all concepts on the subject and present the results to the user in a meaningful manner.

One of these knowledge acquisition programs is the software package "Knowledge Support System Zero" , KSS0 for short. It has been developed by Brian Gaines and Mildred Shaw of the Knowledge Science Institute at the University of Calgary. This program elicits knowledge by means of an individual defining the placement of relative subject matter and their descriptive features. The results of the information are presented in graphical form for easy understanding and interpretation. The knowledge is also presented in numeric terms for more in-depth analysis. The information is then transformed into implied rules or statements of understanding that imitate the thought process. The rules are then transferred over to an expert system shell.

This manual will provide step-by-step procedures on how to operate the program along with explanations on how to understand and analyze the results that are derived. The book is divided into three sections to provide information about the program to people with varying levels of interest. They include the experts whose knowledge on a subject are being elicitated, the developers of the expert system (knowledge engineers), and the researchers in the field of knowledge acquisition.

The first section provides the technical and operational features used in the elicitation process. It describes how to utilize the program from the

viewpoint of an individual trying to place his knowledge onto the program. These people are often considered to be an "expert" in their field since they usually represent outstanding achievement and stand above their peers. The individual can come from any background and may know little or nothing about computers and their operation. This section should be read by all individuals involved including the developers and researchers. This is the only section that elicitated people should concern themselves with unless they are also involved in developing the expert system.

The second section describes how to manage the program in terms of its set-up and implementation. It provides information on how to analyze the results and fine-tune the information in the creation of the logic and the final development of the expert system. This area is primarily intended for the knowledge engineer who will be responsible for the building, testing, and evaluation of the final expert system from the rules generated by this program. Researchers in the area of knowledge acquisition should also read this section to understand the mechanisms involved in the analysis process.

The third section is intended for researchers involved in the development of knowledge acquisition software tools. It is a collection of research papers on the principles behind knowledge acquisition techniques with special emphasis on technical data and analysis methods used in KSS0. As well, the section deals with the operational aspects of the expert system shells that KSS0 can export to including Nexpert, Babylon, and KRS.

SECTION I:

The Elicitation of Knowledge

1. INTRODUCTION TO KNOWLEDGE SUPPORT SYSTEM ZERO

The following chapter will give an outline of what the program can accomplish, the general procedure and principles behind the application, and the role that, you the client, are to play in the interaction. Also, it will provide information on system requirements and start-up procedures when you enter the program for the first time.

1.1 Objectives

KSS0 provides a means of interacting with the program to input information about a given subject in the form of words that comprise its field. It allows you to categorize and position the various components in order to organize the information and analyze the way you perceive the area. The subject matter can be very specific in nature covering only a portion of a topic that you are concerned with or it can be broad-based covering the whole area of your expertise. The subject can be concerned with concrete objects that make up your field or with abstract concepts that help define ideas.

The inclusion of information you want to place into the program depends on what final outcome you are seeking. You may want to show how you answer a given question or set of questions on a subject and reveal how the result was obtained. Or, you may want to see how various items of an area fit together and how much are they related to each other. In either case, you will explore the ways in which you formulate the decisions from the way in which you depict the organization of knowledge.

The program does this primarily through visual representations in graphical form. These graphics give the results in an easily viewed and understandable format so that you can see at a glance how you categorize the information and spacially relate the components to each other. They can be edited to change the information that may be incorrect in its representation or analyzed further using the optional textual information.

This textual information is used in conjunction with each graphical method and provides numerical values to the spatial placement of information along with a measurement of their correlation and relevancy. These graphics and textual screens are contained within the processing section of KSS0 and are automatically generated by simply calling up that particular information in the program. Once you are satisfied with the results presented, you can generate rules that form correlations between the data.

The rules provide the linkage between the information and formulate new outcomes and decisions based on past results. They are implied through the logic you have used to spacially organize the information. The rules include the connections between singular or multiple words. It will show the hierarchical structure of how you move from one conclusion to the

next in the decision process and then extrapolate the results to show new conclusions. Included with the rules are numerical data automatically generated that provide the amount of accuracy and significance of a rule. This information allows you to edit and refine the data so that proper rules reflecting the individuals decision making process is shown.

The rules are exported to an existing expert system shell once the information is fully corrected. The rules become the knowledge base of information with the shell performing the linkage and access capabilities. The expert's understanding of the domain's features can be obtained by interacting with this newly created expert system.

1.2 Organization and Principles Behind Process

Figure 1 shows the major areas within the program. The elicitation portion is a collection of interactive knowledge acquisition screens that provide assistance to the user for input of variables. These variables are words that are used within your domain of interest that help name, define, and describe the objects or concepts of the area. The words are stated into two categories; entities which are words naming the objects or concepts within the area and attributes which are words describing these objects or concepts. Once you have inserted the words into the program, the program allows you to position these variables onto a series of scales to properly define their placement relative to the other words. The program will cue the user whenever there is a discrepancy involved with similarities between the position of relative words and suggest ways of breaking these matches. This procedure will continue until you feel that you have completely defined the area.

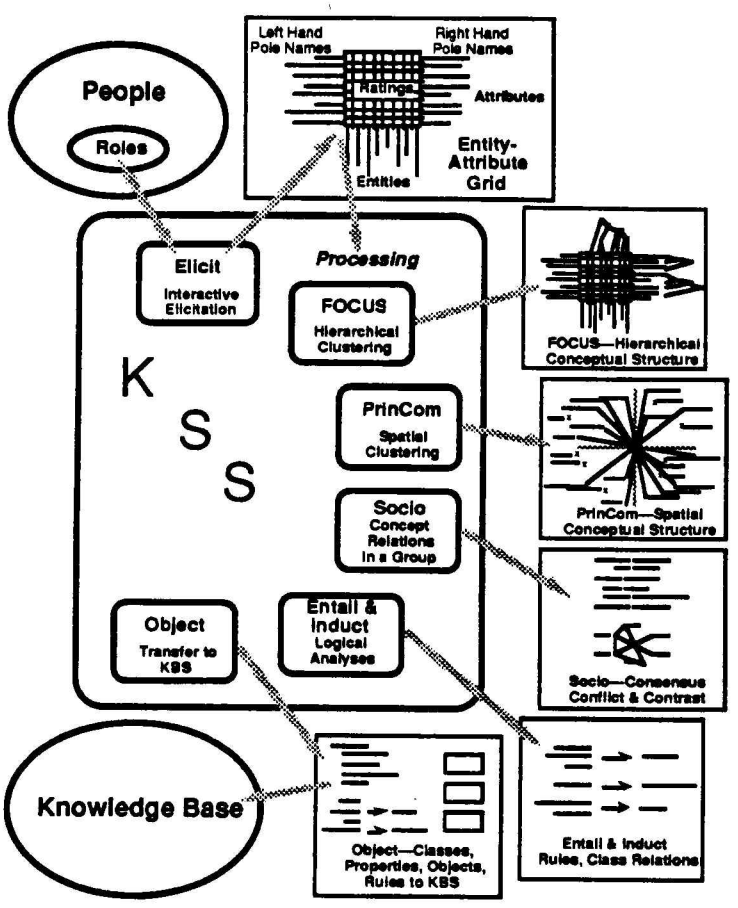


Figure 1: Components of KSS0

The information is organized and displayed in a series of graphical and textual screens to represent the various correlations of the rated words through the processing section. The processing section include entity-attribute grid method through Display, hierarchical clustering of items through Focus, spatial clustering of items in a co-ordinate graph form of PrinCom, concepts derived from multiple-person elicitations through Socio, and rules/relationships in language form through Entail and Induct processes. You can view any one process or any number of processes in any order to give you a better understanding of the relationships and thinking patterns formed. Also, the organized information is used as a form of viewing any erroneous results in the way you think. This allows you to edit the data right at the process screen to change the necessary linkage.

The entity-attribute grid from Display, Figure 2, arranges the information into a grid format with the entity names on the vertical scale with the names of the attribute pairs comprising the horizontal scale. One side of the attribute scale will contain a descriptive word depicting the pole name used in its rating while the other side will contain its opposite as defined during the rating process as the other pole name. The value on the rating bar that you have assigned in the elicitation process will be represented with

its corresponding rated number in the grid. The number will be placed in the grid square that is at the cross point between the entity and attribute names. This is automatically accomplished for all ratings and positioned in their respective grid square.

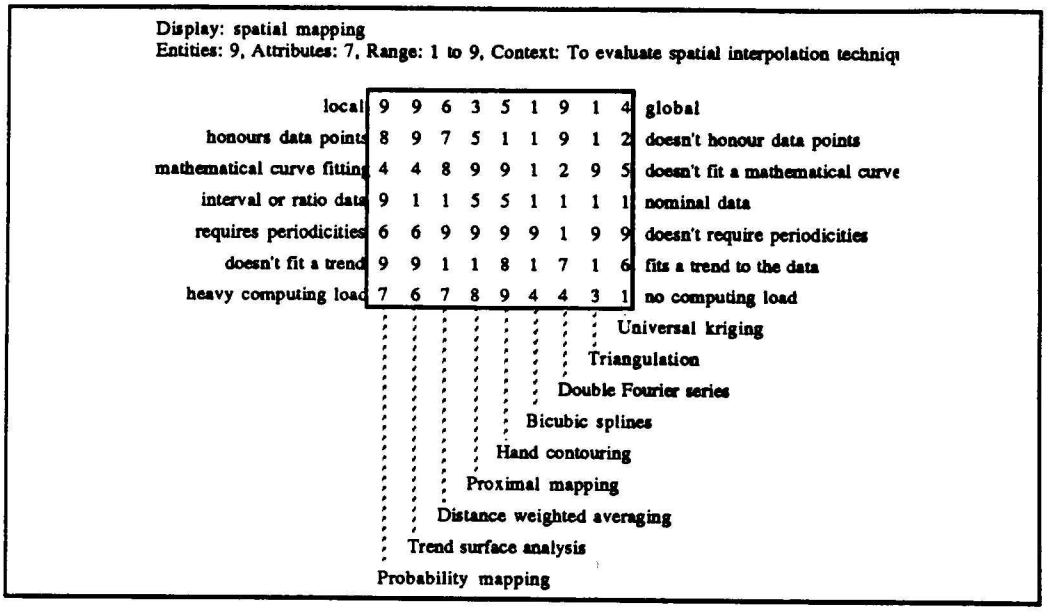


Figure 2: The entity-attribute grid showing the component ratings

The number represents the rating of an entity relative to both ends of the pole. A small scale number will represent a closer relationship with the first-defined pole which can be the left or right hand side depending on how the grid is set up. A large number relative to the scale will represent a closer relationship to the second-defined pole. A number between the extreme scale values will represent the varying degree of influence each pole has on the entity. A number in the middle will show equal influence from either pole name. The grid squares may be shaded different colors or amounts of grey to depict the areas of rating with small numbers being white in color, middle numbers being a light grey shade, and high number region being a darker grey shade. The coloring of grid components is used to show where similar ratings occur and the extent of correlation between the information. The information is automatically arranged to provide a grouping of the different region areas as best as possible given the fact that there is a multiple of factors influencing one entity. This grouping of similar rated items will show the correlations between the different entities as outlined by the attributes. It will reveal the implied linkage of items within the domain.

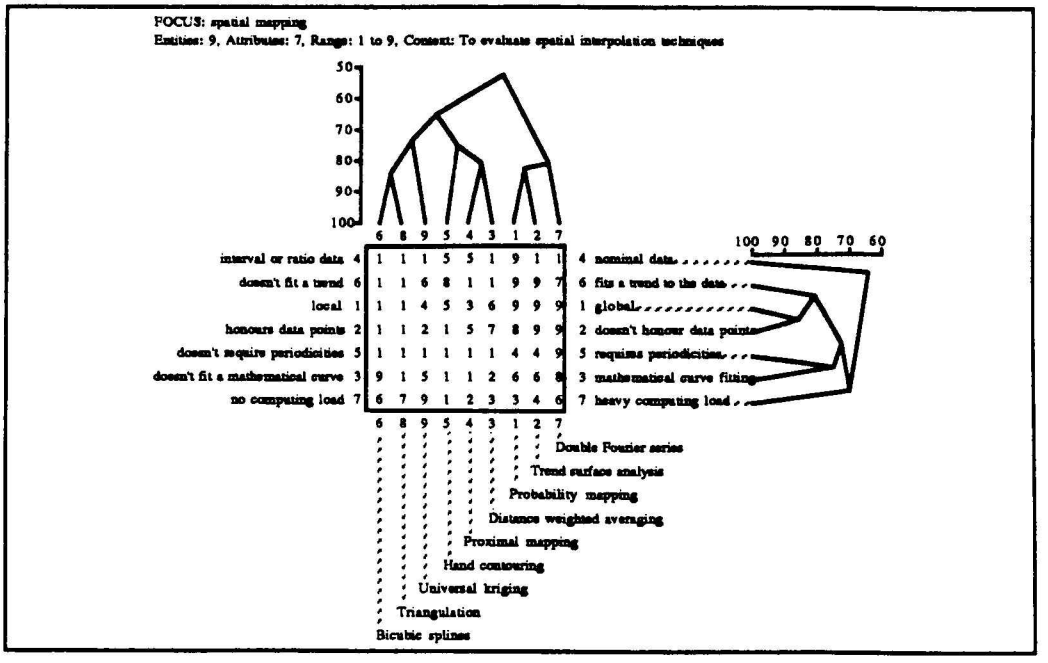


Figure 3: Spatial clusturing affect from Focus

The cluster grid from Focus, shown in Figure 3, is usually created alongside the entity-attribute grid to illustrate the amount of correlation between the various components and clusters of similar value patterns. The names in either the entity or attribute areas are grouped together with lines connecting similar components. The clustering of names to form groups are analyzed in terms of a percentage that show the amount of similarities between the items. The percentage is automatically calculated within the program by means of comparing the set of numerical values and then showing the relative matches and similarities between items or groups of items. The program will find the highest match between any two items or groups and join them together with the junction of the two lines indicating the percentage of correlation. These sets are then compared and connected to other singular items or sets with its junction point showing their correlation. This is continued until all items or groups have been compared to each other but restricted by the lowest stated percentage value obtainable as defined in the program by the Knowledge Engineer.

The spatial clustering diagram created through PrinCom, Figure 4, is another form of graphical presentation showing the correlation between the items within the entity and attribute listings. The items are plotted around co-ordinates in a two-dimensional plane for information represented within a three-dimensional space. It shows the attribute value pairs as a set of lines similar to the polar rating bars. All lines are mapped out from the zero point of the co-ordinate axes to fill the entire space. The length and position of the line is dependant upon its relative correlation and significance between the other attribute lines.

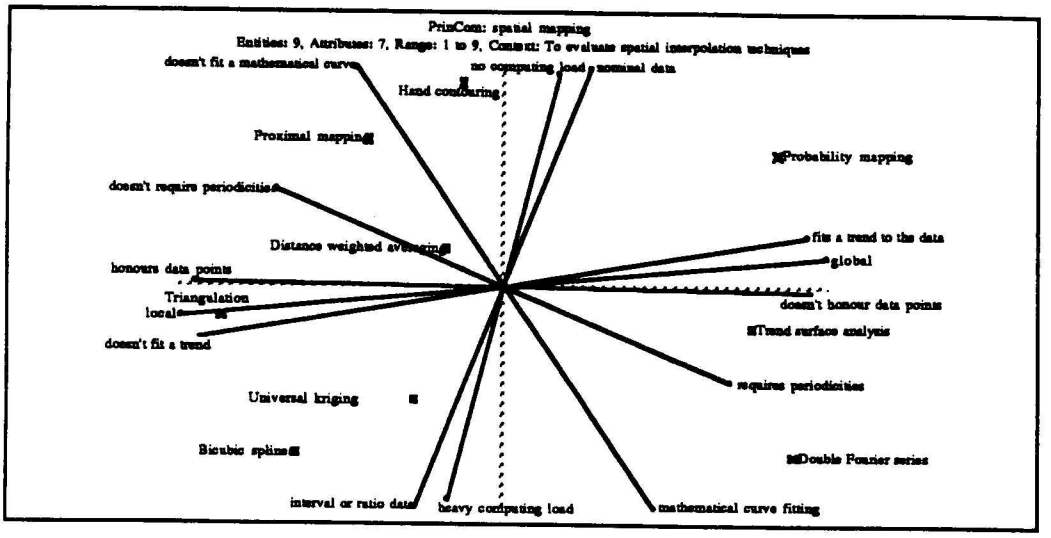


Figure 4: Spatial display through PrinCom

The entity names are positioned at certain co-ordinates from the zero point depending upon the influence the attribute lines have on the entity. The position of the entity point provides a means of viewing the third dimension in the way we conceptualize the information, similar to any object in existence occupying a certain space. An entity position is influenced by the correlations imposed by the position of the attribute lines and by the strength of influence between entity and attribute as dictated by the perpendicular distance from entity name to the attribute lines.

The perpendicular distance from an entity point to the intersection point of any one of the attribute lines with be the third dimension signifying the amount of influence the pole name has to the entity. The attribute lines may have to be extrapolated to allow an intersection to take place. The perpendicular distance is measured exactly the same way as previously stated. The distance along the attribute line from the zero point to the point of perpendicular intersection will show the percent amount of correlation a particular attribute pole has compared to the rest of the attributes. The positions of the attributes and entities are important in showing what items have an affect on each other and by how much.

The information obtained and rated from one elicitation set as a base class can be compared to the ratings obtained from the same or similar information performed by other individuals. This will show what components of information they agree or disagree upon and by how much. This combination and comparison of information for consensus analysis is generated by the Socio process as shown in Figure 5.

Again, the entity-attribute grid is used, but this time, the ratings from all individuals involved are shown as an average value for those items showing areas of similarity or differences up to a stated value. The information is arranged to reveal the highest agreement rating between

items first with the other values below it in descending order as shown in the entity-attribute arrangement. This grid is used as an entity-attribute compare in which you have the same entities-attributes but possibly different values to show whether the experts agree on the definition of attributes. The values in the grid represent the amount of difference from one experts values designated as the base line compared to the other experts' values. You can obtain similar grids that show just the entity values from the base line in an entity compare or just the attribute values from the base line in an attribute compare.

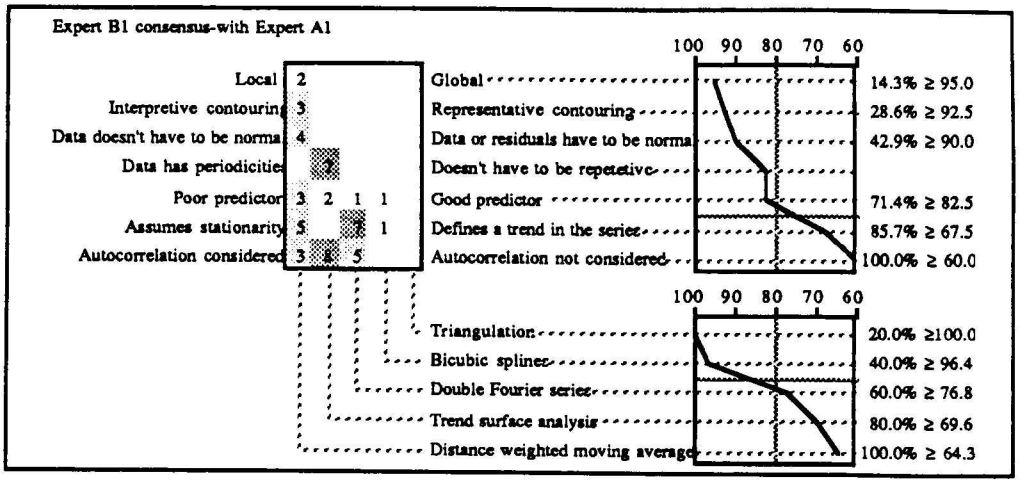


Figure 5: Socio grids showing regions of similarities and differences

A graph of percentage values showing the correlations in similarities and differences between individuals is plotted beside each set of attribute and entity words. These two graphs are known as difference grids. The percent agreement values are plotted against the percentage increments in the amount of consensus between items of similarly matched rating. That is, the second expert's rating of the first expert's entities relative to the attributes are subtracted from the first experts ratings to give agreement or disagreement from the base line. This is done for both entity and attribute areas. As a result, the graph shows where there is agreement between individuals with a high percentage rating in the top left quadrant while revealing some disagreement with items having a lower percentage rating. The grey horizontal and vertical lines placed within the graph show the cut-off positions for acceptable agreement and for items that are to be rejected because of unacceptable conflict. The grey lines divide the graph into the four regions of consensus, correspondence, conflict, and contrast as discussed later in the Socio section of the manual.

Textual information that can be obtained in Socio come in the form of entity-attribute comparison, entity comparison, attribute comparison, mode attributes, and socionets analysis. The comparison text provides detailed information on the amount of difference between the base line expert values and the other experts' values. The mode and socionet analysis are used to group and show the linkage between the experts and their information. They are described in detail in the Socio section of the manual.

The correlation of information is placed into the form of rules as shown by Entail process, Figure 6, and Induct process, Figure 7. Each method has a similar way of determining the correlations and implied links between the various items with Entail being limited to singular links while Induct allowing both singular and multiple links between the items. The > sign has the meaning "implies" to indicate what outcome is implied if a certain entity or attribute item or group of items is considered. The correlations allow KSS0 to link together entity and attribute names to show how one thing leads to or "infers" another. The rules have the form of a natural "english" language style that is readily understood and visualized by people. The correlations and percentage values of truth and probability, located beside the rules, will indicate a measurable amount of accuracy and acceptability of stated rules. These values are calculated automatically within KSS0 from a pre-defined formula with values from the measurable correlations in the other processes.

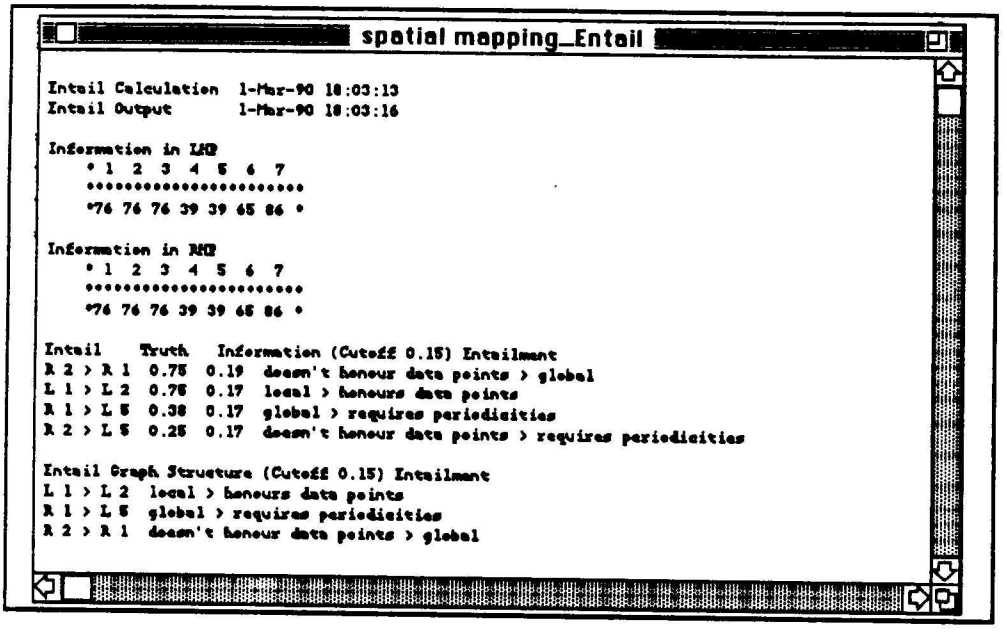


Figure 6: Entail rules showing linkage between the attribute poles

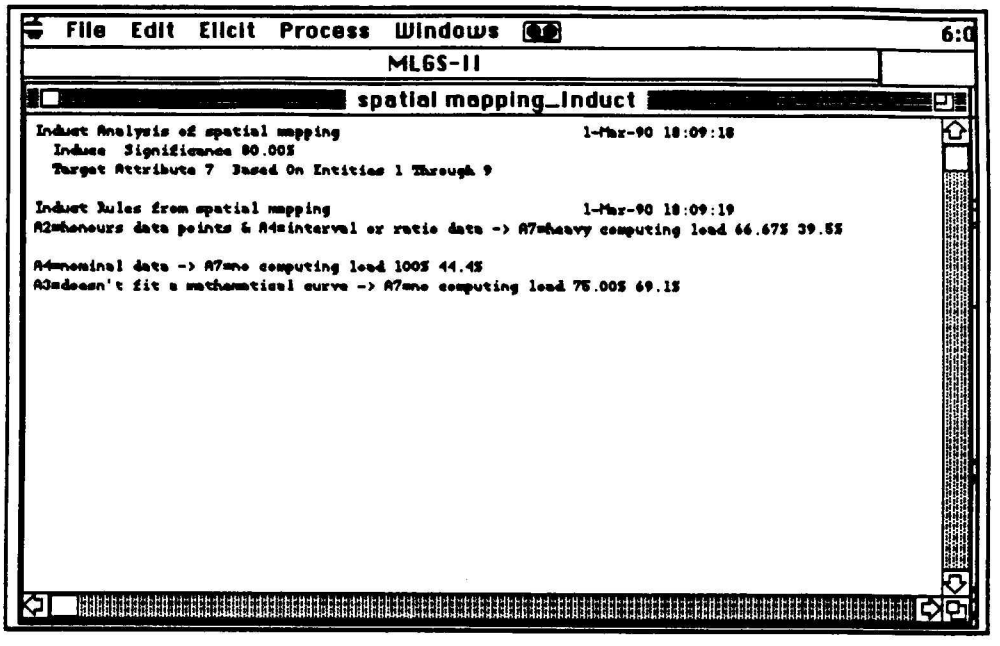


Figure 7: Induct rules showing linkage between the attribute poles

The rules are exported to the expert system shell which automatically changes the format to that required for the particular shell, as shown in Figure 8. The format will divide the information into the various components that make up the field and provide the correct syntax (grammatical form) to the information. The material is divided into property, class, object, and rule definitions. These definitions are used to break the information into divisions that can be used within the shell. Each division is further broken down into components used to define the various parts that make up the rule, listed with the given component names. This is done for the property (attributes) and class (rule sets) definitions as well as the components listed for the objects (entities) and the rule components for both the Induct and Entail areas. All or part of these features are listed and transferred to the shell depending on what is selected as required and relevant information for the expert system as defined by the Knowledge Engineer. With this information now in the shell, the rules become a knowledge base of information within an expert system program. Now, the expert system can be accessed to answer questions concerning the area of expert's knowledge.

```
(@RULE=  Ind2
  (@LHS=
        (No     (<languages>.suited_to_AI))
  )
  (@HYPO=       algorithmic)
 (@RHS=
        (Let    (<languages>.algorithmic)    (True))
  )
)
```

Figure 8: Export rule that is placed into knowledge base of expert system shell

1.3 Role of Client

The word client refers to the individual who is interacting with the program in the knowledge acquisition process. The process may involve only one individual or a number of individuals each interacting with the program separately or in a group. The role of you, the client, is to input their expertise into KSS0 and visually see the results to understand the thought process. You will also edit the data in conjunction with the Knowledge Engineer so that the rules are correct in their meaning. To do this, you must become familiar with the operational aspects of the Macintosh computer including how to move about in the program, how to interact and input information using the mouse and keyboard, as well as how to access various types of information. Also, you must be able to understand the procedure and purpose of KSS0 to complete and refine your input for the generation of rules.

The operation of KSS0 on the Macintosh computer will be explained in Chapter 3 of the manual. The Knowledge Engineer in charge of administering the program will explain the procedures and theory behind the process as well as answer any questions that you might have regarding your role. You are to perform the elicitation process and then display selected results as outlined by the Knowledge Engineer. You will then work with the individual to refine and edit the information so that the resultant rules displayed will reveal your perceptions and understanding of the area. As well, you will compare your results with that of colleagues if there is more than one individual involved in the process. The comparison of data is used to refine the information further to give a correct representation of the field of experts. You may be called upon at a later date to edit and test the resultant expert system for accuracy and integrity of resultant information.

1.4 General Computer Operation Procedures

This component of the chapter is designed to briefly explain the major operations and functions of the Macintosh computer relative to KSS0. It is intended for a user who is not totally familiar with the button/menu and mouse environment.

Interaction with this software involves the movement through KSS0, typing words into the program, and placement of these words onto scales for the automatic generation of graphic and textual linkage of information. These functions are accomplished with the pointer symbol on the screen, along with the mouse device and keyboard attached to the computer.

Movement or access to items of interest is performed by using the mouse and screen pointer or its keyboard equivalent commands. Place the pointer at the desired button or menu within KSS0 or on the window size functions. Click on the mouse key once if the pointer is at a button, size function, or close box. These buttons or boxes can access desired screens or select functions for their influence and control. Click on the mouse key twice if the pointer is at an access application or file icon. Hold down the mouse key and drag the pointer by way of the mouse for access to menus

and movement of screen windows size. The pointer is moved to the desired word under the menu or desired position for screen window and then released. This will move you to that particular location within the program or disengage the positioning action. The location and access time of the various buttons, menus, and size features will become apparent as you use the computer.

You can type words directly into the program from the keyboard when the pointer changes to an I-beam or flashing cursor symbol within a text field. You may have to position the I-beam or cursor by dragging the I-beam symbol over with the mouse or by clicking the mouse key and either symbol at the desired position to obtain the flashing cursor. You can type words into the program without a cursor if there is a greyed out area within a text field containing words already present. The old words will be erased and new letters entered in its position from the typing action.

Words and rating bars within rating screens can be positioned onto the scale at the desired location. Place the pointer onto the desired word or rating bar and hold down the mouse key while you drag and position the item onto the scale. The words can be repositioned anywhere on the scale with the same procedure. The words or rating bars have line connections that attach themselves onto the scale to show the proper location.

1.5 Overview of KSS0 Operational Steps

This component of the chapter provides a quick overview of the steps involved in the operation of KSS0 so that people familiar with the knowledge acquisition field can read this section and obtain a handle on what is to be done. It is intended to be read while you perform the elicitation so that you can understand the various sections of the program. Other individuals will be able to comprehend the general interaction and purpose from these steps.

The purpose of KSS0 is for the user to interact with the program to insert the words that make up and describe their area of expertise. Each of these words are rated on a series of scales to show their relationship to each other. The same words rated in the same or similar position on any of these scales will show a high correlation of data.

The objective is to break up these matches so that smaller and smaller areas are created which define the area of expertise more precisely. Also, measurements can be made between all of the words inserted to accurately depict the influences each word has on the other. Several methods exist within the program which help you break up these matches during the elicitation.

Once the field of expertise is completely defined, process screens are called up which automatically shows these relationships and correlations between the words. The graphic process screens visually depicts the position of all words relative to each other to represent your imagery of their placement and reveal how you think about your domain of interest. The

textual process screens provide accurate measurements of these relationships for in-depth analysis and refinement of the data.

The relationships are used to create the language style rules within the process function to define the way you think about the subject and infer new rules based on past results. The accuracy and relevance of all rules are defined by a percentage value calculated in the program from the distance and correlation measurements in previous processes. These rules are analyzed and edited for accuracy and then exported as a knowledge base onto a shell to create the expert system.

The following points give the overall brief list of procedures involved in the operation of KSS0 and analysis of results generated by the program:

- Open up KSS0 application or any desired file of information you wish to create, view, or edit.

- Type in your name and description of elicitation context in first window of title screen and select "Done" to move to next screen

- To create a new file of information, access "New Data" to bring up a dialogue box requesting file name. Type desired name name for the elicitate file and select "OK" to bring up Status window.

- To reach an existing file of elicitated data, access open command and select desired file name to open it up for viewing with the Status window being the first screen. This holds true for any file or application on computer hard drive or floppy disk. Once opened, you can change the information through the edit command.

- Access "Copy" if you want to elicit and rate previous files. This will bring up a dialogue box requesting a selection of files and a new name. Select "OK" once you have accessed the desired information to bring up Status window.

- Insert or edit any desired information within the Status window by typing words from the keyboard and selecting "Done" to insert the information below or by double clicking on the bold action words to reverse their function. Select "Done" to move to next screen once all revisions have been made.

- A new window will appear asking you to think of six or more entities. Click on "Advice" to view help windows throughout the remainder of the program if it is not already turned on. Select "Done" once you have six or more entities in mind to move to next screen.

- Type in entity name in this next window and select "More" to continue insertion or select "Done" after the last word is typed in the window to complete the insertion procedure and move you to the next screen.

- Choose a method of inputting the first attributes by the Triple or Pair

function from entity control panel, or Add function from the attribute control panel. Selection does not have any bearing on the outcome. The Triple selection is usually the best method to start the input of attributes.

- The Triple button will bring up a window asking you to distinguish between three random or selected entities. You can choose the three selections by clicking on the names in the list before you select Triple. Otherwise, the computer will randomly select three names from the list. Select the one name that is different by clicking on it to highlight and bring up a rating screen.

- Type in an attribute name by means of describing the difference between the two groups and select "Done" to input this value. Insert the opposite of this attribute for the other end of the pole. Position the remaining entities on the scale and move to the next screen by selecting "Done".

- The pair selection procedure is the same except that no screen is required or utilized to separate the names. Each name in the random or selected pair are automatically placed at opposite ends of the scale.

- Movement to the attribute area allows you to input attribute name pairs one set after the other through the "Add" function. Move to this area by selecting the "To Attributes" or whatever name you have provided to the attribute area.

- The values you have inserted are unrated. Click on the desired pair to select and highlight it. Select "Rate" from the button control panel to bring up a rating scale in which you can position the entities on this scale. Select "Done" to return to the previous window in entity or attribute area with the button control panel. The Rate button will change to an Edit button once all items in the list have been rated. Click on one of the names to select it and click on the Edit button to move to its rated screen so that you can change any of the rated values.

- Choose one of the methods that will reveal the similarities between the ratings of entities and attributes to break the matches. These methods include the show button with directional arrows and rating bar, selection of entity or attribute names to show matches, as well as the dialogue boxes used as access buttons indicating specific high correlation matches. These methods are used in both the entity and attribute areas. Access to each area is accomplished by clicking on the appropriate "To Attribute" or "To Entity" or related name button. Any choice in method will not change the results to any great extent in the end. The choice depends on what method you feel comfortable with and what method provides the best form of information to break the match. Try all methods at least once during the elicitation.

- Select the rating bar button to reveal matched items from either entity or attribute list. The highest matched words will be automatically

highlighted in the list while the rating bar above the button indicates the percentage of correlation. Click on either arrow button beside "Show" to move up or down the list of matches. Click on the Show button itself to move to the rating screen for the specified highlighted match. It will contain either a vertical rating scale to show the rating of both entity systems on one scale or a horizontal rating scale to show the rating of both attribute settings on one scale.

- The scales will show the matches between names. You can adjust the position of words or attribute bar settings by dragging the values to a more realistic position. Another option is to answer the question at the top of the window. By answering "Yes" to the question, you will obtain a screen in which you can type in a new entity or attribute pair names, depending upon the form of matches, and select "Done" to accept the information into the area. Then, rate the entity or attribute names by positioning the names or bars onto the rating scales.

- Another form of showing the matched values is to select a random set of listed entities or attributes. Click on any two sets of entities or attributes, depending on your location, to highlight the names. View the rating bar to see the percentage of correlation. Click on the rating bar to bring up matched rating screen for editing if the correlation percentage is high.

- Dialogue boxes will automatically appear on the entity or attribute listing screens indicating a high correlation between certain specified names. Click on the button dialogue box to access this matched rating screen in which you can edit the existing ratings to reduce the matched areas.

- If you wish, you can edit an existing single entity or attribute rating scale by clicking on the desired name to highlight it and click on "Edit" to change the rating of that entity or attribute scale.

- Dialogue boxes can also appear on the entity or attribute listing screens indicating that you have not rated certain items. Click on the button dialogue box to bring up this rating scale that has no ratings or only partial ratings. Position the names or bars onto the scales to complete the rating process.

- You can add a new entity or attribute pair at any time in the elicitation process. This can be done to input new ideas and areas not yet placed in the program from the original set or from the breaking of any matches. Move to the desired area for the insertion by choosing "To Entities" or "To Attributes" or their similar form. Click on the "Add" button from either entity or attribute listing screen to bring up a screen with an input box and rating scale. The rating scale will be vertical for attribute input or horizontal for entity input. Type the names in and rate the opposite values onto the scale. Select "Done" when you are finished to move you back to the listing screen.

- From any area listing screen, you can navigate to the other area listing screen through its access button. This action will take you to the other

section in the program where you can add new names and rate them or find any high correlation of matches for editing. Continue the procedure of adding new rated entities or attributes and breaking any matches until you have entered all you wish to input or can think of as well as broken all or most of the matches to the best of your ability.

- Select a process method from the menu bar at the top of the screen from anywhere in the program or from the button control panel that contains the general navigation areas for opening files and accessing process screens. The button panel can be accessed by navigating back to the Status screen and clicking on the Quit button at this screen to move you back to the title screen with the button control panel.

- The selection or order of selections does not matter. The viewing of certain process screens depends upon what suits your ability to analyze the results. Try all methods first except "Export" to get a quick handle on what information is presented.

- A format window will appear for each process. Change the style output to your liking and click on "OK" or simply click on "OK" to accept the default format.

- The selected process screen will appear in a variety of graphic and text forms showing the relationships and correlations you have made. Analyze the results the see if the amount and position of correlations are correct relative to your way of viewing these items. Edit the data on these screens by clicking on the inserted words and typing the new word in its place. If the placement is incorrect, go back to the elicitation process to adjust the ratings or add new values. The procedure of moving between elicitation and process result screens can occur several times in order to correct and refine the data. Also, the process screens can be accessed during the elicitation to guide you in the proper insertions and ratings. Access back to elicitation windows is accomplished by clearing the process windows to reveal the elicitation windows. Navigate in these windows by way of the various control panel buttons.

- Click on the little box in the top left corner of the process window to clear the screen. Select another process window and analyze its results, making any changes if necessary. Select Socio process if you wish to combine several elicitations from different people on the same topic to reveal areas of consensus or conflict. Continue the selection of processes until you have analyzed all areas and any duplication of processes so that all no incorrect data exists.

- Inexperienced people who do not know how to load a knowledge base onto an expert system shell can quit the program at this point. Simply select "Quit" from any point you are situated within the program.

- Select "Export" from the process section to bring up a format window to select the shell you wish to use and the type of rules to be inserted. Edit

or accept this default parameters to bring up a screen of formatted rules and access to the shell. You will have to interact and answer some dialogues in order to integrate the information into a knowledge base within this newly formed expert system.

- Test the expert system for accuracy by finding out the answers and connections to known, unknown, and erroneous situations. Edit and debug the system as required.

1.6 Getting Started

The following procedures are used to set up KSS0 and its related files onto the computer with the required configuration requirements. It will demonstrate the proper procedure for accessing the application and information files and opening them up for viewing. Several forms of quitting the application or information files are discussed also.

1.6.1 System Requirements

KSS0 will be able to run on any Macintosh Plus, SE, or II with one Megabyte or more of memory and the latest official release of the operating system. Anything less than this will not allow the program to function properly. Although KSS0 can be run off the floppy disk it is sent out on, it would be best to load it onto the hard drive of your computer to take full advantage of the larger memory available.

KSS0 can be run at the same time other programs are operated on the computer. This is accomplished by using the MultiFinder function of the Macintosh along with at least one Megabyte worth of memory. Information from other programs can be imported into KSS0 or vise versa with information from KSS0 being exported to other programs.

1.6.2 Installing KSS0 on Hard Drive

The KSS0 disk should contain the following:
a READ ME file
a KSS0 folder containing the application program and relevant files of information used in conjunction with KSS0

The READ ME file will provide a set of rules on how to operate the program with information on the different components that make up the KSS0 folder for easy reference while in KSS0.

The following procedures should be performed to transfer KSS0 onto the hard drive of your computer:

1. Copy the KSS0 folder to the hard drive by dragging the folder icon to an appropriate location of your choice within the file listing window.
2. Repeat the same procedure for the READ ME icon.
3. Make sure that all of the appropriate files within the folder remain at this location and are at the same level.

1.6.3 Opening Up Program

Double click the mouse button while the screen pointer is positioned on the large K application icon any time you want to enter KSS0 as shown in Figure 9. This allows you to enter the KSS0 application itself where you will receive the title screen of the program. From here, you will be able to create a file for new elicitation material or open up an existing file within the KSS0 folder or any other file/application contained on the hard drive or floppy disk inserted into the computer. You can navigate and interact with the program to input or edit any information within a file once the title screen of the new/existing elicitation file appears.

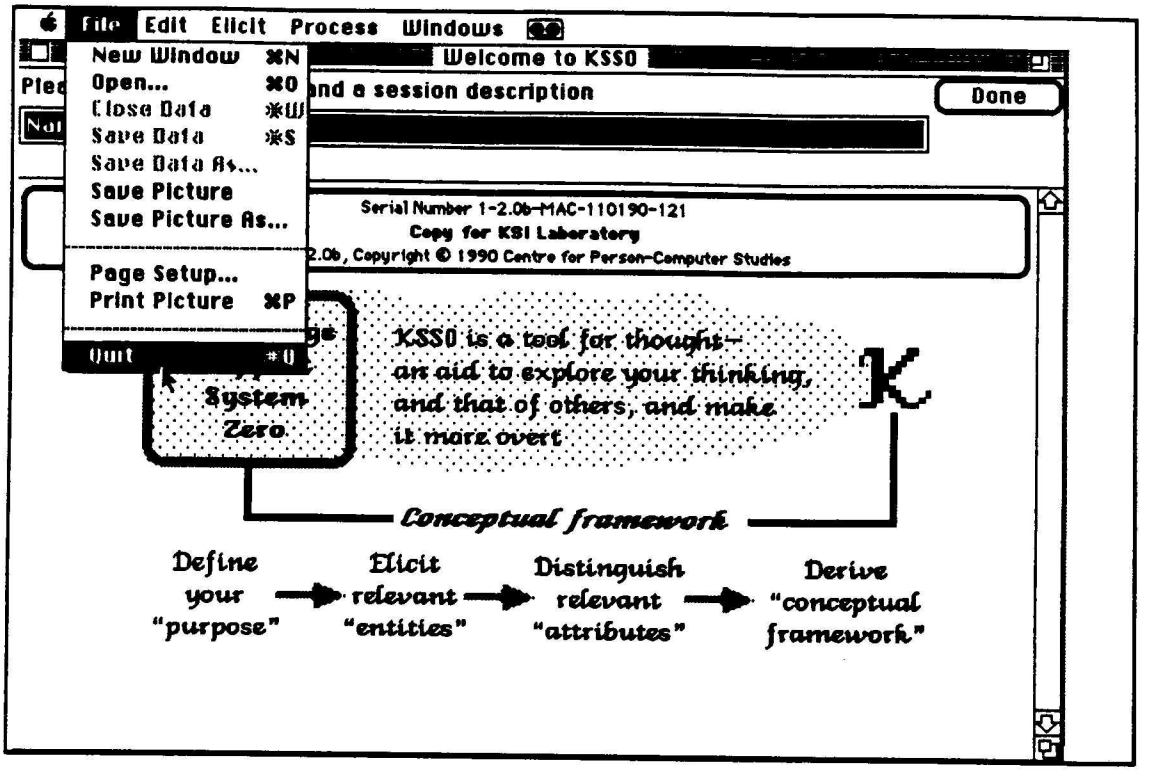


Figure 9: Clicking on application icon to enter program

Alternatively, you can double click on any of the file or application icons contained within the KSS0 folder to access their specific information. If the information opened up requires the KSS0 application in conjunction with the file in order to operate, the file will automatically open up the application at the same time. This is particularly important for files that contain saved data from previous elicitations which require the application to display results. You will be able to access all other applications and files of information on the computer or floppy disk from any application/file that you have opened. This applies to all files and applications contained on the computer.

1.6.4 Exiting To Quit KSS0

Any time you are in the KSS0 application program or any of the files, you can exit the program back to the window of folder icons. This is accomplished by accessing the file menu listing from the main menu bar at the top of the screen, shown in Figure 10. The screen pointer must be positioned at the word "File" while the mouse button is pressed and held down. Then, the pointer is dragged down to the word "Quit" by moving the mouse and releasing the mouse button when you reach this word. The screen will change to the screen of icons where you will be able to access other applications, files, or KSS0 application again. This can be done at any screen within KSS0 or within any screen of other applications and files to quit their operation. If the menu bar is not present, hold down on the apple Command key while you press and release the space bar of the keyboard. This will cause the hidden menu to appear onto the screen.



Second, you can exit using the keyboard commands instead of the menu bar. Simply hold down the apple Command key while you press and release the letter Q key. This will perform the quit function as noted above. Again, this can be accomplished from any screen within any program.

Although a "Quit" button does exist on the status screen of KSS0, a click on it only exits you from this screen back to the button control panel screen for access to files of information.

Any other form of clearing the computer screen will not quit the application even though you may remove the information present. The application or file you are in must be terminated completely in order to quit the application and free up the memory used. Furthermore, this will allow you to access other files and open them up for viewing.

2. COMPONENTS OF KSS0

This chapter will discuss what the program is comprised of and show how the various components are related to each other. It will provide a quick overview of the different graphical, textual, and interactive screens you will use in the knowledge acquisition process.

2.1 File and Application Icons

When you first double click on the disk icon to access the disk contents, you will obtain a window screen with several icons as shown in Figure 11. The icons are graphical representations for the various applications and files that make up the complete KSS0 profile with all of its capabilities. By double clicking on the "READ ME" icon, you will obtain a screen with textual information on the operational set-up procedures for KSS0 along with a description of the various icons that may be present.

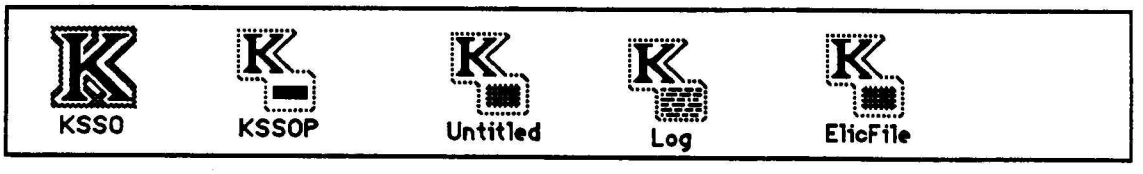


Figure 11: Example icons to allow access to program regions

One of the possible icons will be the application program itself with the large K symbol. This is the icon used to first enter into KSS0. When you double click on this icon, KSS0 will open up to the title screen for access and interaction with the program. There may be other files and applications present depending upon whether set styles have been created for the information or application programs used in conjunction with KSS0. A record file is created showing a list of your entries and tasks performed in KSS0. Data is stored in picture or text files from information placed into KSS0 or information used with KSS0. Included with the disk may be sample files that contain data used with KSS0 to provide examples and illustrate how the program works.

The styles and format for the graphical/textual information are contained in the "KSS0P" parameter file in the NTP form. It will consist of the default parameters such as text font type that are used within KSS0. It is created from KSS0 when you utilize and define set styles in the application. This file should remain with the KSS0 application icon if you decide to transfer the KSS0 system to another disk or hard drive. It is a storage file only and requires no operation by the user.

Other application programs may be present that represent different forms of KSS0 or other applications used in conjunction and accessed by KSS0. The variations of KSS0 and other applications will be clarified in the "READ ME" file.

Each time you log into KSS0 and perform any number of operations,

a record of what you did in the proper sequential order is kept and stored in an external file, known as "Log". This file can be accessed from within any KSS0 elicitation. It contains the transcript of one or more previous KSS0 sessions. The information is normally accessed through a given elicitation program but can be accessed by double clicking on the "Log" icon itself.

Results from previous program elicitations along with external data files used as aides in the program interaction are stored in text and picture files. The type of file depends on the format which the information is presented within KSS0. The data is used in conjunction with KSS0 and accessed from the program. Also, the information can be accessed by double clicking on the specific icon to open it up. This will automatically open up KSS0 application in conjunction with the data for viewing of results in its proper format. A separate file for text or pictures is represented by different icons depicting text or graphics.

Example elicitations along with the elicitations that you create from interacting with KSS0 are represented by grid data files as shown in Figure 11 with the ElicFile icon. These are files that contain the elicitated information which are used in conjunction with the KSS0 application program. The grid data files are given a name when you save the information which is then placed at the bottom of its icon. You can access the information by either double clicking on the appropriate grid icon or through the KSS0 application program itself. In both cases, the application is used with the data files so that you are able to view the information in its original graphical form. Every time you perform an elicitation and save the data, a grid data file icon will be created that contains this information. The information can then be accessed through this icon at a later time.

2.2 Title Screen

The title screen will appear when you double click on the KSS0 application icon, Figure 12. This screen allows you to initiate the session and provide access to the button panel. This is accomplished when you click on the word "Done" to accept this information into the program and access the navigation abilities onto this screen with a button control panel, Figure 13. The title screen exists by itself without any features added or it can contain functions and questions used to input information or navigate through the program. From here, you can access the entity question screen onto the title window for input of your entity names as shown in Figure 14.

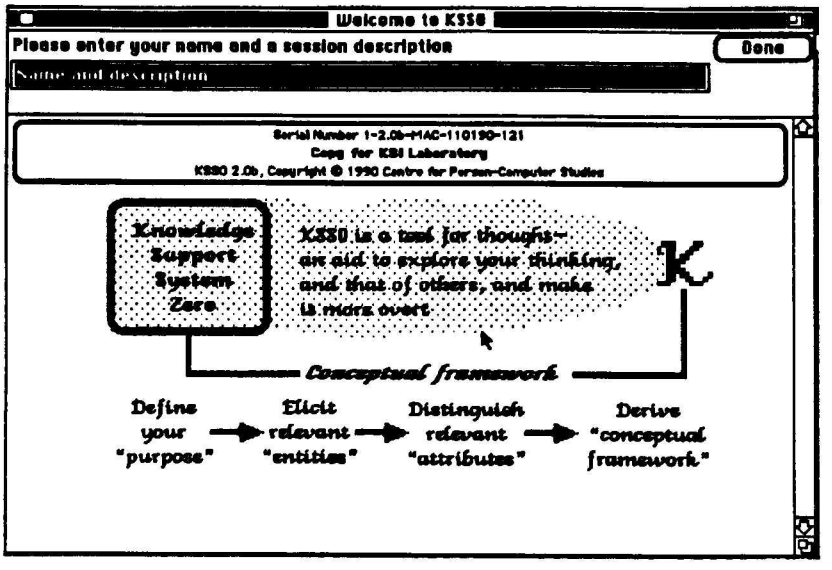


Figure 12: Title screen for KSS0

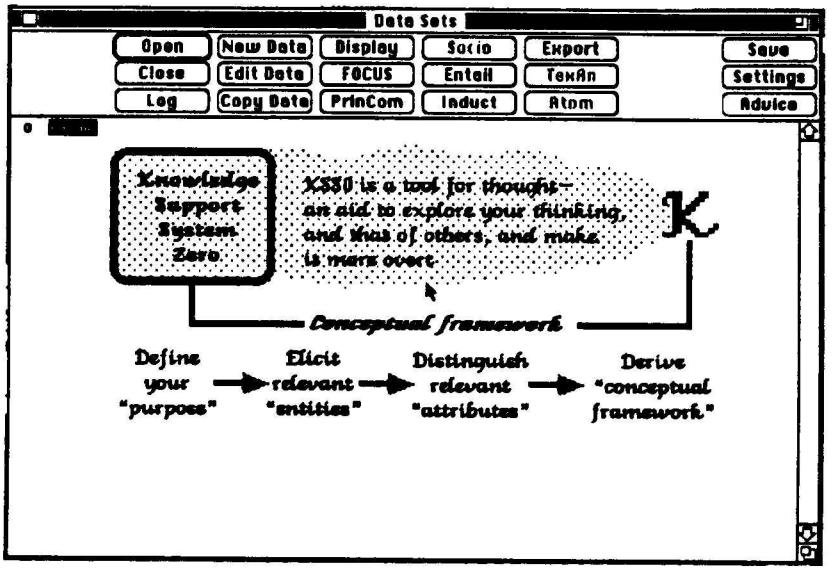


Figure 13: Title screen with access control panel

The information contained within this screen will change for the various applications it is used for in the program. The initial screen will define what KSS0 is used for and give the different interaction areas of define your purpose, elicit relevant entities, distinguish relevant attributes, and derive conceptual framework. An outlined box will circle one of these areas depending on what function you are performing with this screen. The definition in the middle will change as well to define each area that you are in at the time. The name(s) of this file along with any other files will be highlighted onto this screen once you have accessed and named the files.

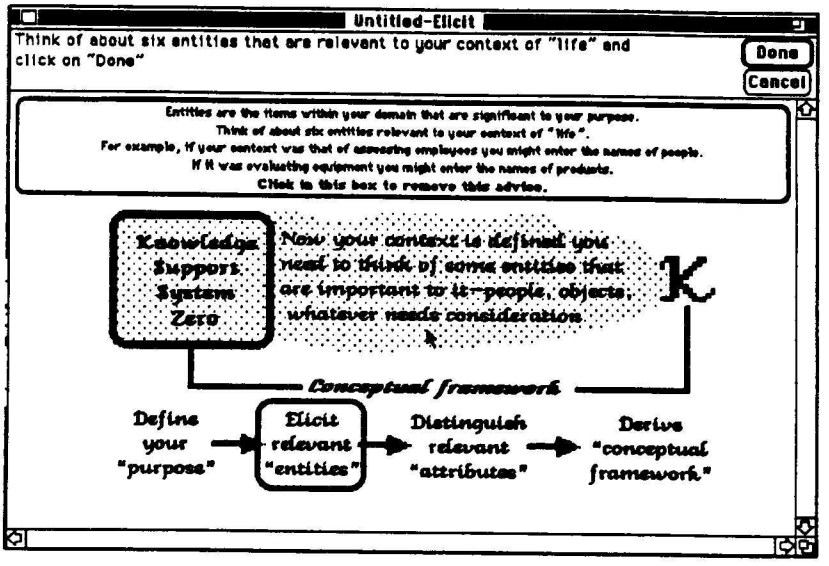


Figure 14: Title screen with access to entity name input

2.3 Status Screen

If you are creating new data, a status screen will appear asking you for information relative to the type of input, names, and range of settings. This is illustrated in Figure 15 and explained in detail in chapter 4. You will also obtain this status screen if there is previous data you would like to access but you want to change the information to the settings you think the information should be positioned. In this case, you will be required to copy the data over and specify the new names and context in the status screen.

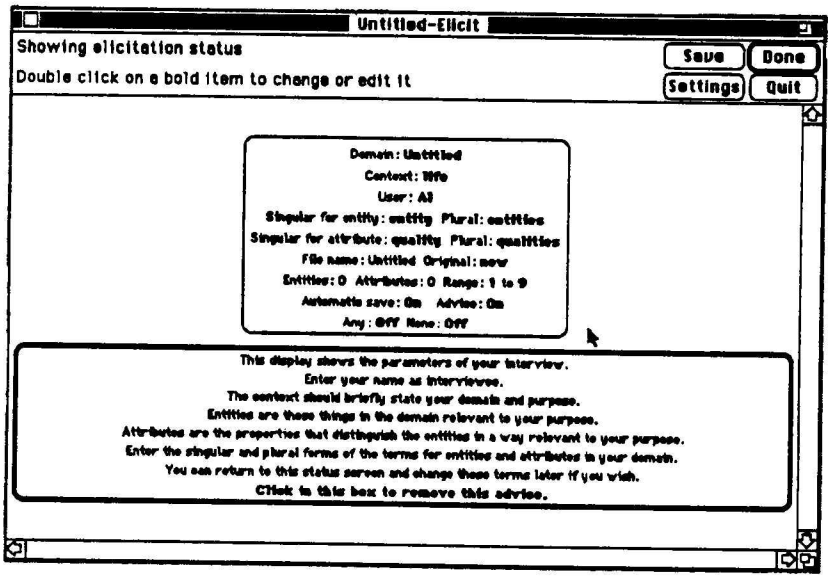


Figure 15: Status screen for input on background information

2.4 Log Screen

As you progress into the program, you will perform a number of tasks and create a number of graphical/textual screens. You may want to view a listing of events to see how you have maneuvered within the program along with the date/time these events occurred for reference purposes. Also, you may want to add your own comments to provide a frame of reference to the elicitation process so that you can go back and review your work. The resultant listing of events is given in the log screen shown in Figure 16.

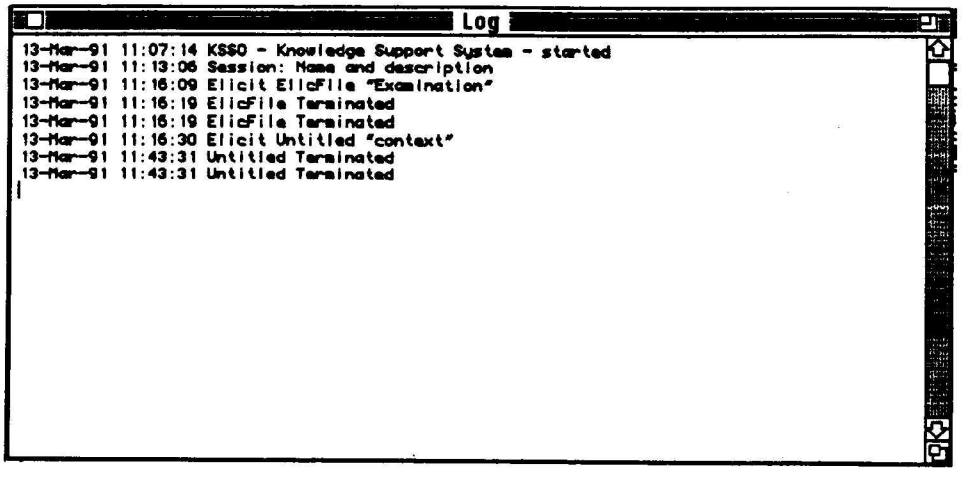


Figure 16: Log screen showing the list of events

2.5 Elicitation Screens

The process of inputting the information into KSS0 is done on a series of elicitation screens. These screens allow you to define what words you want to use within your domain and rate them relative to each other according to their position on a scale. The words include the names of concrete objects or abstract idea entities within the field and the qualitative words used to describe these entities. These screens are updated with advice throughout the elicitation process with relevant material to provide assistance in the breaking of matches.

2.5.1 Navigation Control Panels

During the elicitation, the control panel of buttons will change as different forms of elicitation screens are used. This will allow different forms of access privileges depending on whether you want to access information files or result screens, entity rating screens, or attribute rating screens.

The main control panel contains access buttons for navigation to any area in the program. This includes general information areas in the form of files, result screens, or access to entity definition area as shown in Figure 17. From this main control panel, you may access previous elicitated data (your own or the examples provided) or start a new session for an interactive elicitation. You can access result screens through the process buttons listed at this panel or use the Process menu.

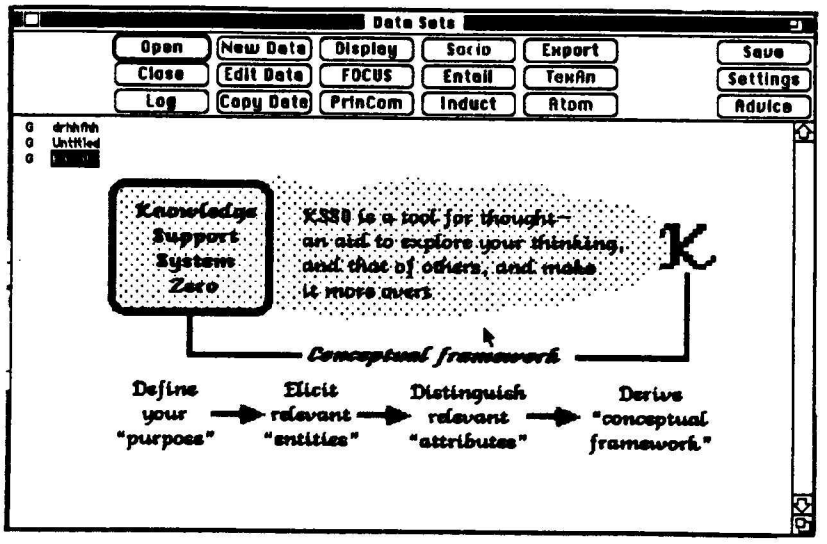


Figure 17: Main control panel of buttons

This panel will change to an entity navigation button panel, Figure 18, when you are defining an entity or its position. The new control panel allows movement in the entity elicitation screens. It is characterized by a button that allows movement to the attribute screens, in this case defined as "To Characteristics". This screen will contain a listing of the entity words you have inserted to that point. The panel contains buttons to access triple or pair screens which provides you with a screen to define the separation of words for the rating process. The add and delete buttons allow you to input or remove entity words. The show and arrow buttons allow you to find listed words that have a high match of similarity with the amount indicated by the rating bar above the buttons. The rate button moves you to the rating scale for a selected entity where you can edit or position the attribute words in relation to the entity word.

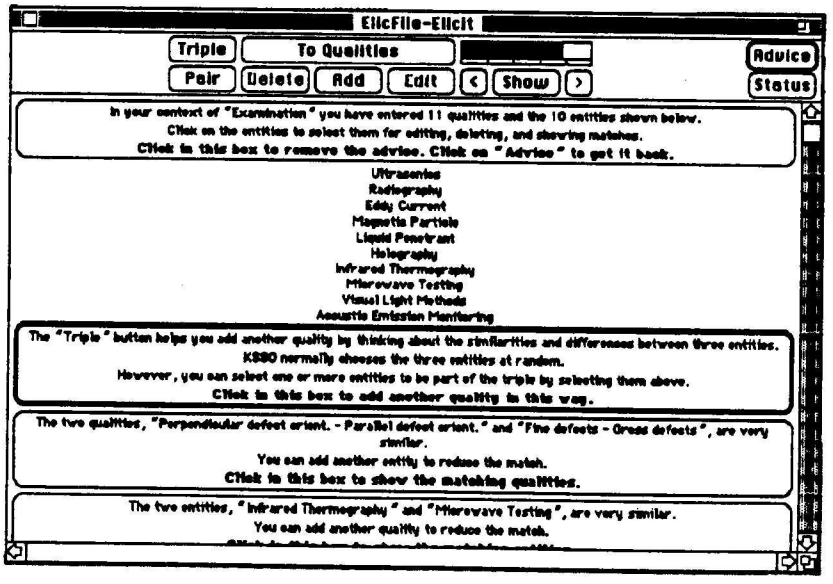


Figure 18: Entity list control button panel

You will obtain another button panel if you are in attribute elicitation screens or if you click on the button in the entity panel that moves you to the attribute screens as shown in Figure 19. The new control panel allows movement through the attribute elicitation screens. This screen will contain an attribute navigation control panel and a listing of attribute pairs defined to that point. This time, the area button changes to allow access back to the entity control panel, in this case called "To Techniques". The buttons of delete, add, rate, show, and rating bar are used in the same manner as the previous control panel except the functions are performed on the attribute words. The rate button will provide access to a rating screen in which you can rate the entities onto an attribute scale. The triple and pair buttons of the entity panel are replaced by the type and flip buttons. The type button provides access to a format screen that allows you to change a selected attribute output setting. The flip button allows you to change the position of a selected attribute pair by reversing the names in the pair.

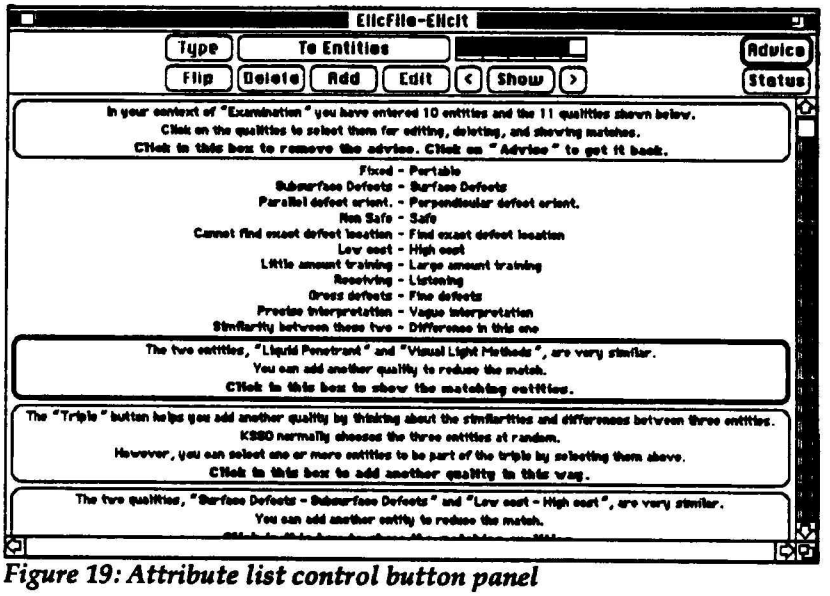


Figure 19: Attribute list control button panel

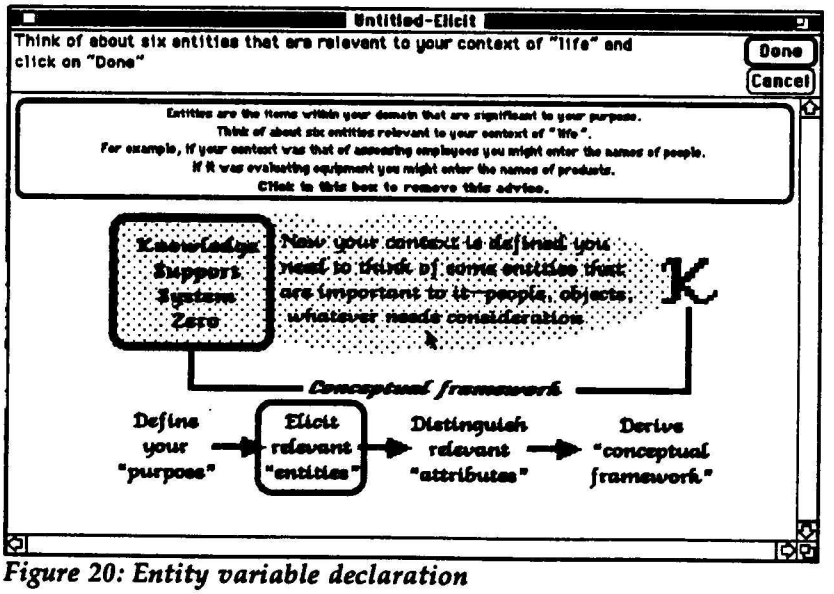


Figure 20: Entity variable declaration

2.5.2 Variable Declaration Screens

Figure 20 shows the screen that asks you to think of the words you want to enter into the program while Figure 21 illustrates the type of screen used to insert the names into KSS0. This form of input screen exists only for the entity area. You can separate the words to obtain a random or selected set of two or three words shown in Figure 22 so that you can break the similarities between these words.

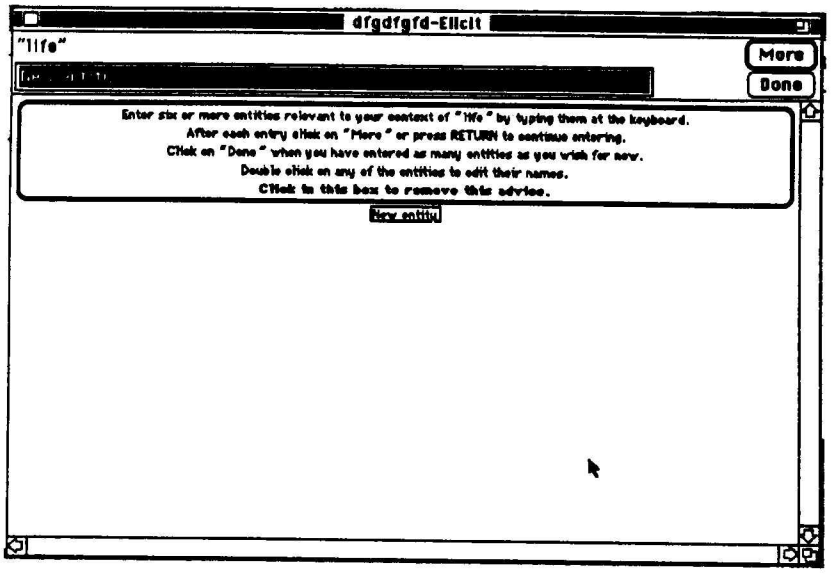


Figure 21: Insertion of entity names

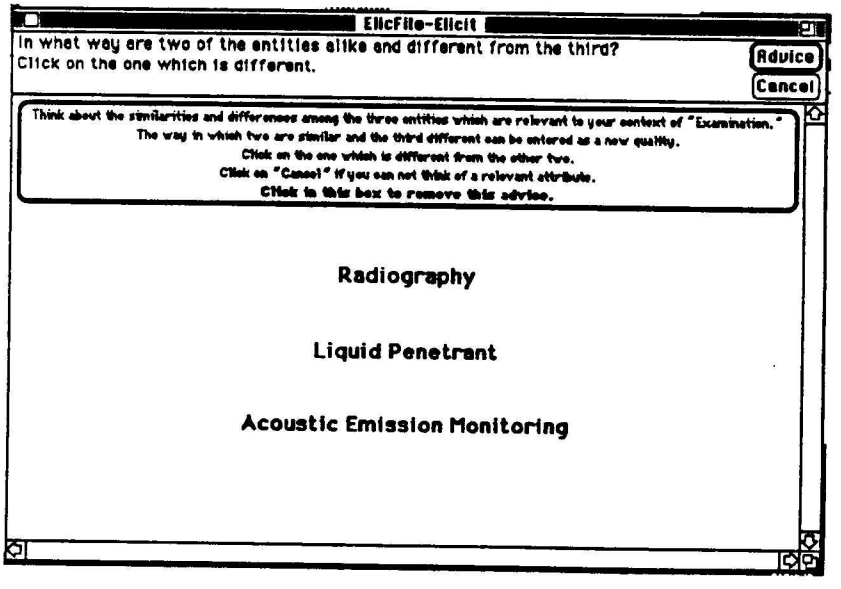


Figure 22: Separation of entity names in order to distinguish the differences

2.5.3 Attribute Rating Construct Scale

A screen that allows you to interact and place the entities on a scale between the two endpoints of an attribute pair is provided in Figure 23. This is known as an attribute rating construct scale since you are rating the position of attribute poles as defined by the entities. The entities can be dragged over and placed anywhere on this scale depending on the position you feel it should be positioned on the pole relative to the other entities and attribute poles.

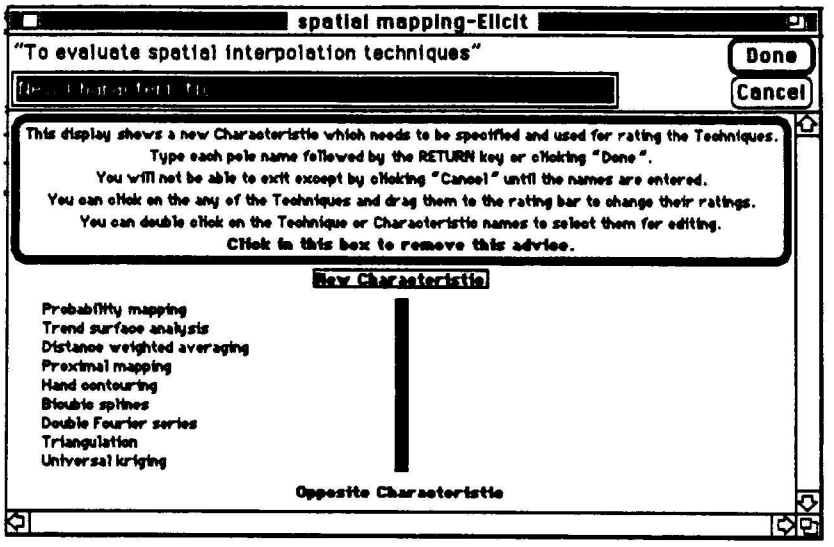


Figure 23: Attribute insertion and rating of entities

2.5.4 Match Type Attribute Scale

After you have rated the entities on the attribute scale, you will be able to show the matches between any two attribute pairs as shown in Figure 24. This scale shows you where there is a high correlation between the position of the same entities relative to both attribute pairs. You will then be able to adjust these positions in a number of ways so as to break these matches.

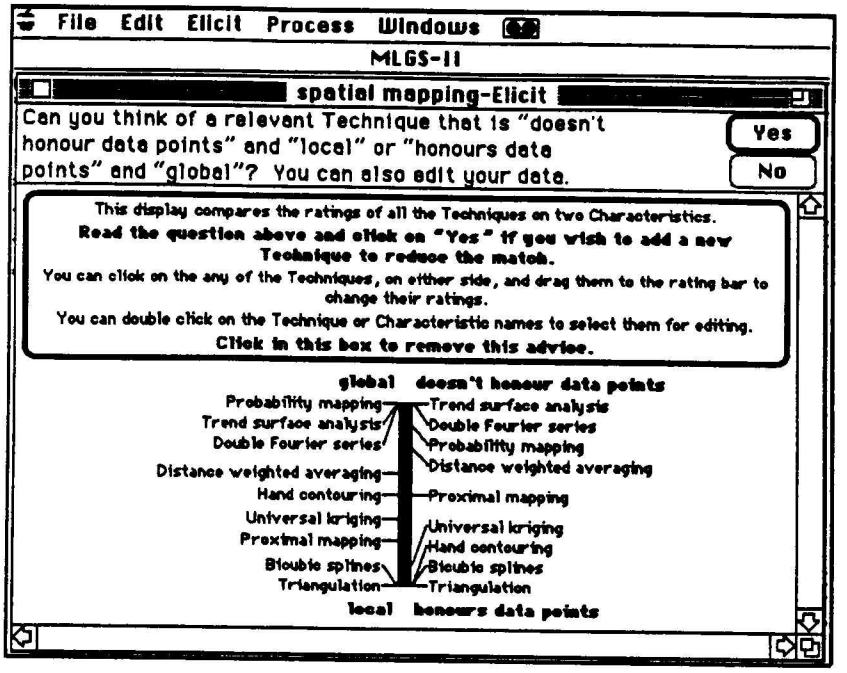


Figure 24: Match type attribute scale

2.5.5 Entity Rating Scale

Another scale that allows you to rate an entity is given in Figure 25. Here, you are defining a new entity after you have found an attribute match. Then , you rate the various attributes already listed relative to this newly added entity. This is known as an entity rating scale since you are rating a single new entity by means of the attributes to show the measure of effect these attributes have on this entity. The vertical bar can be dragged across the line to position it in a location that best describes the percentage of effect a given pole end has on the entity.

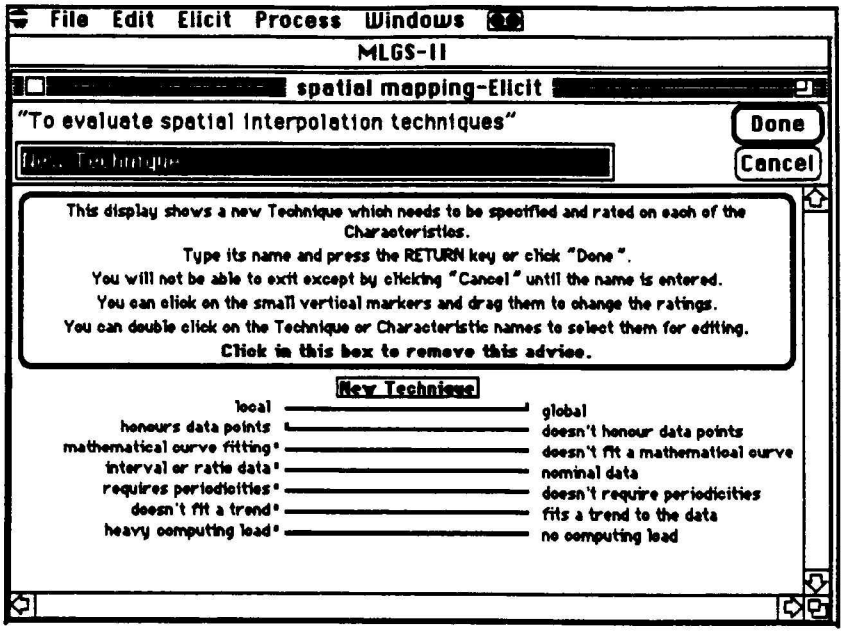


Figure 25: Entity insertion and rating of attributes

2.5.6 Match Type Entity Scale

After you have rated the attributes on the entity scale, you will be able to show the matches between any two entity scales as shown in Figure 26. This scale shows you the matches in rating positions between the two entities. You can then adjust the entity positions in a number of ways so as to separate the incidences of matched entity ratings.

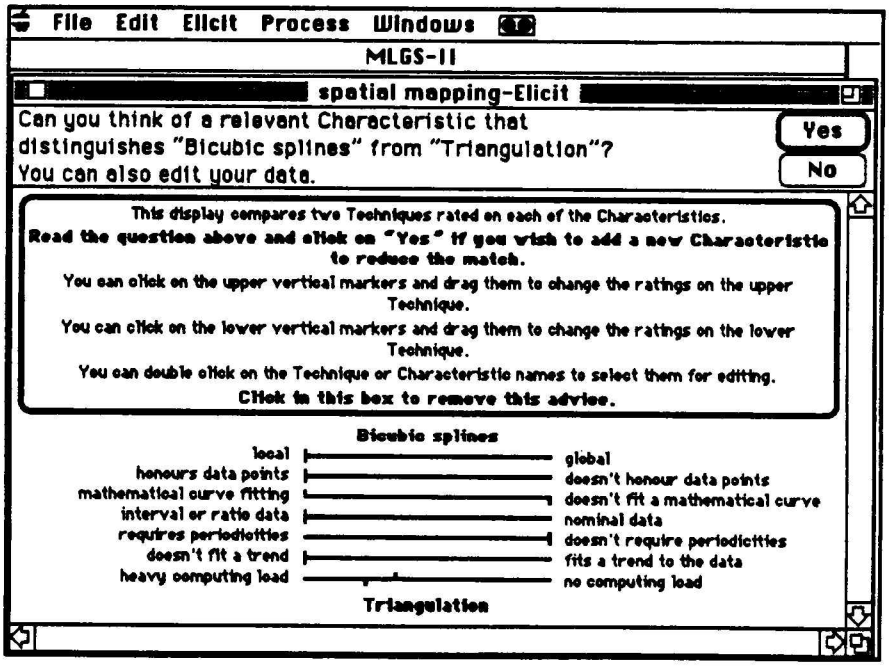


Figure 26: Match type entity scale

2.6 Result and Analysis Screens

Once the elicitation process has been completed, you can then display the information in a series of graphical and textual representations. This information correlates the data and provides a way of analyzing the results to show the underlying principles of thought. From this point, implied rules are created to correlate the data into english language form that indicates the relationships. The screens involved in this process include a format type that allow you to adjust the setting and appearance of the information, a graphical type that provides a visual representation of the data, and a textual type that gives the information in terms of written words and numbers to analyze the relationships.

The areas of analysis include Display, Focus, PrinCom, Entail, Induct, Socio, and Export output parameters. Also, the analysis methods of Texan and Atom may be included within KSS0 output. The novice user will be primarily concerned with the Display, Focus, PrinCom, and/or Socio methods while the Knowledge Engineer will utilize these along with Entail, Induct, Export, and possibly Texan or Atom in the interpretation/analysis of results.

The Display, Focus, and PrinCom screens show the results in terms of spatial and clustering relationships of the data for a single person elicitation while the Socio analysis provides this information for multiple persons performing the same area of elicitation. Entail and Induct screens create the rules of logic; linking the various information together into implied ideas generated from the data. The Export screen transforms these rules into the proper format for the desired expert system shell. Texan and Atom analysis screens are not presently available in KSS0 so am unable to show examples of their use. They provide a means of breaking down information provided in a text file and analyzing the parts to separate out the required information.

2.6.1 Format Screens

The format screens used with the various analysis screens are shown in Figure 27. They include the settings for both the graphical and textual formats for the analysis areas as well as the settings for attribute output. The format screens are: (a) Display Mode format (b) Focus Analysis format (c) PrinCom (principle components) Analysis format (d) Socio Analysis format (e) Entail Analysis format (f) Induct Analysis format (g) Export output parameter format (h) Attribute Type format. Each of these screens can be adjusted to output selected results in a desired format. The formats are initially set up to a default setting that provides the most effective and likely desired format. As a result, the novice user will rarely have to adjust these settings. The adjustments are usually performed by the Knowledge Engineer to establish more in-depth analysis and provide different aspects to the results.

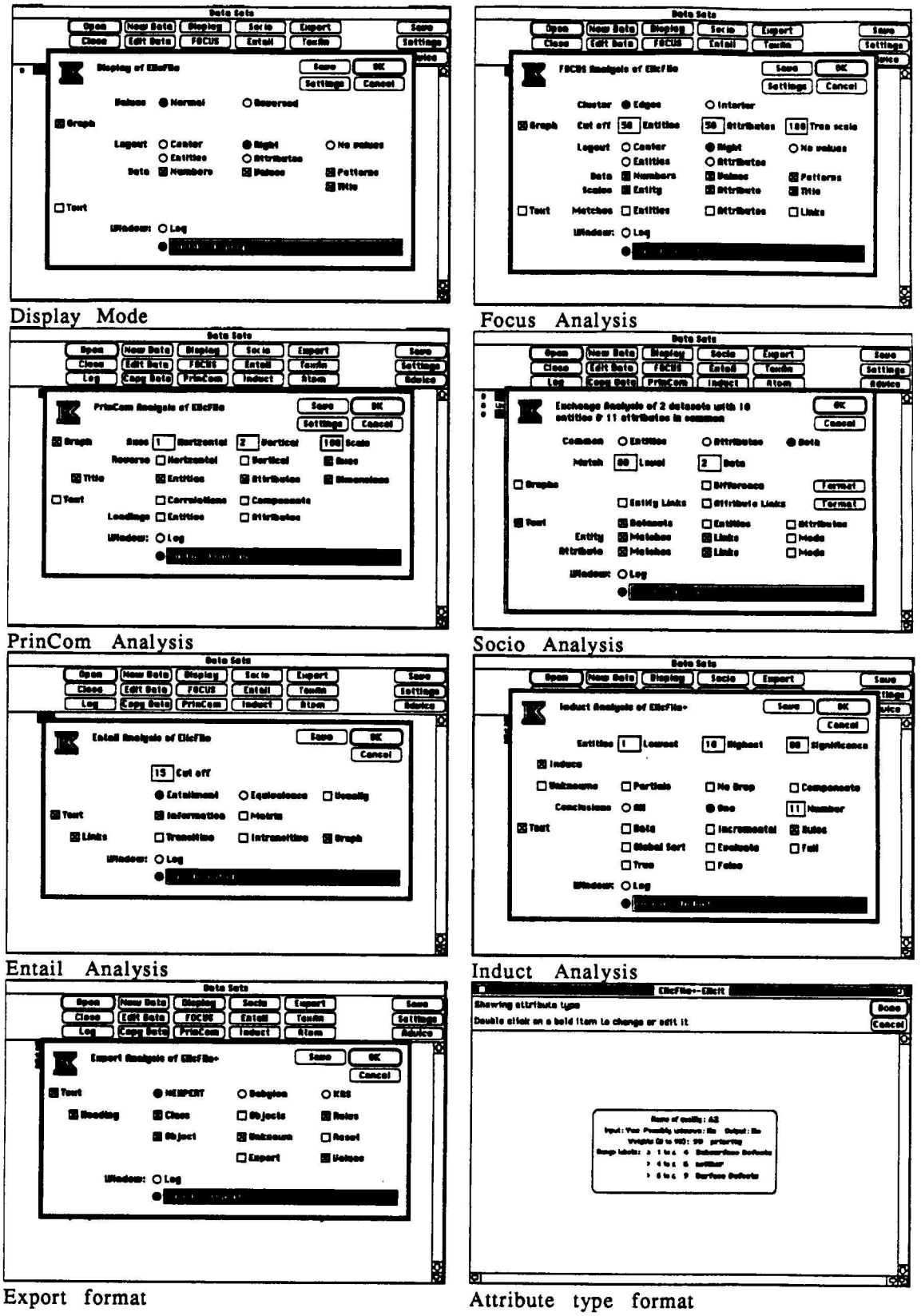
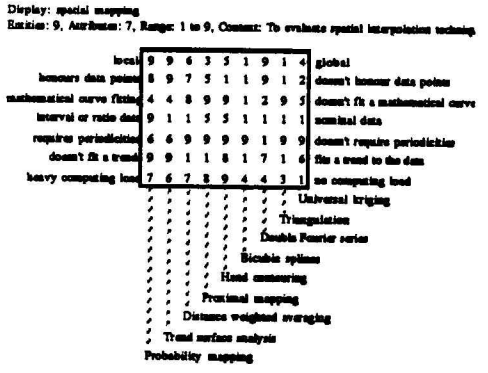


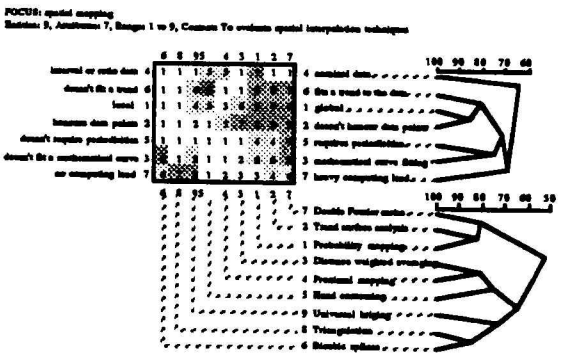
Figure 27: Output format windows

2.6.2 Graphical Output Screens

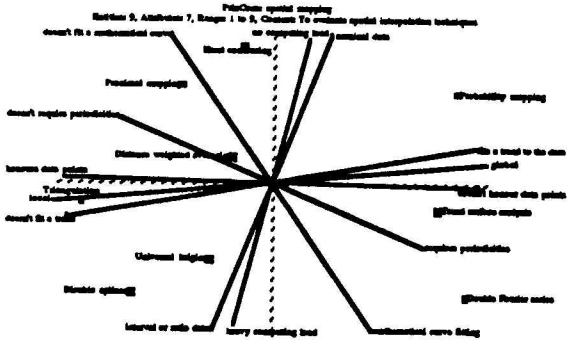
A sample of (a) Display, (b) Focus, (c) PrinCom, and (d) Socio output graphical screens are provided below in Figure 28. If the graphical form is selected in the particular format screen for these areas, you will receive a visual representation of the information you have placed into the program. Each of these areas depend on the concept of distance-based correlation of data. They show, in visual terms, how the components of the elicitation are related to each other and how the clustering of concepts are revealed. From these graphical representations, you are able to determine how you relate the concepts within your field. The visual representations provide a quick and easily understood method of determining the relationships. It allows the results to be explained to the novice user by the Knowledge Engineer in terms that the user will be able to comprehend.



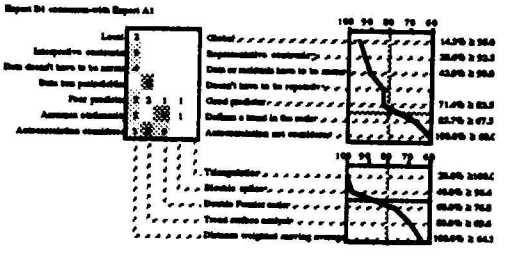
Display



Focus



PrinCom



Socio

Figure 28: Graphical output results

2.6.3 Textual Output Screens

The textual output specifications should be utilized for more in-depth analysis with an example shown in Figure 29. They give the results more accurate numerical interpretations and provide you with the implied textual rules that are derived from the data. The textual format is primarily used by the Knowledge Engineer to analyze the results and create the text used as the basis of logic in the expert system. They provide the numerical measurements and data in textual table form along with statements indicating the amount of relationship or similarity in ideas based on percentage values. The implied rules include Entail, Induct, Socio, and Export. Each of these screens give the rules showing the implied logic in terms of their association with singular or multiple data sets. They provide the measured amount of correctness and usefulness on their limited relationship. The Export output places this data in the proper format for transfer to a specified expert system shell.

```
G1:G2 40.0% over 80.0 (Expert B1 entity-consensus-with Expert A1)
  1:  20.0% ≥100.0   E2: Triangulation
  2:  40.0% ≥ 96.4   E4: Bicubic splines
  3:  60.0% ≥ 76.8   E5: Double Fourier series
  4:  80.0% ≥ 69.6   E1: Trend surface analysis
  5: 100.0% ≥ 64.3   E3: Distance weighted moving average

Entity Links between Datasets
 G1:3G2  40.0% over  80.0 (Expert B1 entity-consensus-with Expert A1)

G1:G2 71.4% over 80.0 (Expert B1 attribute-consensus-with Expert A1)
  1:  14.3% ≥ 95.0   A2: Local - Global
  2:  28.6% ≥ 92.5   A1: Interpretive contouring - Representative contouring
  3:  42.9% ≥ 90.0   A5: Data doesn't have to be normal - Data or residuals have
to be normal
  4:         82.5   A3: Data has periodicities - Doesn't have to be repetetive
  5:  71.4% ≥ 82.5   A7: Poor predictor - Good predictor
  6:  85.7% ≥ 67.5   A4: Assumes stationarity - Defines a trend in the series
  7: 100.0% ≥ 60.0   A6: Autocorrelation considered - Autocorrelation not
considered

Attribute Links between Datasets
```

Figure 29: Example of textual analysis results as given in Socio analysis

2.7 Multimedia Screens

You may want to or be required to access information outside of the program which will assist you in the elicitation and analysis process. This information can come in several forms including textual, graphics, pictorial, video, scanned images, or hypermedia. Access and type descriptions will be explained by the Knowledge Engineer. When you access this information, the screen will contain this information medium over the last screen you were situated at the time. Once this information is read, looked at, or watched; the medium will be disconnected and you will return to this original screen. Disconnection can come in the form of you personally removing / shutting off the information or it can occur automatically when the medium is completed its operation. The information is stored in files within the computer disk or external from the computer in the form of actual video clips.

3. CONTROL FACILITIES

You are able to perform many functions within KSS0 which allows movement through the program along with the creation and formatting of information. The fundamentals of accomplishing tasks on the Macintosh computer and, in particular the KSS0 program, will be discussed in this chapter.

3.1 Accessibility of Control Features

Many features in the program may or may not be accessible at any given time during your interaction. Certain components of the program are operational only at given situations and circumstances. Your ability to access many of the functions depend on the color of the word used to enter their operation. The word could be the name of an access button or an item in a menu. You are able to access the function if the word is in dark print but are unable to access it if the word is greyed out.

As you progress into the programs, the condition of the word color will change depending upon the conditions present. Any word in dark print can be selected to invoke a function that causes movement to a specific location or performs an action such as printing.

Some options of the control facilities change names to reflect different circumstances. These circumstances change the word to an appropriate name given the fact that only certain operations can be performed at specified windows. The specific name is determined primarily by what window is at the front of the screen and the files that are open.

3.2 Use of Menu Bar, Buttons, and Commands

The pull-down menu bar is situated at the top of every screen. Any part of the menu bar can be accessed by moving the pointer to the specific name and holding down the mouse key. This causes a list of items under the name to appear. Each word in the list has access to a specific function or location. Move the pointer down to the function you desire and release the mouse button to generate the action of the function.

A menu could also exist in a pop-up fashion that can create a list of option words. The access to the different functions is accomplished in the same manner as the overhead menu bar. These pop-up menus are obtained when a text icon appears as you move the pointer across certain specific words on the screen. The mouse key is held down to bring up the listing of function words. The pointer is dragged to the appropriate word and released in order to invoke this function.

Another method of accomplishing the operation of a function is by clicking on a button with the screen pointer. These buttons are words on the screen that are sensitive to a single click of the mouse key. The words usually contain a round border around their perimeter to signify that it is a

button but can be any word that invokes an action. Many of the buttons perform the same function as similarly listed items under the menu bar.

A third method of accessing these functions is to use their keyboard command equivalence. Most words under the menu bar will contain a set of symbols used on the keyboard to invoke the same function as selecting its name in the menu or button. After some practise, you will have the commands memorized so that you can perform their operation automatically from the keyboard at the required location. They can be a very fast and efficient form of accomplishing a given task. One special command that is not stated in the menu is the use of the RETURN key instead of clicking on the "Done" button as a means of accepting information into the program or moving forward to the next screen.

Any one or combination of methods can be used depending upon the method that best suits your needs and style that you feel comfortable in performing at a given instance.

3.3 Operation of Windows

"Windows" is a term used to describe the various ports of information on the screen that you can obtain in KSS0 as well as any other application or file. A computer screen can contain a single information window or a series of information windows spread around the screen. The windows can overlap each other with the window at the front being active and allowing interaction as demonstrated in Figure 30. You can have one window contained within another such as a dialogue window over a window requesting further information as shown in Figure 31.

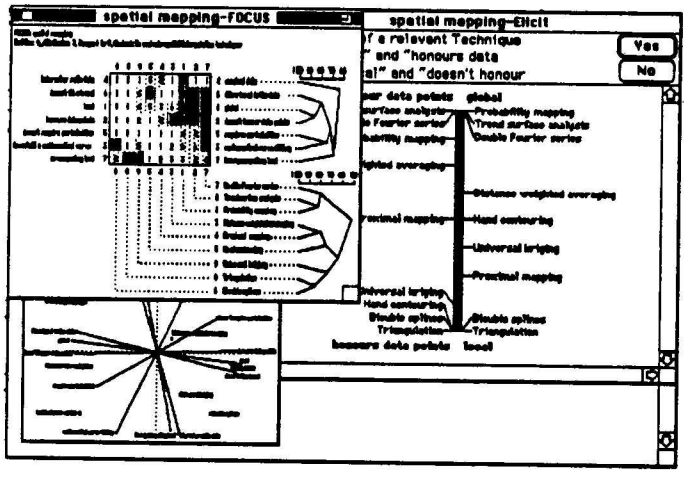


Figure 30: Use of windows in KSS0

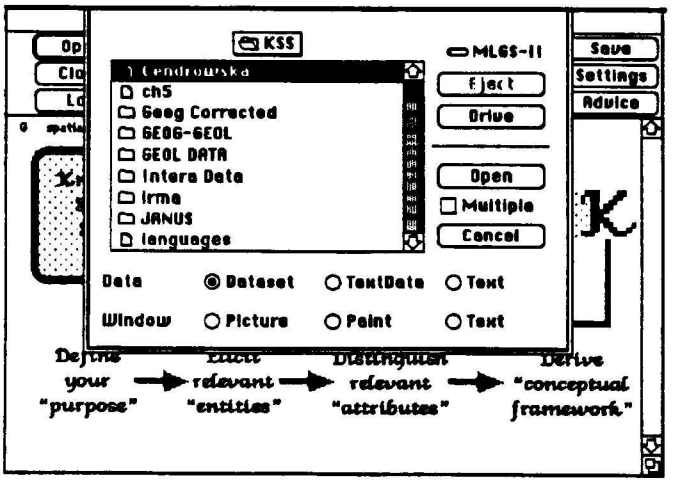


Figure 31: Dialog window overtop access window

Windows may or may not have scroll bars along the vertical and/or horizontal edges. Scroll bars are used to access information beyond the confines of the box outlining the window. You can move about the information by holding down the mouse key with the pointer at the desired scroll arrow. You can resize windows to the desired amount with the symbol at the bottom right-hand corner of the window. Hold the mouse key down with the pointer on this symbol and drag the pointer with the window on a diagonal until you have reached the desired position.

The information in the windows come in a variety of forms including text, picture (such as graphical results), as well as windows that provide access to selection facilities. The windows with selection facilities can be dialog, control, or alert windows.

Dialog windows are used to access and set up the format for the data that is required for given information or action as illustrated in Figure 31. No other action within the program can take place until this dialog window is completed with a selection of "Open", "OK", "Cancel", or by pressing on the RETURN key to signal an acceptance of the stated selections.

Control windows provide a mixture of dialogue settings onto a picture facility containing written and pictorial data as shown in Figure 32. You can interact with any part of these windows as well as access and switch to other windows before you have to select one of the options provided by the buttons within the dialogue part of the window.

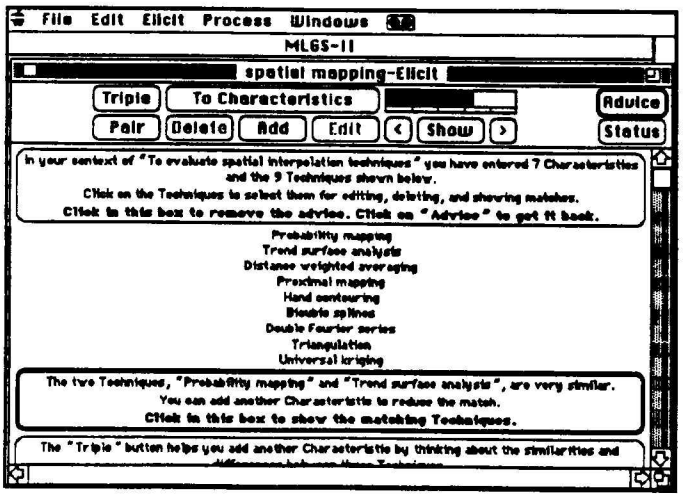


Figure 32: Control window of panel buttons onto listing window

Alert windows pop up onto the screen when you have performed an incorrect action or something wrong in the system may cause problems if you continue. The window will provide information on what is wrong and the possible corrective actions to be taken. The window may simply provide information with no option selection in which case the window will remove itself after a certain amount of time. Otherwise, the window will contain a button section allowing you to correct or escape this situation.

3.4 Items Under Menu Bar

The pull-down menu bar at the top of the screen contains a series of headings with each heading representing the name of a specific area of operation. The headings include: the apple symbol, file, edit, elicit, process, and windows.

The apple menu, Figure 33, contains the following functions that provide information about the operating system, what form is currently being used, as well as special features that help in the setting up of computer facilities:

- "About KSS0" which can access an information screen concerning KSS0 such as the version and date along with information about space and memory utilization that is constantly updated as you use the program

- a possible set of functions to allow access to control features for setting up the computer environment that may provide assistance to you as you operate the computer

- a listing of what system is currently operational (Finder or Multifinder), what application is open (in this case, KSS0) and information about the version and date of the Multifinder system

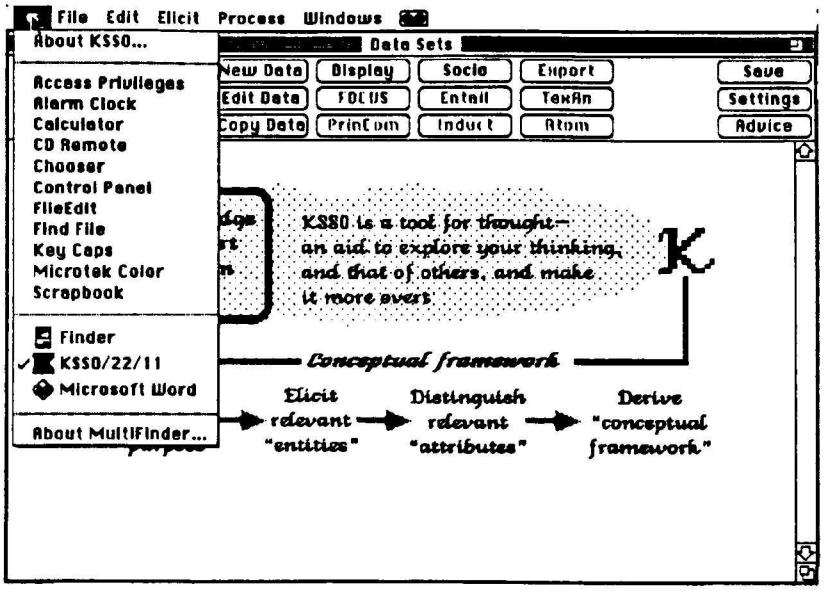


Figure 33: Apple menu components

Files are places of information, either textual or graphical, stored within the computer. The file menu, Figure 34, provides the following functions to access or create files, to format or perform operational functions on the information, along with the ability to terminate the access of this information:

- new window allows you to create a new screen window so you can place additional information into the program
- open function that allows access to existing files from all areas on the hard drive or files on any floppy disk inserted into the computer
- close and save functions for data and picture areas to allow you to clear the screen of this information and save the material in a file with its own name
- page set-up and print functions to format and print the information to be displayed on paper
- the "Quit" function for termination of data files or applications

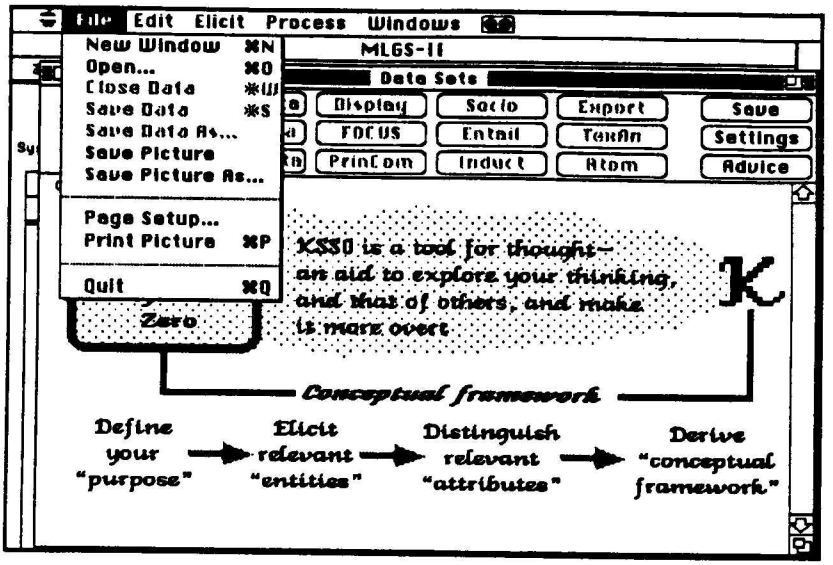


Figure 34: File menu components

The edit menu, Figure 35, allows you to change the format and location of information presented on screen. It contains the following:

- the undo command to cancel the last command you directed in the formatting of information
- format commands of cut, copy, paste, and clear that allow you to change and erase the position or existence of information
- format adjustments of Settings and Dialog that allow you to change the styles used to display information including text style and color settings for color monitor

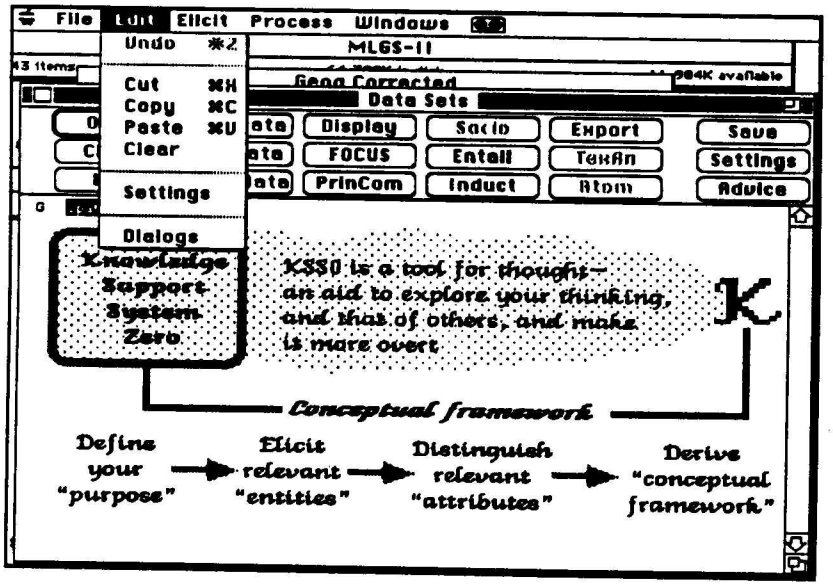


Figure 35: Edit menu components

The elicit menu, Figure 36, provides access to the different forms of elicitation screens that you can use in your interaction with the program. The names of the commands will include the name of the data file when you are in at the time. The listing under the menu name include:

- "New Data" which provides an interactive screen that contains input cues and rating facilities to input and rate new data
- "Edit" command which allows you to change or continue input of information with an elicitation that already exists in order to edit or add new data
- "Copy" command which allows you to enter an existing elicitation file which is automatically adjusted to remove certain word groups or ratings so you can arrange the information present without having to edit any data you do not want present

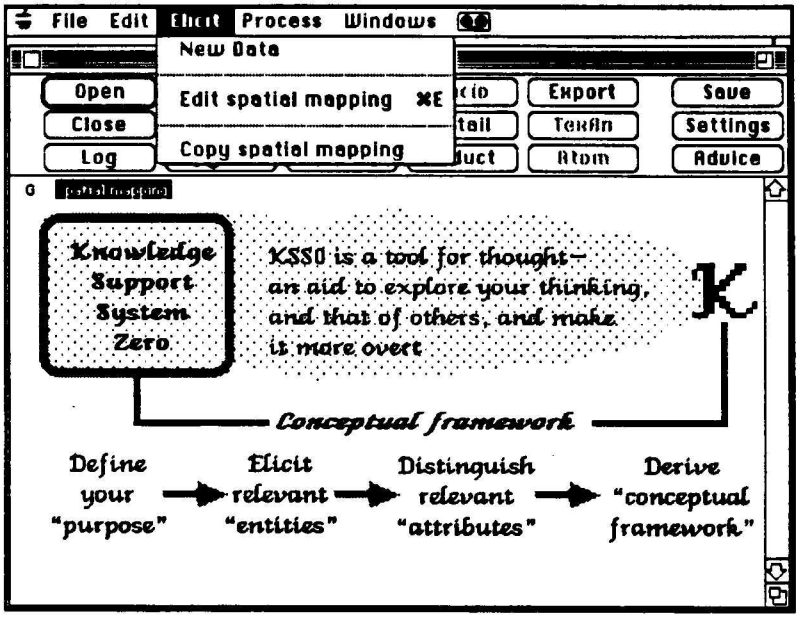


Figure 36: Elicit menu components

The process menu, Figure 37, provides access to the different graphical and text screens which contain the results of your elicitation by forming the data into spatial images and rules. The name of the command will also include beside it the name of the elicitation data file that you are in at that time. The menu will include the following:

- "Display", "Focus", and "PrinCom" commands which move you to these graphical and textual screens showing the results in terms of their dimensional relationships
- "Socio with number of datasets" command to combine the results of a

number of similar elicitation datasets showing the areas of consensus or contrast on a given subject to reveal the usefulness of the data

- "Entail", "Induct", and "Export" commands that provide access to textual screens in the form of rules showing the implied linkage between the data with the export command formatting the results and transferring them to a shell

- "Texan", and "Atom" commands, if operational, allows the breaking up and analysis of textual information entered into KSS0 to separate the information into sections and form relationships from these components

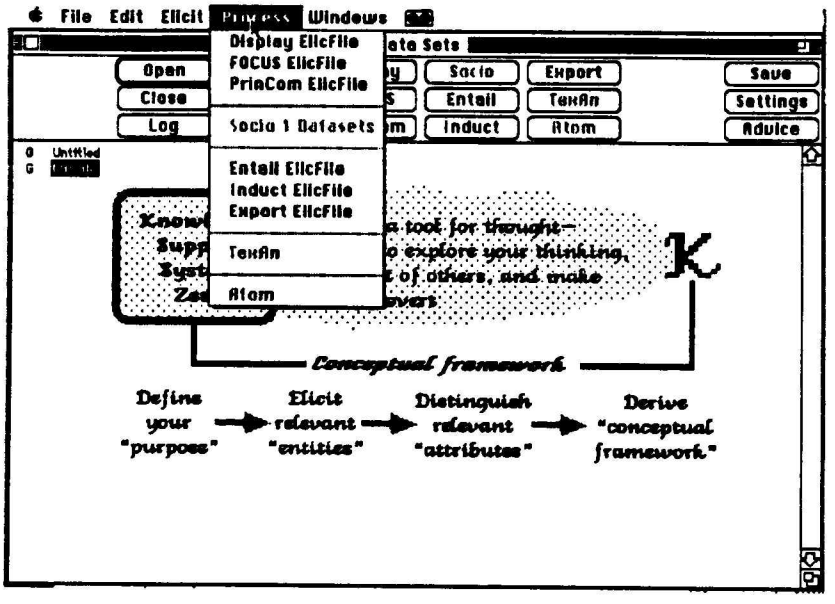


Figure 37: Process menu components

The window menu, Figure 38, provides commands to change the viewing format of the windows and access to particular windows used in conjunction with the elicitation process or windows on the screen but not activated and in front. One of the names listed under the menu has a submenu containing a list of commands as indicated by the arrow beside the name "View". The complete menu contains the following commands:

- the "View" command with changing submenu commands of Fit, Zoom, Icon, and Set Zoom that allows you to change the shape or configuration of the windows on screen

- the "Help" command which can access an information window on screen to guide you through the program's operation

- the "Log" command which can access an information window automatically listing the events that you perform in your interaction

- the names of windows on screen indicated with a check mark beside it for access of a given window to be placed up front for interaction

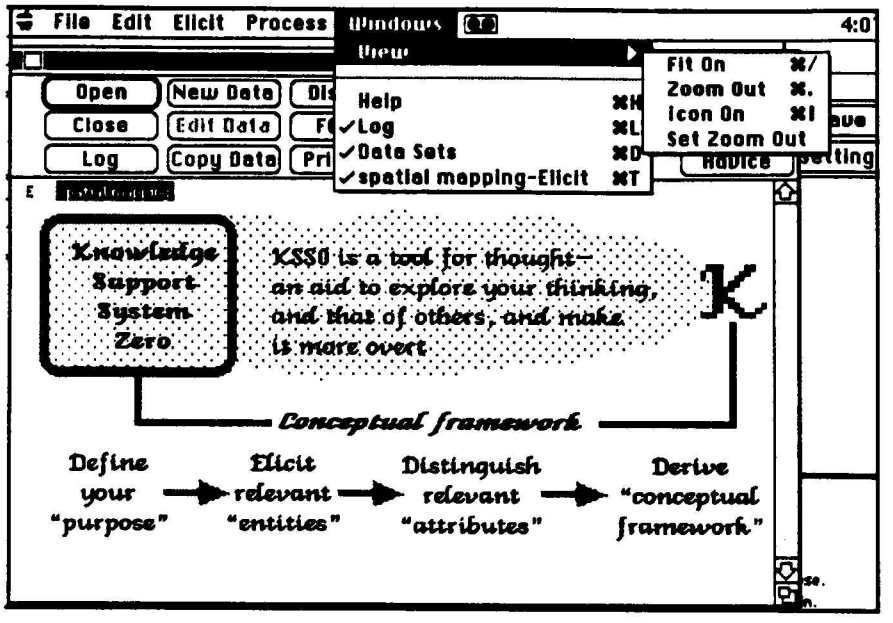


Figure 38: Window menu components

3.5 Access of Files

When you want to start a new elicitation, you will have to create a new file that will store the data. You can produce this file by selecting "New Data". This will bring up a dialogue window, Figure 39, requesting input on what the information should be saved as. You can type any name you wish to call the data into the box containing the highlighted area. Type in the desired name and the highlighted area will be changed to the new word.

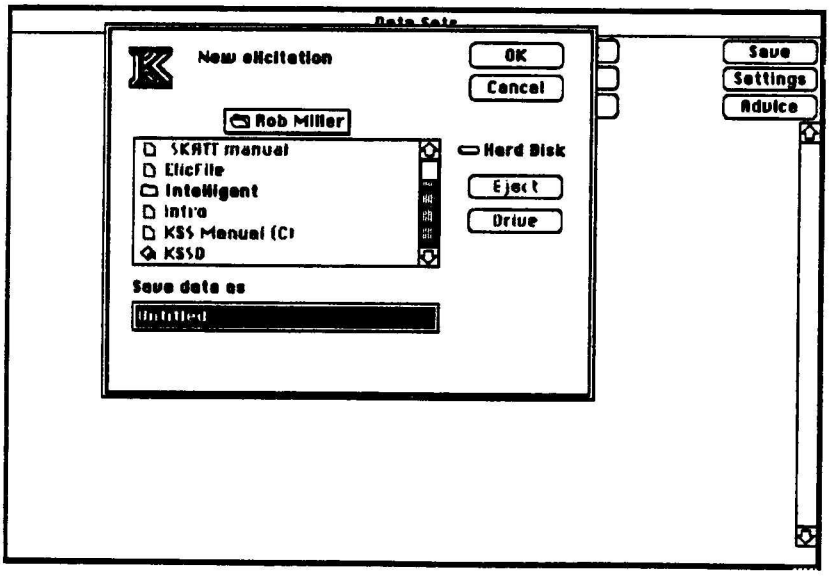


Figure 39: New elicitation window

You can define the location where you want the information stored by keeping the information in the KSS0 folder or by changing drives/floppy disks. Click on "Drive" to access different areas on the hard drive or floppy disk inserted in the computer. Click on "Eject" button to remove any floppy disk in the drive system and insert a new disk. Normally, you will save the data in the default location of KSS0 folder so you will not have to worry about the procedures for changing location.

Click on the button "OK" to accept the creation of the file and automatically bring up a KSS0 window so you can start the elicitation process. Click on the button "Cancel" to exit this dialogue box and bring up the previous KSS0 window if you accessed this area by mistake.

Click on the button "Open" in the button panel or select "Open..." under the file menu when you want to access a file of elicitation data already created. You may want to open existing files to view the results or edit the data to suit changing conditions. A dialogue window will appear, Figure 40, where you can select the name of the file you want to open from the file listing area.

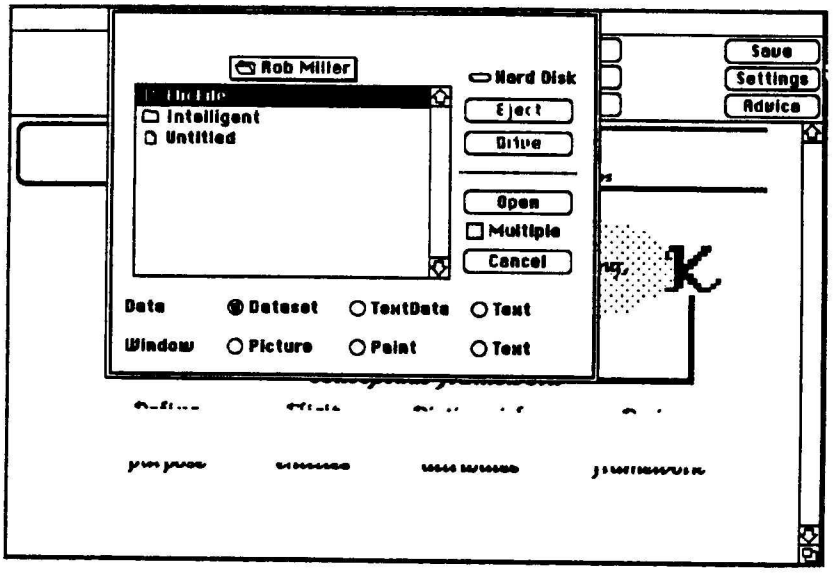


Figure 40: Open dialogue box for access to files

You can access files from the KSS0 folder or any other area on the hard drive or floppy disk. Select what type of file you are seeking from the list of "Data" or "Window" types at the bottom of the dialogue window. You will not have to worry about performing the file location task if you select the desired file name in the file listings window already present on the screen. Otherwise, you can click on any desired radio button to place a dot in the desired button area and de-select the dot in any other button. This allows you to select that particular style of data so that you can obtain the listing of files with that format. The selection depends on the form of data within a file you are searching for including:

Dataset for the selection of elicitation results files

Text data for the selection of elicitation data in the form of text only
Text under Data area for the access of text files only
Picture for the selection of files containing picture type results
Paint for files with access only to windows with MacPaint drawings
Text under Window area for files with access only to windows with text

When you have found the correct listing of files, double click on the file name to highlight its area and then bring up that file with the data onto the screen. Also, you can click once on the file name to highlight its area and then click on the button "Open" in this dialogue box to bring up this file onto the screen. You may want to open several files at the same time so that you can see the information from a number of areas onto the screen together. Click on the box beside the word "Multiple" to place an X in its area to select its function. Then, click once on a number of file names with a click on Open button in dialogue box to open them up for viewing simultaneously. Click on the Multiple box again to remove the X mark and de-select its function.

3.6 Access and Viewing Format of Windows

You can access any of the windows within KSS0 including elicitation, external, and process windows by using the menu bar at the top, using command key alternatives, or by clicking on a button within the windows. These commands will move you to the next logical window through acceptance of input information as shown by answering questions with a click on an acceptance button or using the RETURN key. They can navigate you to a desired location with the area name represented by the command such as Display to bring up that process window. The commands can access external information onto a KSS0 window. This is shown by selecting Help or Log commands under the Windows menu or Open commands at various locations to bring up these dialogue boxes. They can move a particular window already on the screen to the front and activated for interaction as performed by selecting any one of the check marked names under the Windows menu to bring up that existing window on the screen to the forefront.

Pull down the Windows menu to access the View listing and then move the pointer across to select any one of the submenus in order to format the viewing of a given window. The names for the submenu will change their name and accessibility depending upon the window you are at as well as the present format of the activated window. The opposite name will appear in the menu from the selected name the next time you access the menu to reverse the present setting of the window when this function is invoked.

The Fit On/Off option allows you to fit an entire window automatically onto the screen by changing its dimensions to the screen or revert this procedure by turning the function off. This is especially valuable when you want to compress a large picture to the confines of the screen for total viewing while still retaining its interactive capabilities for editing.

The Wrap On/Off option allows you to wrap the window text around at word boundaries if it exceeds the screen width or revert this procedure by turning the function off. This allows you to move the text from one line to the next without having to worry about changing lines that are out of viewing range. It provides freedom to type into a window without actually seeing the contents. The Wrap On facility provides a freedom from having to change lines and should be kept on unless certain circumstances arise that inhibit the use of this function.

The Zoom In/Out option allows you to magnify or reduce the size of the active front window by placing the window at one enlarged and one regular size position. You may want to view the information in an enlarged state to specifically view certain areas more closely. You can select the function again to return the image back to its original shape (standard position). Use the zoom box symbol in the corner for quick adjustment of window size, but not the information size, to view contents beyond the boundaries or to clear a screen area to access any window underneath.

The Icon On/Off/Out option changes the size of a given active window to a small symbolic size (thus the name icon), Figure 41, so that you can fit up to a maximum of 16 windows onto a screen at the same time. You can also shut this feature off to return you to standard sized windows onto the screen or select Icon Out to remove this window from the screen. This iconization feature allows you to see the various components of the program that you have created and provides a quick access to a desired window. You just have to click on the zoom box symbol in the upper right-hand corner to give you the full size of this desired screen. Iconization provides an effective style of managing the screens so that you can interact with the various facilities and change from one window to another quickly and without distraction.

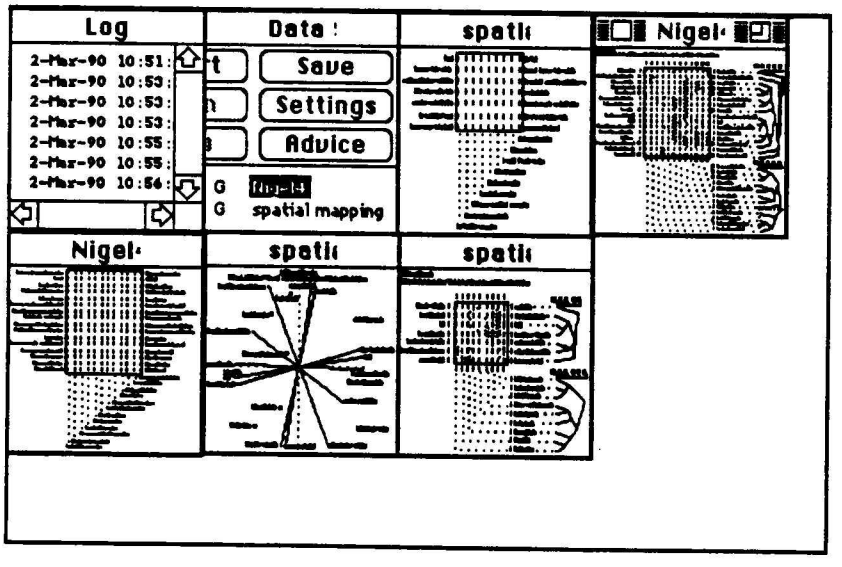


Figure 41: Iconization of program windows

The Set Zoom Out option establishes the current screen size setting as the standard position. You can then adjust this picture using the zoom and icon facilities to enlarge or miniaturize this new standard size. As a result, you can change the size and detail of the information contained within the window to any conceivable size with the combination of Zoom functions.

3.7 Access of Elicitation Screens

You can access the different elicitation screens by first signifying that you want to create a new elicitation session through New Data button or menu and answering a file name dialog window. Click on the button "OK" once you have answered the dialog box so that it can create this data file and automatically bring up the status window. The adjustments to this window are made to fit the occasion and accepted into the program. This will bring up a window that asks you to think of six or more entities to start the elicitation process. A control panel of buttons exist on the majority of elicitation windows for access to the various name, rate, and match windows in either entity or attribute areas. Other access commands will bring up the remaining elicitation windows in logical order.

You can enter elicitation screens that have already been developed if you are in that data file of information. Select the edit command with the particular elicitation name under the Elicit menu or button control panel to bring up the elicitation screens for that application. You will obtain the first elicitation screen in which you can click on the acceptance button to insert edited or unedited session information. This will bring up a window with a button control panel to begin your navigation to a desired window for editing.

Select the Copy command under the elicit menu if you want to start a new interview session based on information in an old file that is not rated. A dialogue box will appear, Figure 42, asking you to input the name of the new file and the areas you which to interact and change. Type a new name directly from keyboard or leave the name with the automatic plus sign added to denote an updated version. Click on the boxes at the bottom to insert an X mark into the areas you wish to become activated or click on an X mark to remove it and de-select that area. Selecting one or a combination of Entities, Attributes, or Ratings allows you to change these values in the new file. This includes the words used as Entity values, words used as Attribute values, along with the ratings these values were given. The normal default is to have all three areas selected for change.

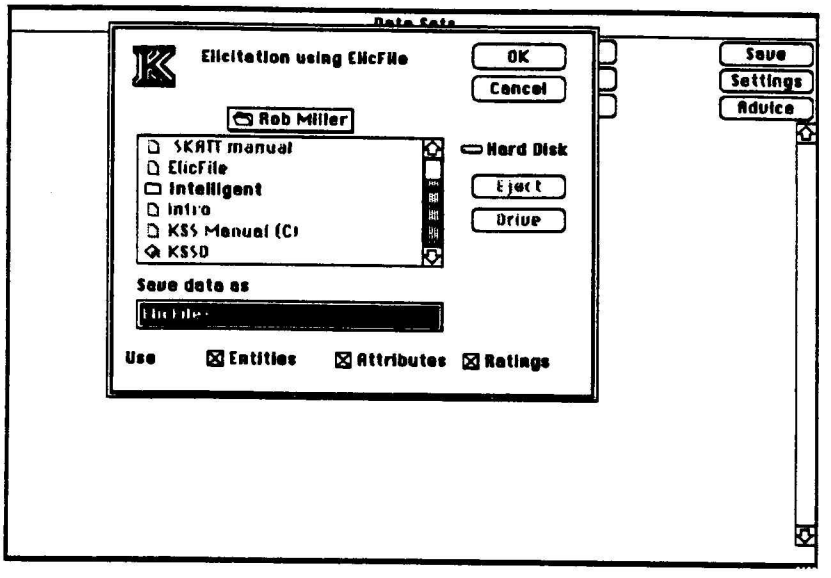


Figure 42: Copy dialogue box

Click on OK to accept the changes which will bring up the status window for any modification. This information is accepted into the program to bring up a window with the button control panel to access the other windows within the entity and attribute areas. Click on Cancel if you do not want to copy an old file over and change its values. This will bring you back to the window you were last at before receiving the dialogue box.

3.8 On-Line Help

You can obtain help on proceeding through KSS0 while you are in the program. Elicitation windows will have a button labeled Advice. Click on this button to obtain a number of dialogue boxes with information pertinent to the operation of the active window as well as how to proceed with the elicitation. You may have to scroll the window area in order to see all of the advice dialog boxes which may be present at that particular moment. You will receive all required advice boxes on all windows throughout the program once the advice function is selected for use.

Click on any of the advice areas to remove all of the advice boxes from that window and all subsequent windows. You may want to do this if you have already read this information in previous circumstances which are now cluttering up the window. You may want to receive advice information only when required and not at any other time. This removal procedure also is accomplished by clicking on the advice button a second time instead of clicking on the advice boxes. You will not receive any advice on further screens once you de-select the advice windows.

The advice information provides you with clues and helpful information on what to do next as you interact with KSS0 which will change for every window. Some of these advice boxes may indicate they are buttons which provide assistance by taking you to the proper window once it is clicked upon so that you can perform the stated advice action. Any of

the advice boxes will provide the reasons and principles behind the actions you should take. The advice is intended to help the first time user navigate through the program without having to rely on outside help from another individual.

A second method of obtaining advice is by the Help command under the Windows menu. Select Help to bring up a window on further operational information. This information could be in the form of on-line access to this manual in computer form or it could be a textual window on specific helpful information. At present, this window does not contain any information and is not connected to any external file. Its access will only bring up an empty window. Click on the small box in the top left-hand corner of the window to remove it from the screen.

A third method of help consists of the questions or operating statements that are situated on some of the screens which require an answer or some form of interaction as shown at the top of Figure 43. The form of these questions will change slightly for different windows and vary with the type of information you are entering. Some of the questions may require you to select one of the buttons beside it in order to continue with the elicitation while other questions may not require an answer if you choose one of the other elicitation options. The questions are intended to set the framework on how to approach the problem and direct you to finding new ways of breaking up the problem and adding new words to the area.

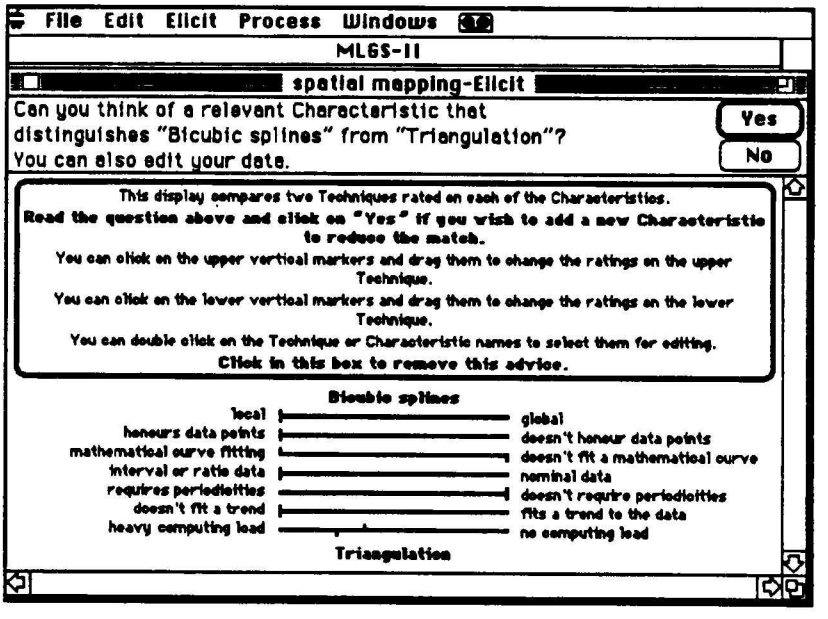


Figure 43: Advice information as questions or procedural statements

Ask the Knowledge Engineer for information if you have looked at all these methods of on-line help and are still lost as to what direction you should take. He/she will be able to guide you in the proper direction. Remember not to get overly concerned with making an error while interacting with the program as any option you decide upon will produce

similar results. Take your time and look at all the options before deciding on your action. All the information that you need to operate the program and make a decision is present on the screen.

3.9 Determining Your Location

You can determine your location from any window in the program along with the path taken to reach this position. Access the Windows menu and select the name Log to bring up a window onto the screen listing the events that have transpired during your interaction, illustrated in Figure 44. These events contain a listing of screen changes and actions that you have performed along with the date and time these situations have taken place. They are in chronological order from the start-up of the program to your present position. It allows you to see the steps you have taken and the current location you are at within KSS0. Click on the small box in the top left-hand corner of the window to remove it from the screen and return you to the window underneath which is the previous window to the log window.

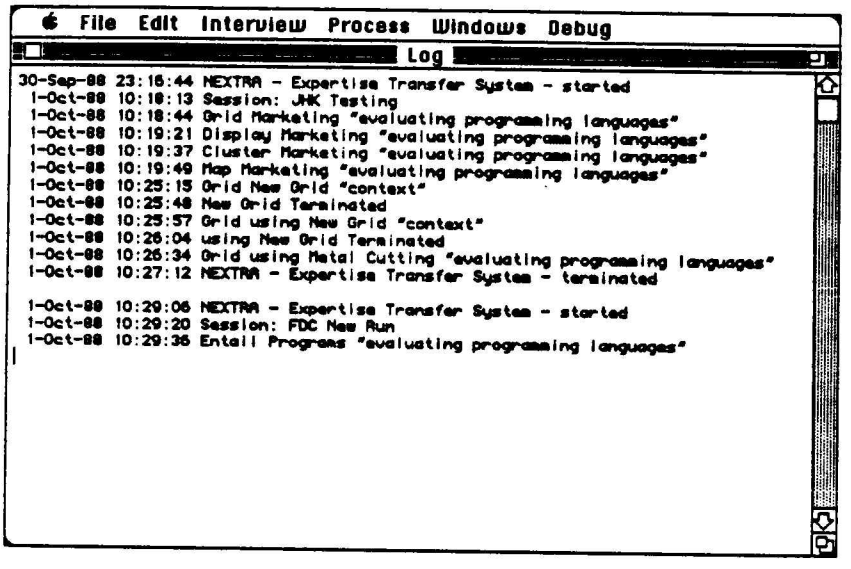


Figure 44: Log window showing events during interaction

You can always navigate through the program to access the main button control panel from any window within KSS0. This is done by moving to the Status window through its button on the entity or attribute button control panels. Then, accept the Status information to bring up the main control panel. From here, you can move back to any part of the program by selecting Edit. Navigate back to the entity control panel by accepting the inserted material already present. The entity control panel provides access to the various input and rating windows as well as access to the attribute control panel which lead to its own input and rating windows.

The above procedures are performed to navigate you to the various control panel windows which are the starting point into the various KSS0 locations. This is done so that you do not become lost within the system. Remember, the program is a simple procedure of adding new words and

rating values to new and established input/rating windows by moving back and forth between these windows until you have completed the cycle.

You can access any one of the process windows at any point during or after the elicitation process. Its window will be placed over the last elicitation window you were situated at that time. Likewise, any further process windows generated will be positioned over the previous process window. This is prevented by closing each process window with a click on the close box in the upper left corner before you access another process area. All process windows are removed by clicking on each close box until the last elicitation window becomes visible.

3.10 Input of Log Text

You can enter your own words into the log window at any time during your operation of KSS0. This may be helpful in stating events and ideas about the interaction and keeping track of these thoughts while you proceed in the program. Click on the button "Log" at the main control panel to bring up an interactive window containing a question requesting input of information as shown in Figure 45. Type the information directly from keyboard so that the highlighted line will disappear and be replaced with the information you have just inserted. Click on the button "Done" beside this line or hit the RETURN key to accept this piece of information. You can check your entry by selecting the Log window from the menu bar. The log window, Figure 46, will contain this text along with the date and time you entered this information into the system.

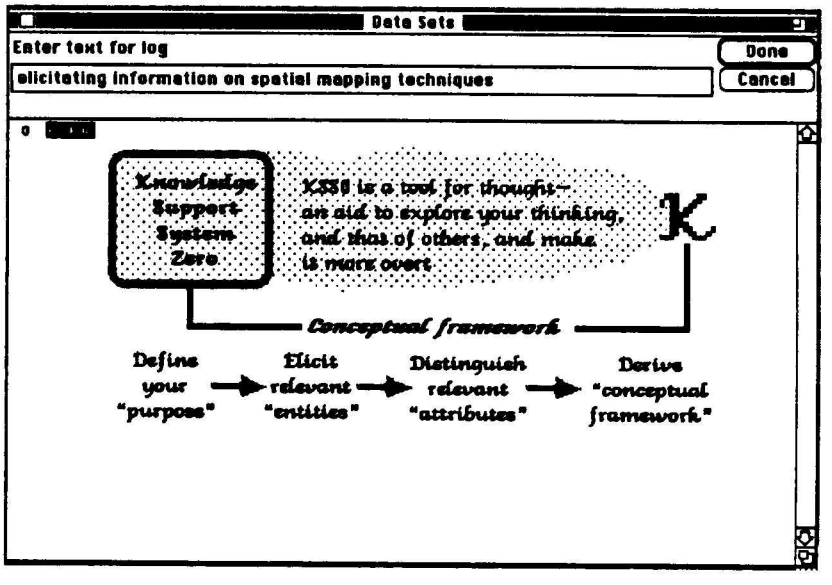


Figure 45: Inserting text into the log window

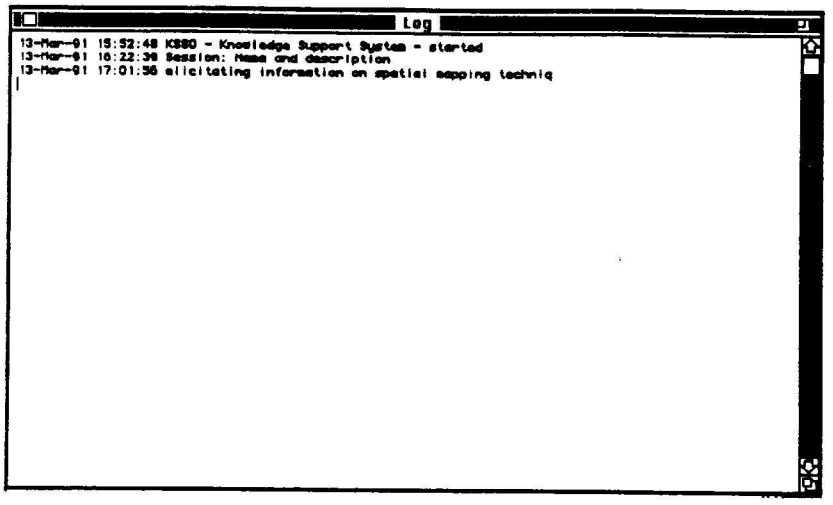


Figure 46: Text placed into log window

3.11 Navigation In The System

You are able to move through the program by the following methods:

selecting a required screen location command under the menu bar
using its comparable keyboard commands
clicking on a desired control panel button
answering any question presented and inserted by button or command
clicking on an inserted name within the interactive window

Many of the commands of the menu bar, buttons, and their keyboard equivalencies have names that represent specific locations in KSS0 or the creation of results screens, files, or applications. Access to the elicitation screens can be obtained from the Elicit menu or its equivalency in button and keyboard functions. The new result screens can be obtained from the Process menu or its equivalency in button and keyboard functions.

You can access a completely new set of elicitation screens or existing files of past or present elicitations through the "Open" or "Edit" modes. This can be accomplished from any screen within the program and at any time during the interaction with the Elicit menu or at certain windows with the main control panel of buttons.

A pop-up menu exists at the end of certain words in the program particularly the entity and attribute names of the listing screens. This menu will contain the functions listed in the screen buttons or pull-down main menu. It allows you to use this form of navigation as you interact with the words for easy access to the functions. A text page icon will appear at these words. Hold down on the mouse key to pop-up the list of functions and drag the pointer down to the desired function name. Release the mouse key to invoke the action of the function and move you to that screen.

Different windows present on the screen can be accessed through the Windows menu to bring the desired window to the forefront and be

activated. This is accomplished by selecting one of the names with a check mark beside it. Special information windows can be accessed through the Windows menu to bring up Help or Log windows onto the screen.

The button control panel will change as you move to the entity or attribute declaration screens. Access to each of these areas is accomplished by clicking on the "To Entities" or "To Attributes" buttons or their equivalent names you have given these values in the Status screen. From each of these regions, you can navigate to the desired insert or rating screens. These include the Add, Edit (Rate), and Show for both areas as well as the Triple or Pair buttons at the entity rating area only. Each of these buttons will bring up an insert, rated, or unrated screen for a name selected in the entity or attribute list.

Another form of movement can occur by answering a question by insertin information or simply clicking on an answer button contained within a number of windows or using the RETURN key as a keyboard equivalent. This will change the window on the screen to the next area of elicitation you have decided upon. The button you have chosen could be used as a form of signalling a continuation of the process or you may have to input an answer to a question first and then select one of the option buttons to accept the answer into the program.

Some words that you have inserted into the program then act as individual access panels to a related window for positioning of information. This is shown in Figure 47 with the names of three inserted words, each acting like a button to access a rating window, shown in Figure 48.

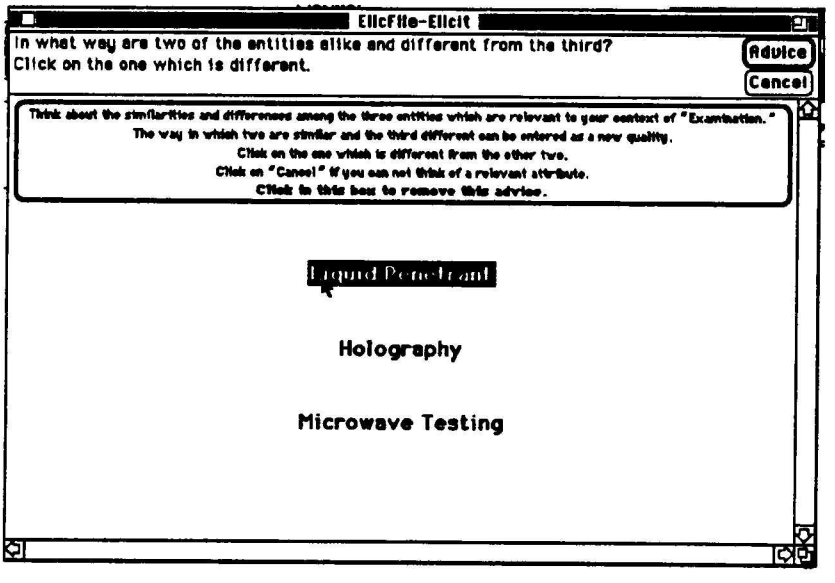


Figure 47: Selecting a Triple entity to access rating screen with name positioned

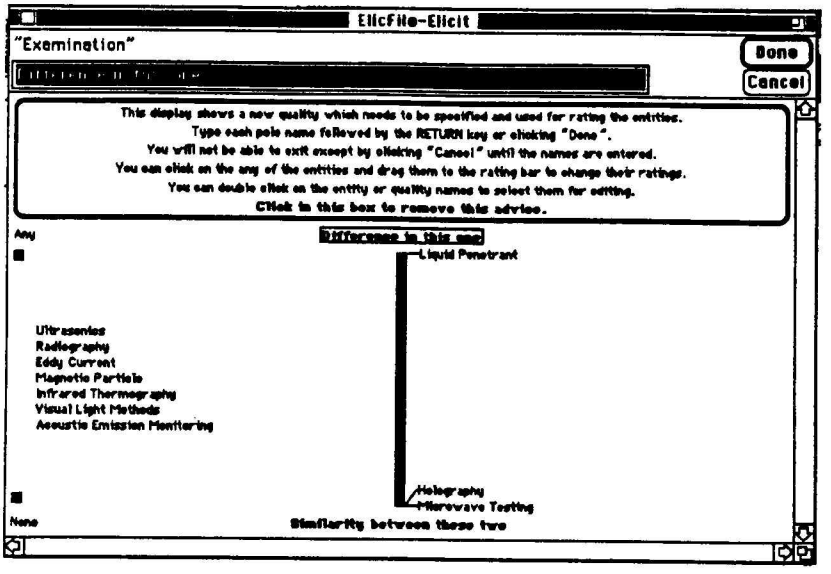


Figure 48: Rating screen from Triple selection

3.12 Accessing Information On Matched Values

You can see what names in the entity or attribute list have a high correlation of matches between them shown in Figure 49. Click on the rating bar button above the Show button at the control panel with the list of either entity or attribute names. This will highlight two words in the list that have the highest percentage of similarity between their ratings. The percentage is shown on the rating bar scale with the end of darkened bar area representing the amount of correlation in a percentage as indicated by the scale divisions.

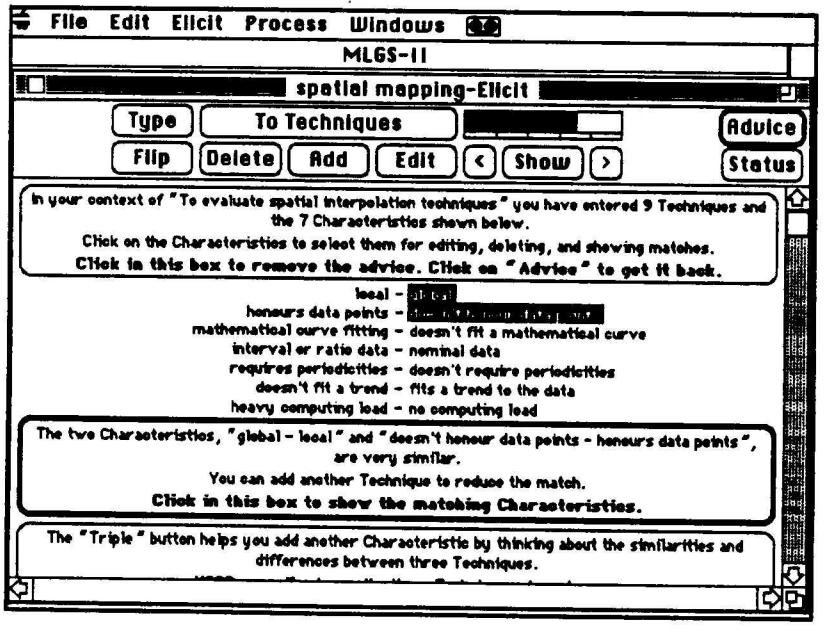


Figure 49: Showing matched items on list screen

The arrow buttons beside the Show button will allow you to move up or down the list of matched words as well as provide the amount of correlation indicated by the rating bar for each pair of matched words. The left arrow button will move you to the next high matched pair in the list and highlight these words when you click in it. Click on this button again to move to the next matched pair and so on down the matched pairs. The right arrow button performs the same function except that it moves up the list of higher percentage matched pair of words as indicated by the increase in amount shown by the darkened rating bar. A click on either button at their opposite top or bottom matched pair will wrap around to the start of the opposite list and continue to move in the same direction through the list.

Alternatively, you can click on two separate words of your choosing from the list of entities or attributes. The words will become highlighted and the percentage of their correlation will be shown on the rating bar.

Click on the Show button for any of these highlighted matched words that you wish to view or edit to change the high matches between their ratings. The rating scale that contain both areas ratings on one scale will be brought onto the screen. You can interact and change any of these ratings.

The highest matched pairs of words are also presented automatically on screen in the form of dialogue buttons that indicate what words are similarly rated. Click on these dialog buttons to access the matched rating screens. You can interact and edit these ratings or answer the question which will provide a method of breaking matches through the addition of new information.

3.13 Inserting and Changing Information

Several commands exist that allow you to change the format and position of information already situated within the program or new information that you are about to insert. You are able to input, add, edit, delete, transfer, or change the format (style) of information. These functions can be performed on textual and/or graphical forms of information. Some or all the functions can be used on a given window depending upon the type of window you are situated at and the circumstances surrounding the events. Again, access to these commands come from the menu bar, buttons, or their keyboard command equivalencies. Many of the operations required in the insert or change methods is explained in the on-line advice windows.

You can access and change information that already exists by clicking on the "Edit Data" button or selecting Edit from the Elicit menu (or its keyboard equivalency). This applies to the program file of information that you situated at the time. Click on the button "Open" to access and edit any other file of data on the computer.

3.13.1 Input of New Information

Windows that allow you to input text into the program will contain a highlighted box at the top. The highlighted area will contain information on what is to be placed into the area or example words that briefly explain what information you are to insert and its relationship to the elicitation process, illustrated in Figure 50. Type the information directly from the keyboard without any concern for placement. This will clear the highlighted area and place the typed information into the cleared area.

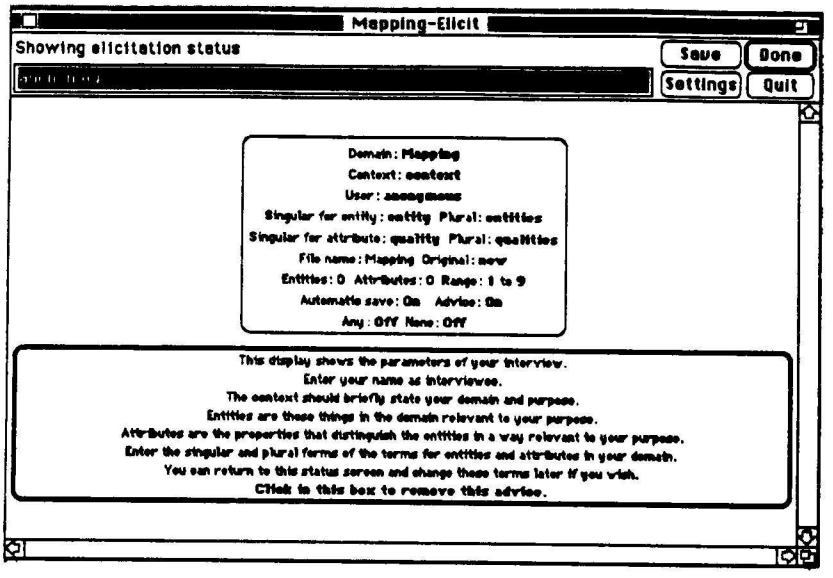


Figure 50: Typing in text to replace highlighted region

Register the information into the program by clicking on one of the buttons beside the insertion point depending upon whether you have more information to insert or are finished with this process. This will usually mean clicking on the Done button to complete the action, clicking on More button to renew the process, or using the RETURN key any time you wish the program to accept information you have inserted. The Cancel button will remove you from this window and place you back to the previous window with no acceptance of information into the program.

A small box outlining the spot where the information is to go will contain the same wording as the highlighted box. This will change to the inserted words you have entered when you click on the desired button. If you have more information to add to this area, a new small insertion box will be placed under the previous insertion. Sometimes, the information inserted with the highlighted box will go directly into the program after it has been accepted without the use of the small boxed insertion point. Care must be taken to perform the insertion in the proper order as dictated by the directive in the accept or insert boxes as there may be several insertions within the same window.

Other methods of inserting the information include clicking into the desired area of interest in a text field zone with the I-beam pointer to obtain a

flashing cursor. Type the desired information from the keyboard to insert the text at the flashing cursor. This method should be avoided as it is an inefficient and cumbersome compared to the simple task of typing directly from the keyboard to accept the data and then insert it in the proper location.

3.13.2 Editing and Deleting of Input/Output Information

The most common method of editing is performed on words that have sensitive zones enabling it to be selected in one step. Double click on the mouse key with the pointer near the desired word to select and place an enclosed box around its region. On certain screens, a highlighted section will also appear in which you can type the information into this region and then accept it into the boxed area using the button or RETURN key accept function. Otherwise, the information is inserted directly into the boxed region from the keyboard.

If a flashing cursor exists, new words can be inserted at that particular location while any old words may have to be deleted. Regions that allow changes to be made to the text have the pointer change to an I-beam symbol when it is passed over the sensitive text field region. Click the I-beam symbol at the desired location to obtain the flashing cursor and delete old words and/or insert new words. Another method of editing is to select the whole phrase of information that is of concern. Insert the flashing cursor at the beginning of the phrase and hold down on the mouse button. Then, drag the mouse with the cursor across the phrase until it is highlighted over. This is also accomplished by clicking once at the beginning of the phrase to highlight it. Once the text is selected, type the new information directly as this will change the highlighted area into the new letters.

Editing of the rating scales is accomplished through the Edit button on the control panel of the entity or attribute name list. The word or matched word pairs you wish to edit have to be highlighted in the list in order to obtain their rating scale. This is done by clicking on the desired word(s) or highlighted through the match function. Click on the Edit button to bring up the rated scale with either one rating for a single highlight or a double rating scale for two highlighted areas. You can move the ratings on the scale by holding down the mouse key and dragging the items or you can answer the question given on screen. The Edit button will change to a Rate button if the particular words in the list are not already rated. A click on the Rate button will bring up an empty scale in which you can rate the items.

Deleting of text and graphics come in several forms including the Delete key, the Cut command, Clear command, or Delete button at the control panel. First, select the desired text or graphic with a box outline or highlight. Press the Delete key once for outlined or highlighted text or a number of times with a flashing cursor to remove one letter at a time. Alternatively, you can use the Cut or Clear command from the menu or its keyboard equivalent once the text or graphic has been selected. A question will pop onto the screen asking if you are sure you want to delete the item. Click on OK or any accept button to affirm the action. The Delete button at the control panel will delete any highlighted entity or attribute name in the

list along with its rating screen. It will also alter the remaining screens that contained this information as part of their organization. Click on this button if you wish to permanently remove all of this information from the program.

3.13.3 Moving Text and Graphics

You may want to transfer a section of text or any graphical picture from one position to another. KSS0 and any other Macintosh environment allows you to move text and graphics from within a given window, from one window to another in a particular application, and from one program to another. This allows you to move text or graphics from one place to another or provide a copy of the first information to a second location.

First, select the text or graphical pictures as noted in the procedure of Section 3.13.2 so that the information desired is contained in a highlighted state. This can only take place on text or graphics that are allowed to be selected and do not count for the output result windows or any other graphical window that is locked to prevent entry.

Second, select the cut or copy commands under the edit menu or use their keyboard command equivalencies. The selection of cut or copy depends on whether you want to remove the information entirely and place it in another location or whether you want to keep the information where it is and make a copy of it to place in a second location. The information will be temporarily stored in a clipboard until you indicate its new location. The clipboard is a hidden window that provides a storage area for text and graphics. Only one selected item can be stored in the clipboard at a time. Any new item selected and placed in the clipboard will remove the previous item with the new item.

Third, navigate to the desired location and click the mouse button with the I-beam at the point of entry for the data to obtain the flashing cursor. Don't worry about the exact position as the information can be adjusted to fit properly once it has been inserted.

Fourth, select the command Paste under the Edit menu or use its keyboard command equivalency. This will insert the selected information into this new location. Access to locations that will allow deletion and insertion may be restricted to certain sensitive and accessible areas. Try and see if you can obtain the flashing cursor in any desirable area before you attempt to move information to another location.

Select the Undo command from the Edit menu or use its keyboard command equivalency to cancel the previous command you have performed under the Edit menu. This provides you with the ability to stop any change that you may have accidently performed but it will only prevent the last command taken. Any procedure done before this last command cannot be erased.

The attribute pair names in the attribute list area can be re-arranged using the Flip button at the Attribute control panel. Any one or both the

attribute names in the pair must be highlighted in order to perform this function. Click on the Flip button to reverse the position of the pair names so that each name now occupies the other side. This is done to arrange the data in a more meaningful manner and display similarly rated information.

3.13.4 Changing Information Formats

You can change the way information is presented on the screen by selecting Settings under the Edit menu or by clicking on the button Settings in the top right-hand corner of the window. This adjustment can be performed from any elicitation screen within KSS0 and pertains to information you have inserted, generated through result screens, or information already contained within KSS0 that presents the program onto the screen. It pertains to both textual and graphic format in terms of text size, text type, text special style features, as well as text and graphic color arrangement for use on color monitors.

Any change in format style is usually performed by the Knowledge Engineer in the development of new presentations or by an elicitee who is familiar with the procedure. Figure 51 shows the dialogue window that you will obtain when the settings command is selected. The procedures for changing information format is explained in detail at Section II, Chapter 2.

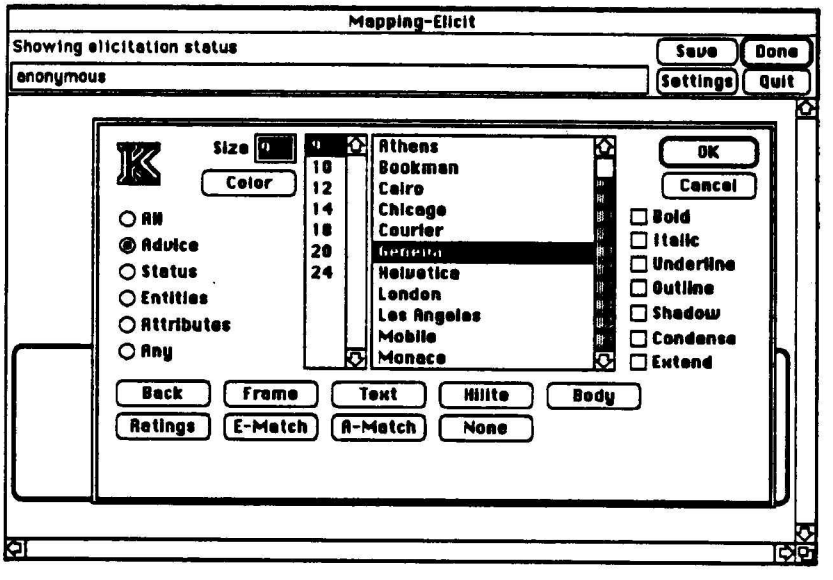


Figure 51: Settings dialogue box to format information style

You can obtain the adjustment for color settings by selecting the word Dialogs under the Edit menu. This will bring up a revised form of dialogue box to that of Settings in that it will contain only information on the adjustment of color patterns and not on the text format. The Dialogs setting panel will only contain the five access buttons of Back, Frame, Text, Hilite, and Body. Click on the desired button to access and change the settings as noted in Section II, Chapter 2.

When you access a results process screen through the button control panel or menu bar, you will obtain a format dialogue window requiring input to select various forms of information. This format window is set and defaulted to various settings as performed by the Knowledge Engineer. The setting of the process formats are explained in Section II, Chapter 2. Also contained in the dialogue box, is a Settings button that allows access to the same format and color adjustments as discussed in the previous paragraphs for the process windows.

A special format feature contained within the elicitation screens is the Type button located at the navigational button control panel of the attribute listing screen. Any one or both the attribute names in a given pair must be highlighted in order to perform this function. Click on the Type button to access a format window that allows you to adjust the settings for the attributes, illustrated in Figure 52. These settings include the selection of attribute areas to be applied in the form of Input, Unknown, or Output locations, its relevancy rating as a weighting, and the range names for the values. Each of these values can be adjusted or changed to meet the varying conditions during the elicitation.

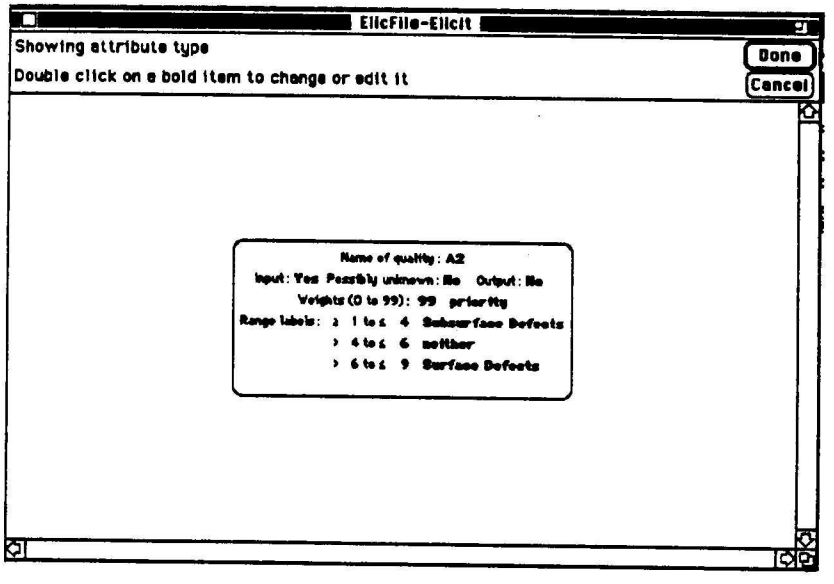


Figure 52: Changing Type specifications

The Type adjustments are preset by the Knowledge Engineer before the elicitation with the default values providing the necessary requirements. Adjustments can be made during the elicitation procedure along with access to the process screens to change the values and amounts of the ratings as you proceed in the interaction. These can only be done by people knowledgeable in their operation, usually limited to the Knowledge Engineer. The description of their settings is given in Section II, Chapter 2.

3.14 Creating A New Window

Creating a new window is usually performed by the Knowledge Engineer in developing and integrating different forms of information as an

aid in the elicitation process. It is mentioned here to briefly explain where the feature is located and what is its purpose. The procedure is explained in more detail in Section II, Chapter 4.

Select the phrase New Window from the file menu or use its keyboard command equivalent to bring up new window dialog box, Figure 53. The selection is performed at the program screen where you want the new window to be inserted, right after the present screen. Set the name and format of the window and accept the information into the program. This will bring up an empty window onto the screen where you can place any form of information within its contents. You are able to type new text into the area or import a graphic from a pictorial generating program such as MacPaint or MacDraw. Once you have completed the information on the new window, you can link it to the proper area and quit the program. The next time you navigate through the program, this new window will be in the assigned position within the program or accessed from a button or pull-down menu.

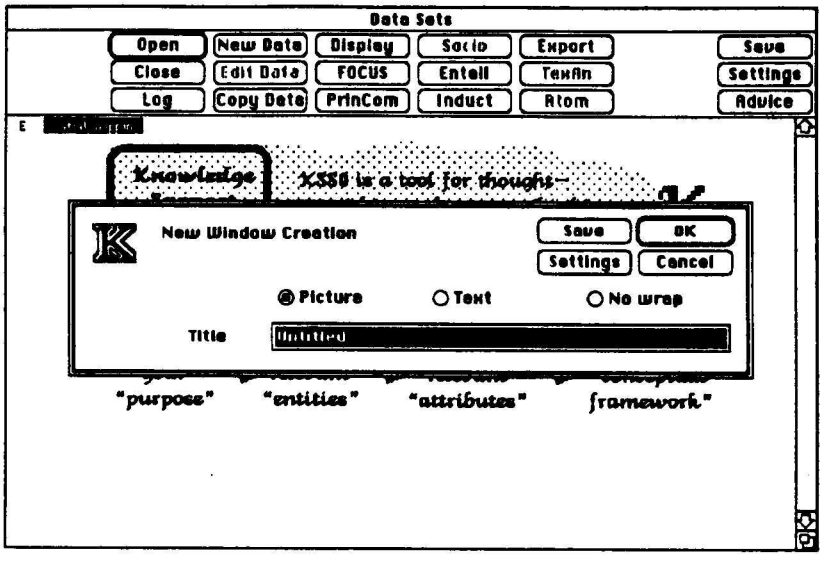


Figure 53: New window dialogue box

3.15 Saving Information

You can save the information that is placed into KSS0 at intervals throughout its interaction. This prevents the inadvertent loss of information if the system shuts down for any number of reasons. Use the save feature when you feel that any information inserted should be stored for access at any time. The Save function is also performed by anyone creating a new window in which text or graphics are included.

You can cause the program to automatically save the information while you perform the elicitation so that you do not have to worry about constantly saving the data at intervals by means of the Save button. The Status window at the beginning of KSS0 contains an Automatic Save feature with an On/Off switch. Click on the Off word to toggle it to On to cause the program to save any information as you type or edit it into KSS0.

The Automatic Save is usually left On at all times so that you do not have to worry about saving during an interaction.

A number of ways exist for saving the information not Automatically Saved depending on what type of data it is and where you want to store it. Click on the Save button at the control panel or use its keyboard command equivalence if you are saving the information as you interact with KSS0. This will automatically save the information to the name of the file given to the data. Another method of performing the save is to select Save Data or Save Picture under the File menu depending upon whether the information is in textual or graphic form as shown by the greying out of inactive section. Again, this will save the information to the file already named.

Select Save Data As or Save Picture As under the file menu if you wish to place the information entered to that point into a file and rename the file with the new data. The selection depends upon what type of information is being saved shown by what feature is accessible. This allows you to save edited, additional, or rearranged information from an old file into a new, separate file. A dialogue box will appear, Figure 54 for text and Figure 55 for pictures, requesting a new name for the file. Type the new name from the keyboard so that the highlighted area will change to the new name. You may also want to leave the name as it stands with the plus sign added to the name signifying a revised version. The plus sign added to the name also appears when you perform the Copy function to access and change the information from an old file.

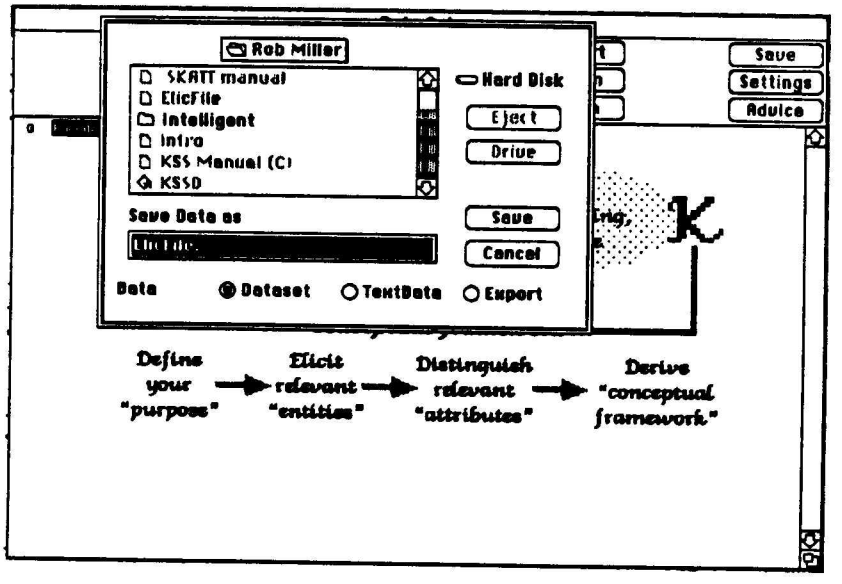


Figure 54: Dialogue box for saving information to another text file

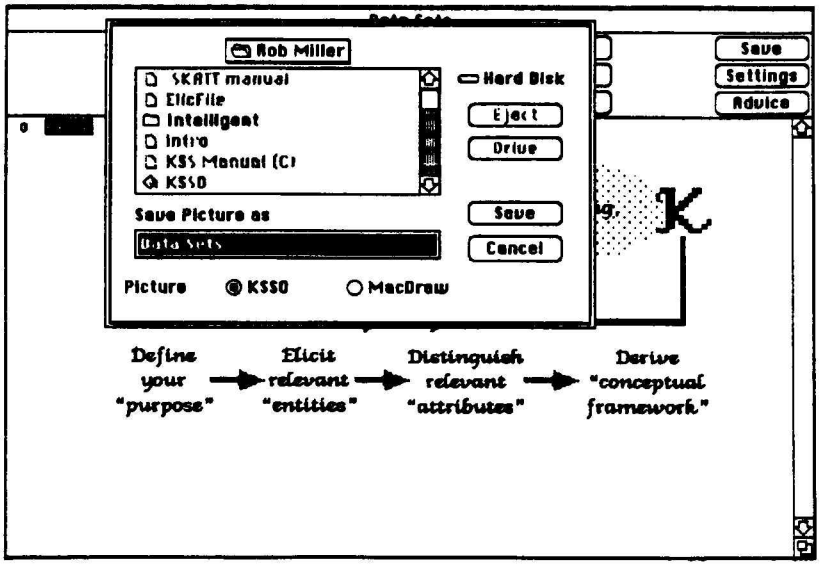


Figure 55: Dialogue box for saving pictures into file

You can change the location of storage by clicking on another folder listed in the scroll box or accessing other areas with a click on Eject or Drive. The picture save dialogue box contains a selection area for either KSS0 or MacDraw. Click on desired radio button to select area where you want the information to be placed. The two check boxes below the file name allow you to save the information in a fast save without any interruptions or to make a back-up or copy of your new file so that you have two files of the same information saved. The Fast Save is selected with an X by default. Click on any empty box to insert an X mark and activate its function. Click on the File Format button if you want to change the style of how the information is presented. Most likely, you will simply click on the Save button in the dialog window without changing any format settings. Click on the Cancel button if you decide not to save to a new file.

3.16 Displaying Output and Printing

You can access any process output screens during an elicitation or at the end of the interactive session. Viewing a process screen may help you in your elicitation procedure by showing your logical thoughts to that point, directing you in the proper area of information addition, and indicating what areas have a high match for further reductions in similarity. The Knowledge Engineer will direct the interviewee to select certain process screens at a given time as well as what process screens to view at the end of the elicitation process.

Select the desired process name from the list under the Process menu or click on the appropriate button at the control panel. This will bring up a dialogue box inquiring about the information format. The Knowledge Engineer will have selected the format, as outlined in Section II Chapter 2, so you just have to click on the OK button to access the output screen. The output will contain the elicitated information in a structured graphical or textual form showing the relationships between the components. Any

number of output windows can be displayed on the screen at the same time through resizing of windows.

Before the process window is displayed, an update window will appear onto the screen with a set of two buttons. Some time is required to arrange and display the information. The buttons allow you to see the progress of the window establishment or to cancel this procedure if you feel that it will take too long for you to sit and wait. Click on the Status button to bring up a scale depicting the time remaining as a percentage before the process window will appear. The darkened area will grow displaying the time elapsed in the establishment procedure. The start and finish time is displayed to show the elapsed time to complete this procedure. Click on the Cancel button if you want to exit that particular process.

You may want to view any window on screen on paper for more scrutiny, particularly the process output windows. Select the Print command for Data or Picture from the File menu depending on the form of screen information or use the keyboard command equivalent. A dialogue box will appear asking you for printing specifications including the number of copies, start and finish page numbers, section area, and paper source. Click on the OK button once the specifications have been set or click on Cancel button if you do not wish to proceed with printing. The OK button will initiate the printing until completed, at which time the dialogue box will be cleared returning you to the last screen at time of printing.

Select Page Set-up from the File menu if you want to change the way your information is viewed on the screen or printed out on paper. A dialogue box will appear allowing you to set the orientation of paper as well as specialty settings for the presentation of the information. Their setting follow normal Macintosh parameters and should be changed only by individuals who are aware of the styles. This feature will be defaulted to set parameters so that the individual performing the print will not have to worry about its selection. Click on the OK button to accept this format or click on Cancel if you do not want to change the settings.

3.17 Accessing Outside Information Media

Any outside information that needs to be accessed during the elicitation process along with when and how will be stated by the Knowledge Engineer. Information media can come in a variety of forms including text, graphic, LaserDisc, and HyperCard media systems. They are used to augment the elicitation process so that better and more accurate decisions are reached.

They are accessed by means of buttons inserted at the desired areas or from pull-down or pop-up menus that appear when you move across selected words on the screen with the pointer. Click on buttons with the appropriate name when you want to access certain information. When text is used as passage to this information, the pointer will change to a symbol of text on paper at these words. Press down on the mouse key to bring up the menu when this symbol appears. Move down the list of options with the

pointer and release the mouse button to select this area and bring the information onto the screen. Click on the OK button when you have finished reading the information or wait until the information is complete and the system returns you to the screen you were last at in the elicitation.

3.18 Exiting/Closing Windows

The following rules are to be performed when you wish to exit a certain section of KSS0 or the whole program itself when you have finished with your elicitation and analysis.

Click on the small box at the top left-hand corner of any process output window to remove it from the screen and return you to the windows underneath. If other process windows are uncovered from this procedure, click on their little boxes to remove all subsequent process windows. This allows access to the last elicitation window present on the screen before you entered the process windows. It is best to remove a process window once you have finished observing it before you access another process window unless you wish to resize and view several process windows on the screen at the same time. Select Quit from the File menu to exit the program while you are at any process window. This will close all the windows left on the screen.

Any elicitation window present can be closed to remove it from the screen but must also have a "quit" function performed on it to exit the screen as well as the program. You can exit and quit the program from any elicitation and process window present on the screen. The main control panel window will have a Quit button on it to remove that particular window and uncover the previous elicitation window. This is done to access the Status window for editing of input values that have a direct affect on what file a chosen. This does not quit and exit you out of the program. Select Close from the File menu, use its keyboard command equivalent, or click on the Close button of the control panel to remove that particular window from the screen and uncover the previous elicitation screen. If no further windows are present, you will receive a blank screen. This does not mean that the program and file information have been exited. You must select Quit from the file menu or use its keyboard equivalent to exit the program. Otherwise, the program is still running when you leave the computer.

4. LOGGING ON

The following chapter will explain the procedures used to set up identification and parameter information on the elicitation once you have clicked on KSS0 application icon and received the title window onto the screen.

4.1 Entering Name and Accessing New Elicitation File

The title window, Figure 56, asks for information about the elicitation.

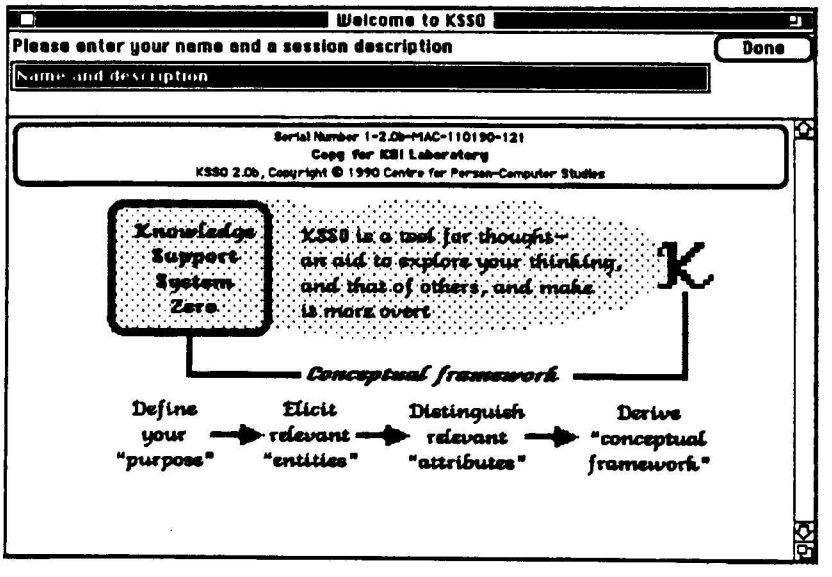


Figure 56: Insertion of name and session description

- Type your name and brief description of what subject matter you are going to enter into the program.

Be specific in your description to show the relationship you want to portray between items. Limit the interaction to a small, well-defined subject that can be built up into larger fields of interest after the first interaction. You may also want to look at a broad, general overview of an entire area as a first interaction before you break the information into smaller areas. The Knowledge Engineer will help you define the area of expertise that is required.

- Click on the Done button for the program to accept the information and bring you to the next elicitation screen, the control window. Here, the title window will contain the control panel of buttons as illustrated in Figure 57.

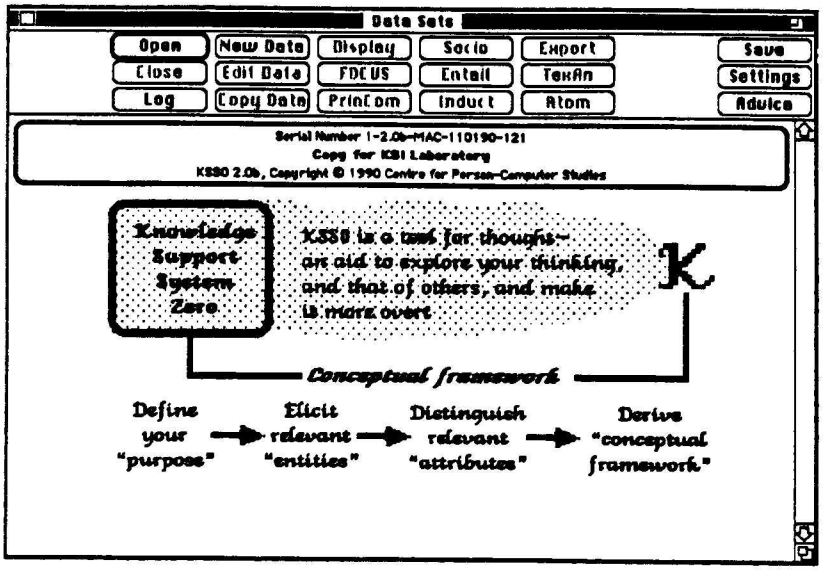


Figure 57: Accessing control panel for movement through the system

4.2 Opening New or Existing Elicitation File

Once you have repositioned yourself back to the control screen, you can proceed with the elicitation. Click on Advice to obtain information on how to proceed through the program along with a description of the major components and functions. This will provide advice dialogues throughout the elicitation. Click on any advice dialogue box to remove it and all advice boxes from the screen and all subsequent screens.

Procedures for accessing new file:

- Access New Data from this screen to bring up the dialogue box requesting a name for your new file of data.
- Click on OK button when you have finished with this dialogue box. This will bring up the status window onto the screen.

Procedures for accessing existing files:

- Access Open by clicking on button, selecting menu item, or using keyboard. A dialogue box will appear with a list of file names.
- Double click on a file name or click once and then click on Open to open it up and access its contents, either to perform a new elicitation on the information or for viewing of the results. Select Multiple if you wish to access several files at the same time. Select several file names and click on Cancel button to access the files through KSS0.
- Click on Edit to access the contents of a desired file once you have reached the control window of the desired file. This allows you to view and continue the elicitation process on the information in its original form. The window with the main control panel of the file will appear.
- Click on Copy if you wish to elicit the results of a previous file in a changed form to allow revision of the entries. A dialogue box will appear where you can rename the file to bring up the status window.

4.3 Status Window Input

The status window, Figure 58, will ask for input on defining various parameters used to establish the elicitation format. It does this by stating the defaulted name in the highlighted area at the top. Enter the information in the order that appears in the highlighted box and then change any of the bold words not having an input capability.

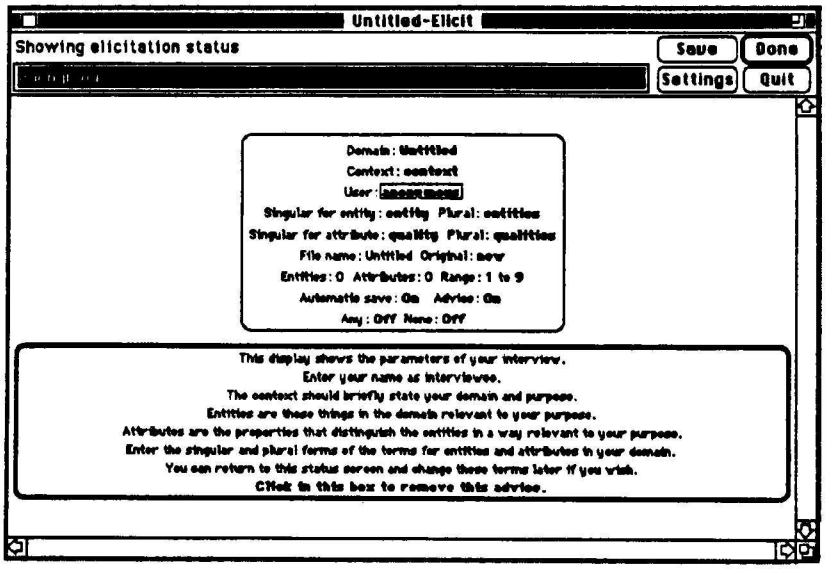


Figure 58: Input of background information on Status window

- Type the word you wish to enter into the parameter area from the ` keyboard. This will remove the highlight and insert the new word(s) in its place.
- Click the Done button to enter this word(s) into the parameter area. A new highlighted area may appear in which you are to repeat the previous steps to enter the new word into the parameter area.
- Click on the Done button without changing anything if you want the word to remain the same as listed in the parameter area.
- Double click on any of the input bold words in the parameter window to select a box around it for editing. For boxed words, the process is the same as noted above. Click on the remaining bold active words to switch the value of the word to its opposite.
- Click on the Quit button if you wish to go back to the control window and access further information or files.
- Click on Done button if you have no further revisions to the status window to exit you to the first elicitation screen. This is on the condition that no more boxed words are situated in the parameter area as this means more revisions have to be made. This includes any words not requiring change but need to be accepted into the program with a click on the Done button.

The Domain refers to the subject area that you wish to analyze while the Context refers to the form of relationships that you wish to make within

the subject area. Enter your name as the User. These three values are used to reference and file the information under headings so that the information does not become mixed up with other similar material.

The singular and plural values for the entities and attributes can be changed to names that better reflect the context of your subject matter. The entities are the objects or concepts you wish to define for your area and the attributes are the descriptive features of these entities. As shown in Figure 59, the word " sp. interp. technique" better describes the entity area while the word "construct" better describes the attribute area. These new words are then inserted into the program everywhere the words entity and attribute exists along with the plural form of these words.

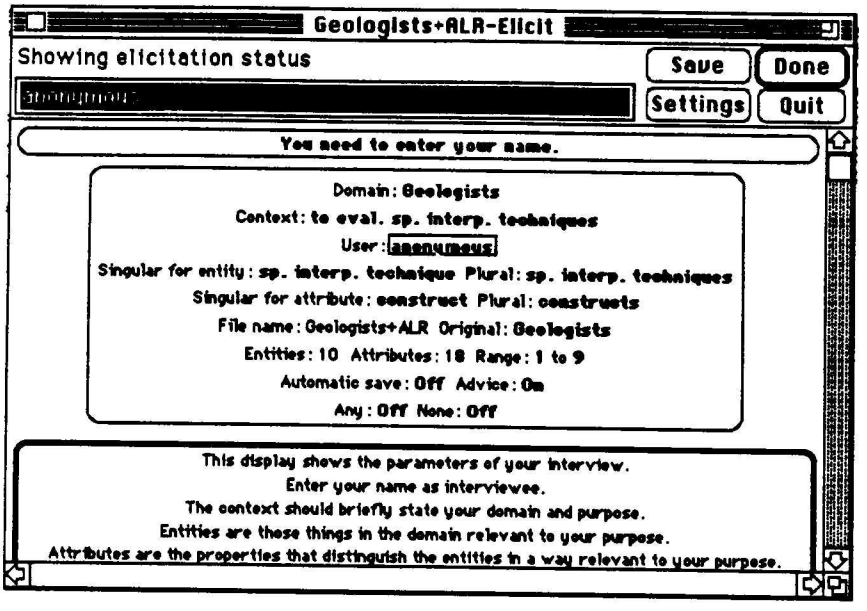


Figure 59: Input of entity and attribute definition names

The File name is inserted into the area from the name placed into the dialogue box when you first established a new file for the information. The term Original refers to the name of the file that the information originally came from. For new files just created, there is no original file. As a result, the default value of "new" does not need to be changed as this reflects the state of the file. Some files may be copied over to perform an elicitation on this existing information. This results in the old name used for the original file to be automatically placed into the Original slot.

The entity and attribute numbers will show you how many of these values have been listed in the file. For new files, the numbers will be both zero. For files that are copied over for elicitation, the numbers will reflect the amount of both areas listed in the old file. The Range allows you to set the rating scale of minimum and maximum values used to position these entities and attributes relative to each other. The default value is "1 to 9" but you can change this to reflect the value system you want to rate the items. You may want to rate the items from "1 to 3" or from "1 to 5". The default range provides the proper mixture of size and numbered spaces for the

establishment of rating areas along a bar pole. As a result, this value should not be changed unless you have a specific reason to create a new range.

The Automatic save can be toggled on or off by clicking on the bold word. This allows you to turn the save on in KSS0 so that any information you place into the program will be saved in the file without having to save the information by other means. Switching this feature off will require you to save the information throughout the program if you wish to retain the information for further evaluation. The best policy is to have the Automatic Save switched On.

The Advice dialogue windows can be switched on or off so that you can either have access to these dialogue windows throughout the program or disable the Advice button to prevent access to this information. Most likely, this feature will want to be installed and remain active in its access. Therefore, the value should remain "On".

The Any value refers to a specialty case in which ratings at both poles of the rating bar is allowed or denied. If switched on, you will be able to place a name or marker at a special position that signifies it represents features of both poles in equal amounts. If switched off, this feature will not show up in the program. It should be turned on if you feel that any of your items will exhibit this quality. It is a required feature if you want to position something exactly in the middle. This can clutter the screen with inappropriate information that doesn't help break the matches. The feature is defaulted to off and should remain in this position unless you have a specific application in mind. If this occurs, you can navigate back to this screen and turn the value on.

The None value is another specialty case in which ratings at neither poles of the rating bar is allowed or denied. Neither pole means that the item does not represent any characteristics of one pole or the other to any great extent. If switched on, you will be able to place a name or marker in a special position that will represent features of neither pole. If switched off, this feature will not show up in the program. It should be turned on if you feel there is a need for a neither in the elicitation process. The feature is defaulted to off and should remain in this position unless a specific situation occurs requiring this feature, in which case you can switch the feature on at that time.

5. KNOWLEDGE ELICITATION INPUT PROCEDURES

The following chapter will provide a step-by-step approach to the procedures required in the elicitation component of KSS0. It begins with the window requesting you to think of objects or concepts within your area of concern, as shown in Figure 60. When you have thought of six or more of these items within the field, click on the button Done to move you to the next window in the elicitation, the input of entities window. Click on the Cancel button if you can't think of any items and you wish to exit at this point. This action will take you back to the status screen. The advice box on the window tells you what is the meaning behind entities, its relationship to your subject, and some examples of their use.

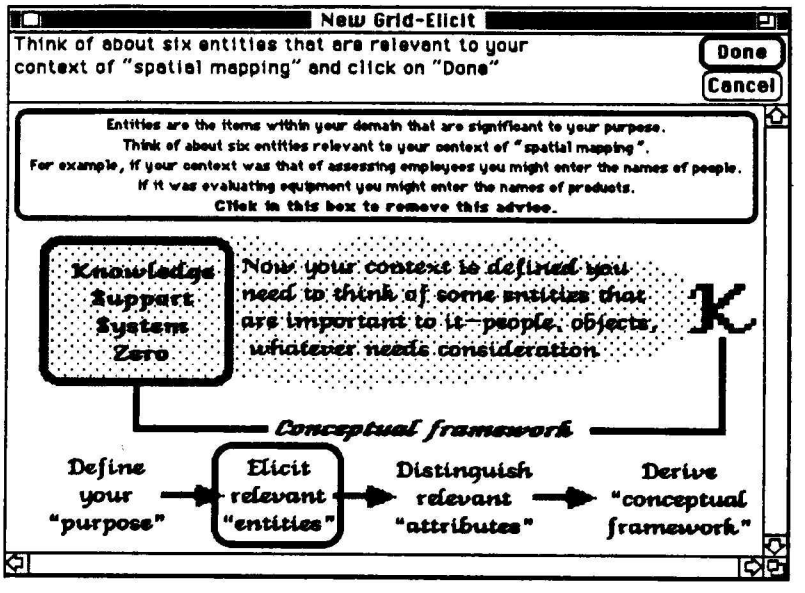


Figure 60: Thinking of six entities to insert

5.1 Defining Your Entities

The entity window will appear, Figure 61, requesting that you enter the six or more entity words chosen to represent your area.

- Type the first word from the keyboard so that it replaces the highlighted box at the top.
- Click on the More button to enter this word into the program and bring up another access box for further input. When this is done, the box containing New Entity in the middle of the window will be replaced with the input word and the box will move down one line to accept another entry.
- Type another word from the keyboard with a click on More and continue this process until you have entered all desired words. You only need to enter six entities at this time because you can enter more entities during the rest of the elicitation.

- Double click on any of the entries in the middle of the screen to obtain a box around it for editing if the word requires changes. You will then be able to type the correct word from the keyboard and click on More or Done depending on whether you have further inputs into the screen.
- Click on Done when you have finished editing or entering any entities. This will take you to the next elicitation screen.

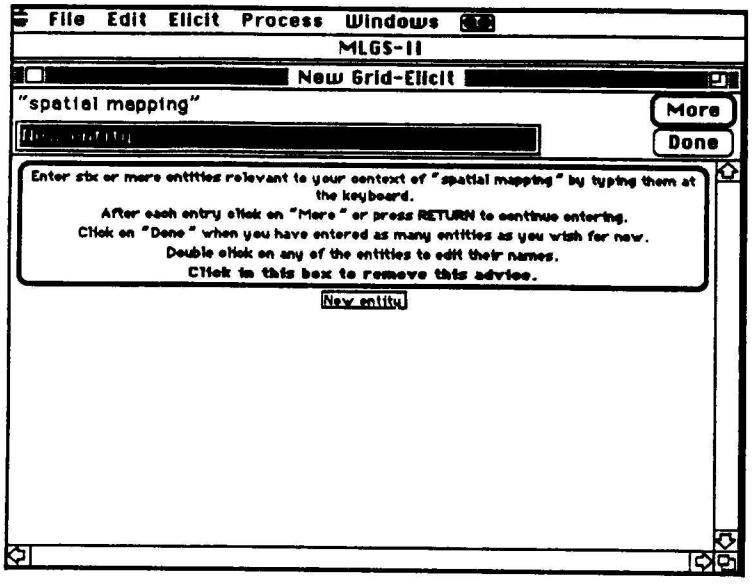


Figure 61: Input of six or more entities

5.2 Defining Your Attributes

The attributes are placed into the program in a number of ways. These words are used to describe the entity words and therefore can be assigned values in terms of position relative to the entities. Attributes are a series of paired words representing a descriptive feature that define the objects or concepts within the subject matter and its opposite value. The best method of defining the opposite value is to place a "non" in front of the initial attribute word to represent this second pole in the pair set.

From this point onward in the elicitation process, you will be able to choose how you are going to enter the information and in what way the information is related to each other. Figure 62 is the next window to appear on the screen in the elicitation process. From here, you can enter the attributes and rate their qualitative features relative to each other. You can also enter new entities in the process or utilize the various methods of breaking the matches between the words in the entity or attribute listing. As a result, this begins the process of reducing the similarities by adding new entries and rating their relationships.

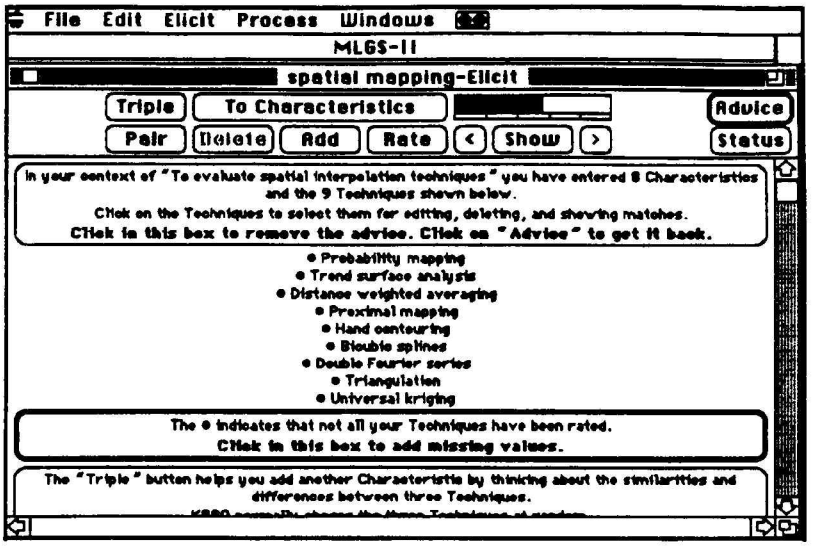


Figure 62: Input of attributes for rating of entities

Chapter 5.3 and 5.4 will discuss the procedures taken when you encounter any rating bar during the process. Chapter 5.5 will discuss the various methods one can use in the addition of new words and breaking of matches. Each method will require the ability to place the items onto the rating bars or edit their position. Any one of the methods will produce the same result, that is, to reduce the information into distinct and separate categories.

5.3 Rating Entities On Vertical Construct Pole Bar

You will receive an Entity rating scale every time you enter a new attribute pair set or rate/edit an existing attribute pair as shown in Figure 63.

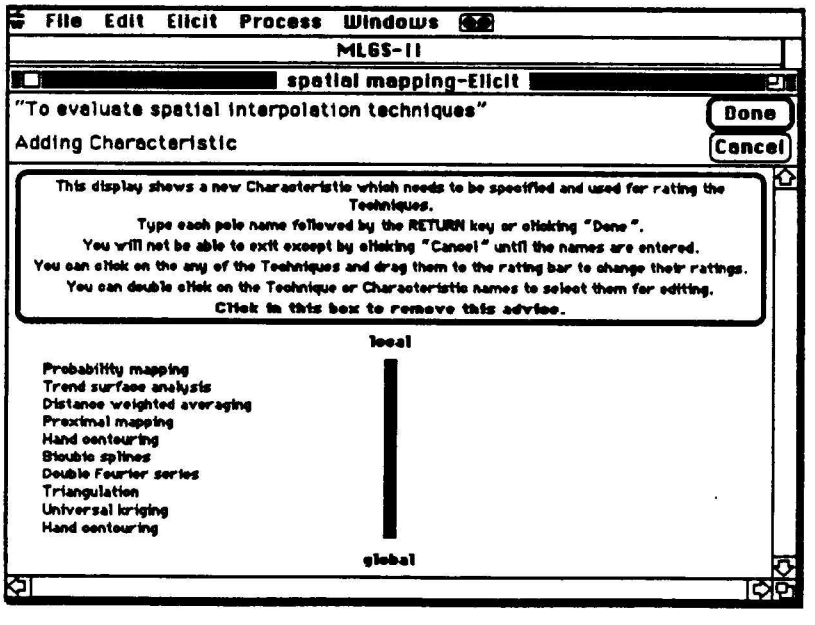


Figure 63: Rating of entity names on vertical pole

- Type in and enter the attribute name and its opposite value for the pole ends if they are not already defined as is the case for existing rate scales.

Some of the entity names may already be positioned at the pole ends. This is automatically done when you choose the Triple, Figure 64, or Pair, Figure 65, method of rating. The selection of the different word in the Triple method will become the singular name at one pole while the other pole will contain the other two entity names. The Pair method will split each entity to opposite ends. These prepositioned entities will allow you to define the differences between the words. Make sure you place the proper attribute component names for the specified pole. The remaining entity names are placed to the side of the scale. All or part of the entity names are placed to the side if you are accessing an unrated scale through the Rate facility. All entities are already positioned on the scale if you are accessing a rated scale through the Edit facility.

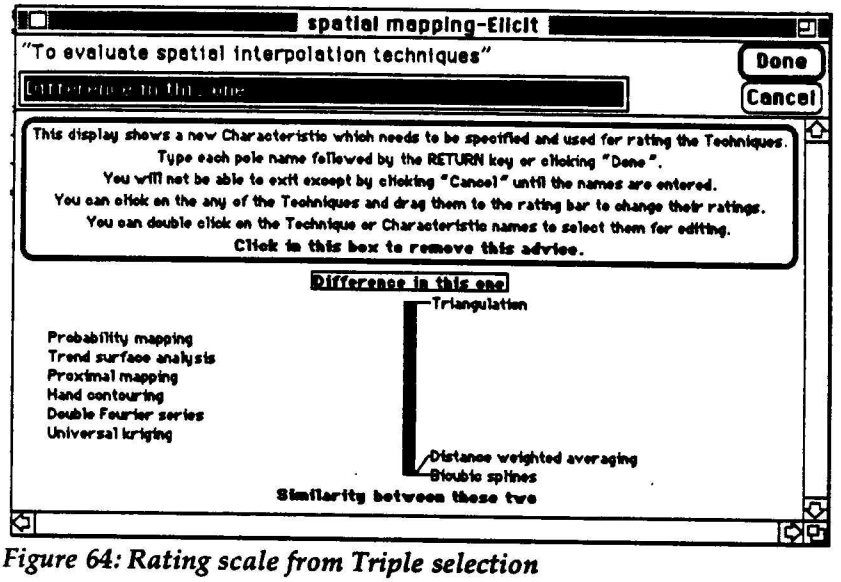


Figure 64: Rating scale from Triple selection

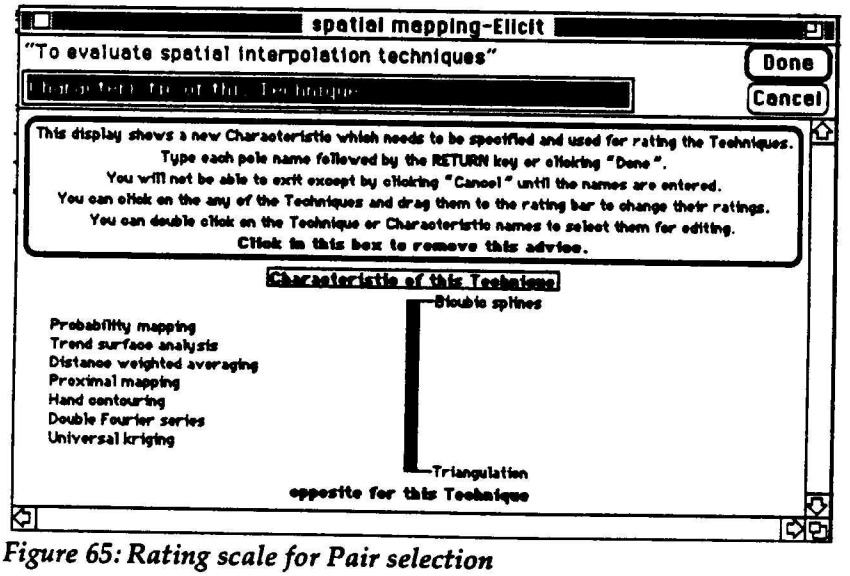


Figure 65: Rating scale for Pair selection

- Place the screen pointer on an individual entity name in the side list, hold down on the mouse key, and drag the name over to the scale. The word will develop a line to its side as you drag it, Figure 66.

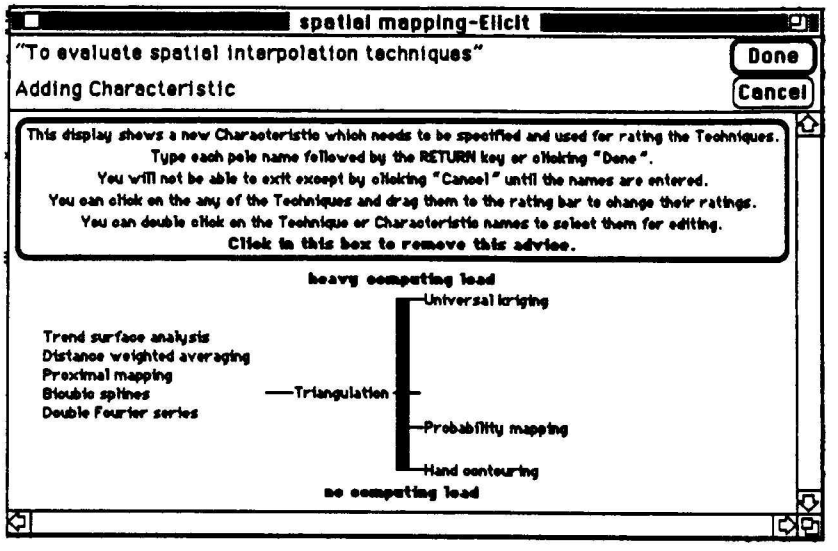


Figure 66: Placing entity names onto scale

- Position the word or its line fixture onto the scale at roughly the position you want it placed.

The words can be positioned anywhere on the line including the poles or over top other rated words. The line will connect to the same location but will bend to position the word underneath the last word. You don't have to be exact in its placement since the scale is divided into range settings as defined in the Status window so that the word will automatically adjust to one of these divided setting points.

- Release the mouse key to insert the word with its line at that point.

- Continue the process of rating the entity words until all are positioned onto the scale. All entity words are positioned relative to the attribute pole names to show the amount of interrelationships and affect either pole has towards the entity.

- You can reposition any of the entity values by holding down the mouse key with pointer at the word, dragging it to the new position, and releasing the mouse key.

- Edit any of the entity or attribute names by double clicking on the name to create an enclosed box so that you can type the new name in its place.

The poles establish the endpoints between all remaining positions. As a result, any end position can represent a pole value with all other

positions being relative to this end value not being at the pole end. Therefore, a pole end does not require an entity be placed at its location although it makes things simpler if the pole ends represent the rating ends.

You will receive special box areas beside the vertical scale, Figure 67, when Any or None are selected in the Status window.

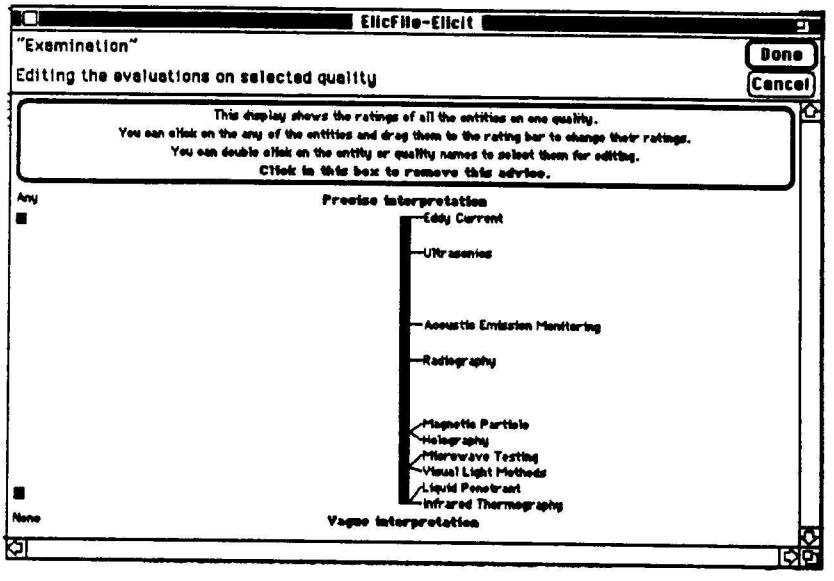


Figure 67: Selection of Any or None on rating scale

- Drag any of the entity names to either box and release the mouse key to connect the word to the box. This is done if you have an entity name that represents both pole pair names of equal value (Any) or has no affect on either pole name (None) as outlined in the Status window description, Chapter 4.2.

You will receive two sets of Any and None boxes, Figure 68, with a set for each side for matched scales with two rating sets on one scale. Each side of the scale represent the entity ratings for the given attribute pair of that particular side. Edit the matched scales in the same manner as previous scales, except this time, position the entity line on the proper side of the scale so as not to place it on the other scale side.

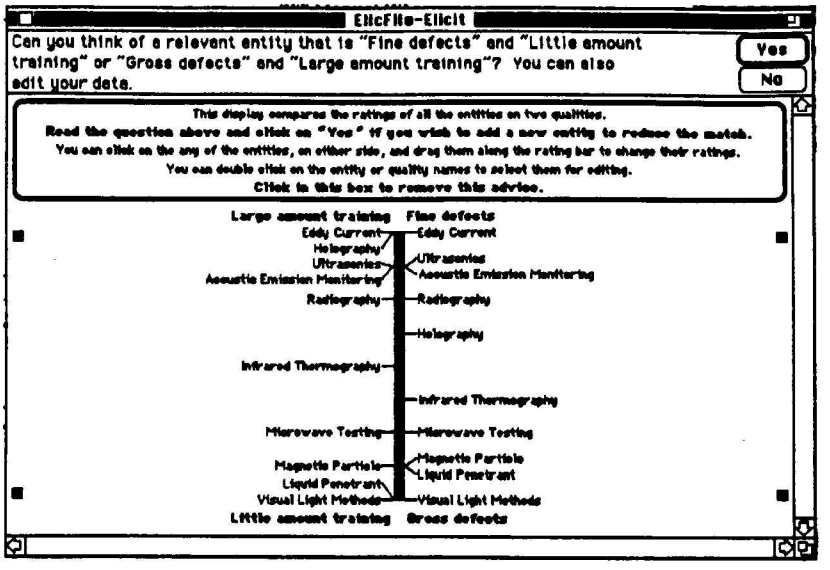


Figure 68: Selection of Any and None for matched scales

- Select the accept function of Done button or RETURN key when you have finished the rating or editing of the scales. This will bring up the entity or attribute control panel with the listing of names so that you can continue with the elicitation cycle.

5.4 Rating Attributes on Horizontal Construct Bar

You will receive a series of horizontal attribute rating scales, Figure 69, any time you add a new entity name or rate an existing scale. Each single scale has an attribute pole name at each end.

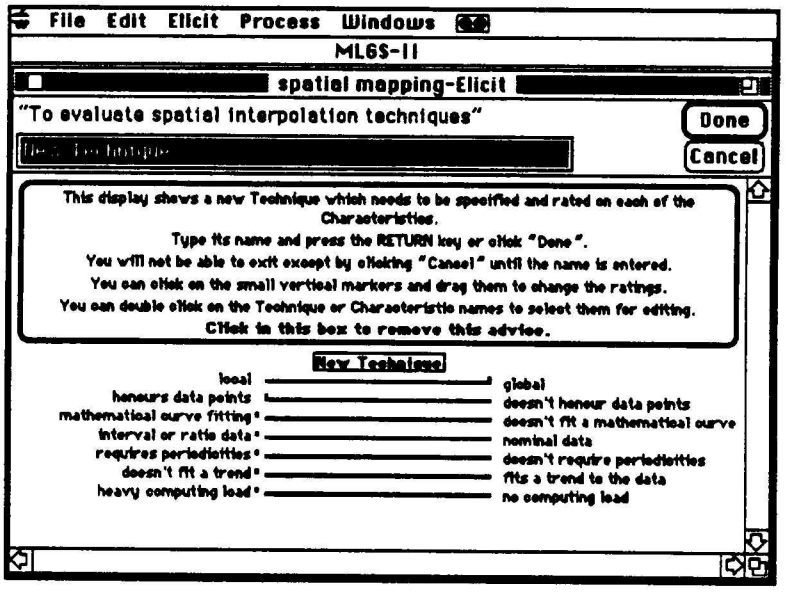


Figure 69: Attribute rating on horizontal scales

- Type in and enter the new entity name or leave the existing entity name as it stands for existing unrated or rated scales.

- Place the screen pointer on the small vertical bar beside the left pole name, hold down the mouse key to highlight bar, and drag the bar onto the scale line.

- Release the mouse key when the bar is roughly at the desired position.

You don't have to be exact in its placement since the scale is divided into range settings. The bar will automatically adjust to one of these setting points. Position the bar relative to the amount of influence either attribute pole has on the entity word. This will give the proportion affects of the attribute.

- Continue this rating process for each of the scales present.

- Edit any of these ratings by holding down the mouse key and dragging the bar to its new location by releasing the mouse key. Edit any of the entity attribute names by double clicking on the name to create an enclosed box. Then, type the new word and insert it into the box.

You will receive special square rating boxes just off either end of each scale, Figure 70, when Any and None are selected in the Status window.

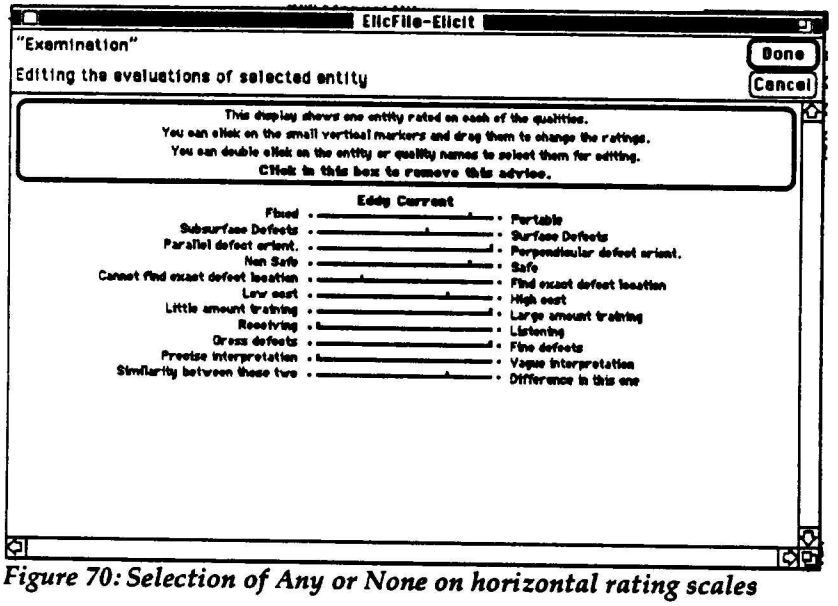


Figure 70: Selection of Any or None on horizontal rating scales

- Drag the rating bar to either box and release the mouse key to connect the bar to the box. This is done if you have an attribute set that represents the entity name in equal amounts (Any with the box on the left side of the scale) or has no affect on the entity (None with the box on the right side of scale) as outlined in Chapter 4.2.

A single set of Any and None boxes will appear for matched scales with rating bars on top and bottom of each scale, Figure 71. The top rating bar on each scale represents the amount of attribute pole influences for the top listed entity while the bottom rating bar on each scale represents the attribute influence for the bottom listed entity.

- Place either bar from the top or bottom side of the scale on either the Any or None boxes if you wish to represent the rating on either of these positions. You are able to place two bars onto one of the Any or None boxes if both top and bottom rating scales need to be represented by the same special case box.

- Select the accept function of Done button or RETURN key when you have finished the rating or editing of the scales. This will bring up the entity or attribute control panel with the listing of names so that you can continue with the elicitation cycle.

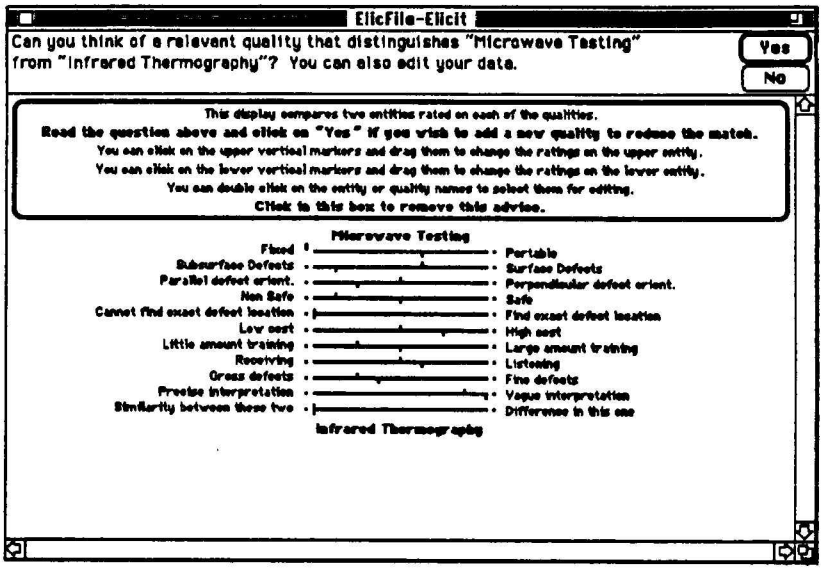


Figure 71: Selection of Any or None on matched horizontal rating scale

5.5 Methods of Information Input and Similarity Reduction

The following methods are used to input new words in the entity/attribute areas and rate their relationships. They are also used to access match screens showing the similarities between two entity words or two attribute pair words which can be edited to remove the matched areas or to access an input and rate screen through a question and answer field for the input/rate of a new entity/attribute word that will help break a match.

5.5.1 Triple Selection Method

The Triple button at the entity list window allows you to enter an attribute pair name by selecting three entity names, determining their difference, and adding attribute words onto the ends of a scale that help

define this difference between the selected entity words placed on the scale.

- Select and highlight with a click on any three words in the entity list that you feel can be distinguished between each other into two groups. Alternatively, you can let the program randomly select any three words in the list when you access the Triple function without the selection.

- Click on the Triple button at the control panel to bring up a window with the three entity names, Figure 72. The window will ask you to differentiate one of the names from the other two.

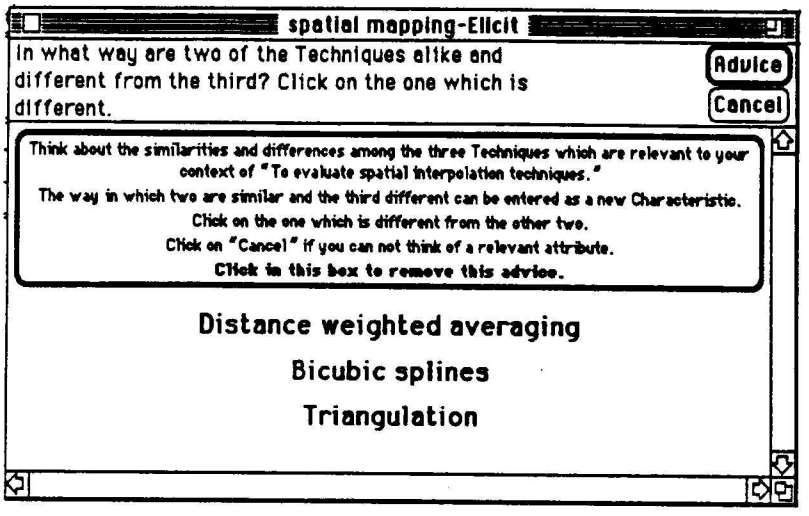


Figure 72: Triple selection entity names

- Click on this different entity word to bring up a rating window, Figure 73, in which this entity word is positioned at one end of the entity rating scale while the other two entities are placed at the other end.

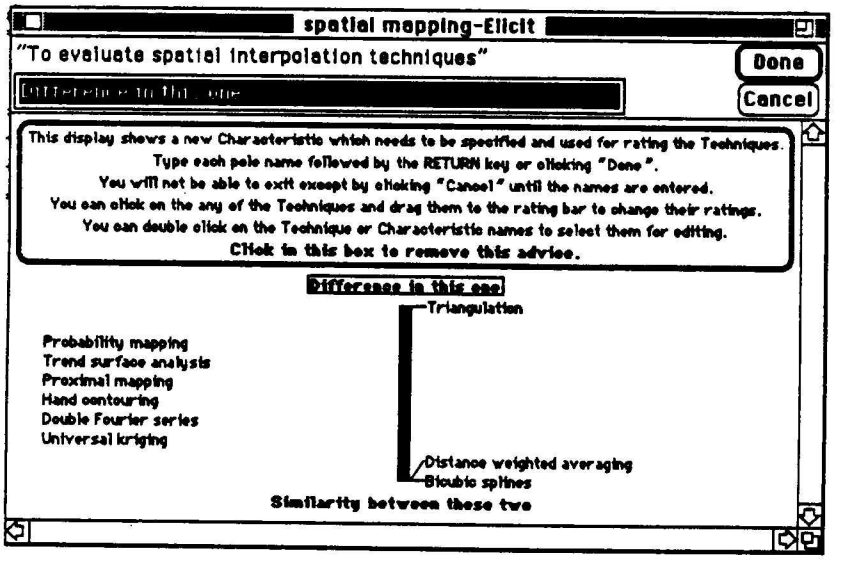


Figure 73: Accessing rating scale through Triple word

- Insert an attribute pair name into the pole regions that describes and distinguishes the differences between the two entity groups at the ends of the scale.

- Place the remaining entity names onto the scale at the desired positions to show the relative influence the attribute pole name has on a given entity name.

- Accept this information into KSS0 through the Done command to bring you back to the entity list window and control panel.

5.5.2 Pair Selection Method

The Pair button at the entity list window allows you to enter an attribute pair name by selecting two entity names and adding attribute words to the ends of a scale that define the differences between the two entity words. The Pair function is very similar in operation to the Triple function except that it distinguishes differences between two entity words only. The Triple method is more suited for breaking the differences and defining items more distinctly while the Pair method is suited for defining differences when only two words can be separated in the list.

- Select and highlight any two words in the entity list that you feel are uniquely different from each other. Alternately, you can let the program randomly select any two words in the list when you access the Pair function without the selection.

- Click on the Pair button to bring up a rating scale, Figure 74, in which each of the two entity words is placed at either end of the scale.

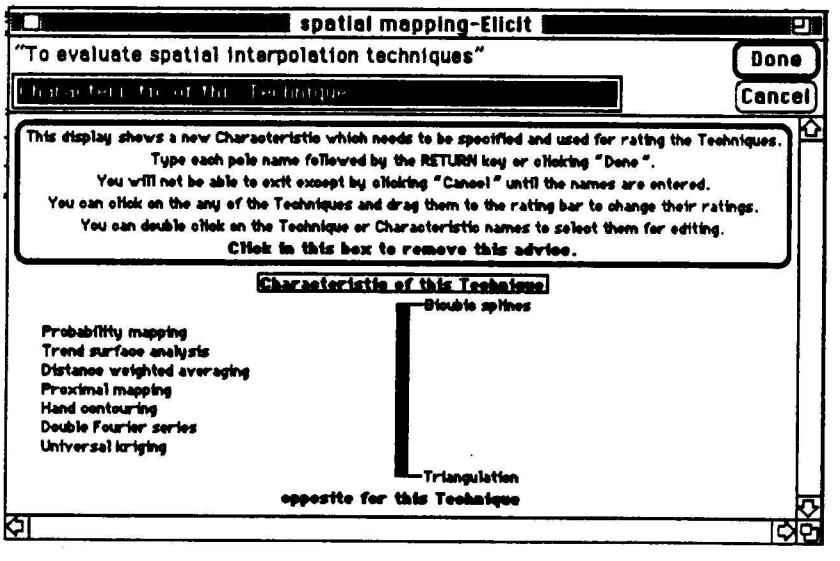


Figure 74: Pair selection rating scale

- Insert an attribute pair name into the pole regions that describe and distinguish the differences between the two entity names.

- Place the remaining entity names on the scale at the desired positions to show the amount of influence the descriptive attributes have on the entity word.

- Accept this information through the Done command to bring you back to the entity listing with the control panel.

5.5.3 Entity Addition Method

The Add function of the entity list window allows you to insert a new entity name and rate the attribute values already present in the program relative to this new entity. This method provides a means of inserting new entities without having to compare it to the previous entities or matched values. It can be used to extend the list from your own ideas without having to find an entity through comparison analysis. Also, you can enter the words without having to rate them by accepting the rating screen with the function Done used twice. You can go back and rate the new words later when you have time to think about all the different relationships inserted into the program during the continuation of KSS0.

- Click on the Add button of the entity control panel or the Addition dialogue box below the list to bring up a horizontal rating scale, Figure 75.

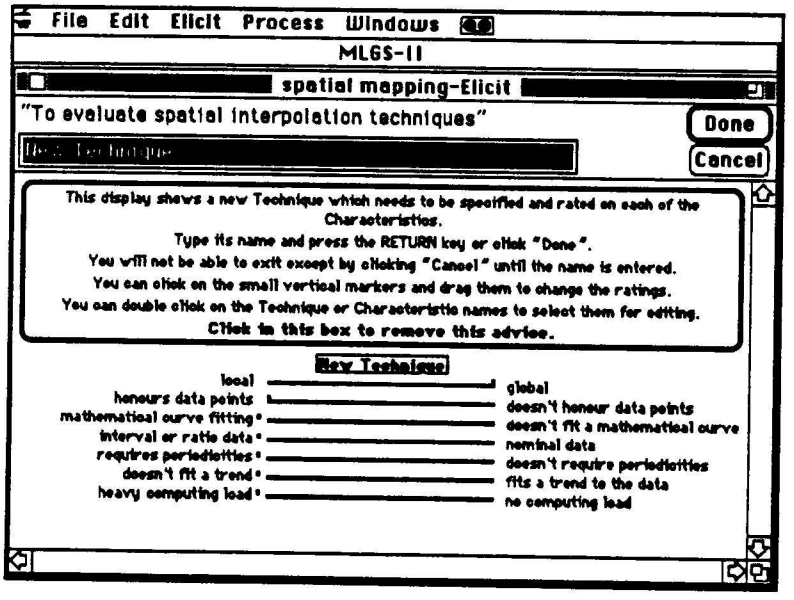


Figure 75: Addition of new entity through add function

- Type the entity name and insert it into the rating area.

- Rate all attribute settings to describe their affect on this new entity.

- Accept the information with the Done function to bring you back to the entity list with the control panel.

5.5.4 Attribute Addition Method

The Add function of the attribute list window allows you to insert a new attribute pair of words and rate them relative to the present entities. It is the same function as the entity addition method and provides a means of inserting attribute words without having to create them through comparison analysis. Again, you can enter the word pairs one right after the other without rating them if you wish by selecting the accept function Done twice and then rating the words at a later time.

- Click on the Add button of the control panel or the Addition dialogue box below this list to bring up a vertical rating scale, Figure 76.

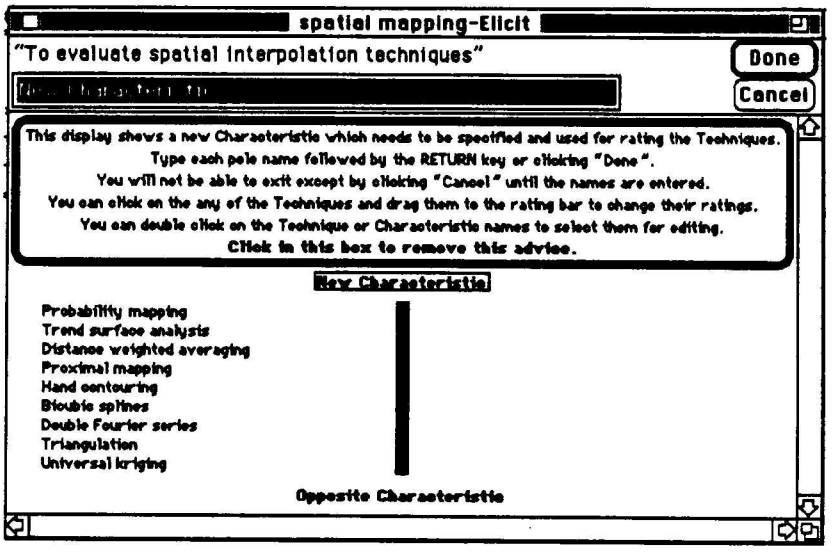


Figure 76: Addition of attribute through add function

- Type the first attribute pole component, insert into rating area, and repeat for the second attribute pole component.

- Rate all entity names onto scale to position the words relative to the attribute poles.

- Accept the information with the Done function to bring you back to the attribute list with the control panel.

5.5.5 Accessing Matched Values

Several methods exist to locate where high matches between ratings occur and how to access these combined rating scales to change or insert new information so that the high matched areas are reduced. Any one method can be used at any time to reduce these similarities between the words and break up the information into more distinct and accurately

defined areas within the subject matter. Pick the best method that you feel reduces the matches and work your way down the list of possible choices in order to reduce the amount of matches. Don't worry if any high matched areas still exist after you have completed the editing cycle as this happens when you have similar words that you can't distinguish apart. The location and access methods include:

a) location of entity or attribute words in the lists that have high matches between the ratings of these words through the rating bar of the entity or attribute control panel
b) changing the matched listing of words and rating bar correlations by the arrow buttons
c) location of words with high matches through the automatic dialogue boxes that pop up onto the window when a certain percentage of correlation is reached as indicated with the entity or attribute matched names in the dialogue box
d) movement to the matched rating screen with the Show button for the selected matched words in the list
e) movement to the matched rating screen through the match indication dialogue boxes that act as buttons

- Click on the rating bar of the button control panel for either the entity or attribute list window. This will highlight the word(s) in the listing that have the highest matches between their ratings with the percentage shown by the darkened area of the rating bar as shown in Figure 77.

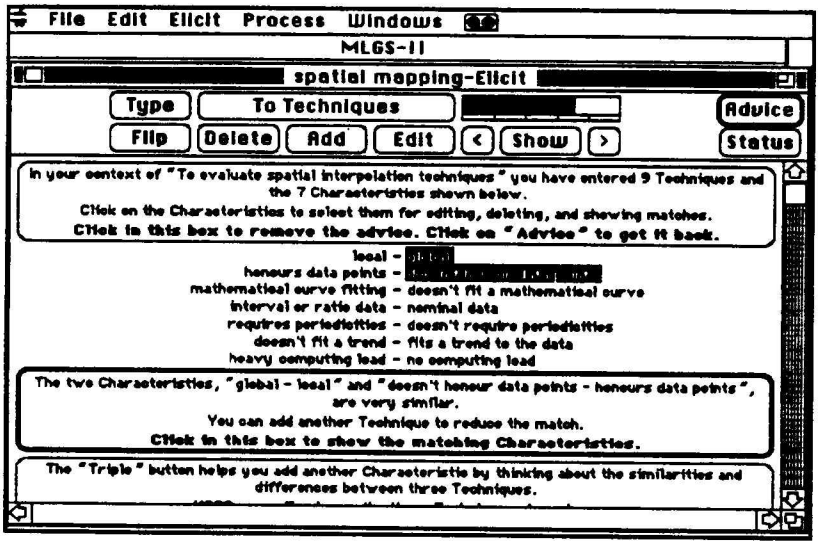


Figure 77: Showing percentage of matches through rating bar

- Click on the left pointing arrow of the control panel to move to the next highest matched words in the list as indicated with the new highlight area and the change in rating bar value. Repeat the clicking of this arrow to move down the list. Click on the right pointing arrow to move up the scale of matched words.

- Click on the Show button of the control panel for any one of these highlighted matched words to bring up the combined rating scale that you wish to see for viewing of problem areas and editing the matches.

- Click on any dialogue box that indicates a high match to obtain its combined rating scale for viewing or editing.

- Continue the process of viewing highlighted or stated matched words and accessing their scales to break the matches to the best of your ability so that most high correlations are reduced.

5.5.6 Answering Question or Editing to Break Match

You will receive the vertical entity match scale, Figure 78, or the horizontal attribute match scale, Figure 79, onto the screen once you have used one of the access methods to show matched values. The form of scale depends on whether you access an entity or attribute match in the designated list or specified words in the dialogue boxes. Make sure you navigate to both entity and attribute listing areas to view all matched values of entities and attributes. Either area will contain all existing dialogue access boxes to show the high matches. Any inputs or edits may still leave the items at a high match rating which will be revealed on the rating bar or dialogue boxes showing they require further changes if possible.

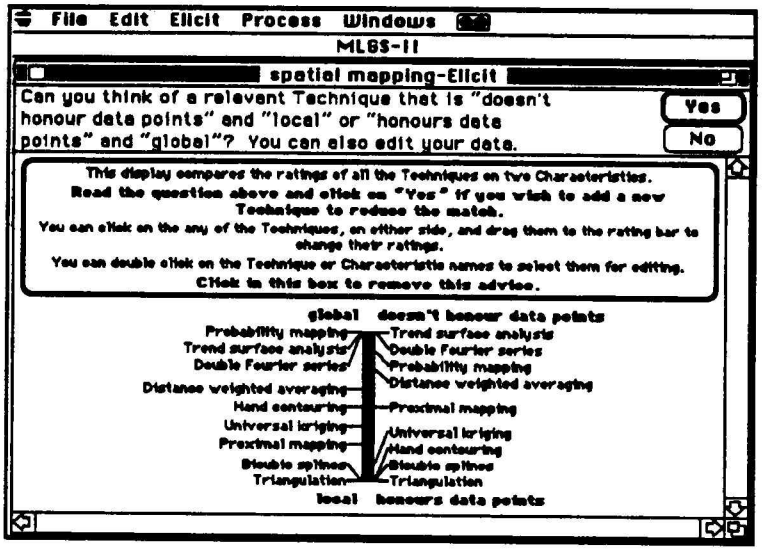


Figure 78: Answering question on vertical entity match scale

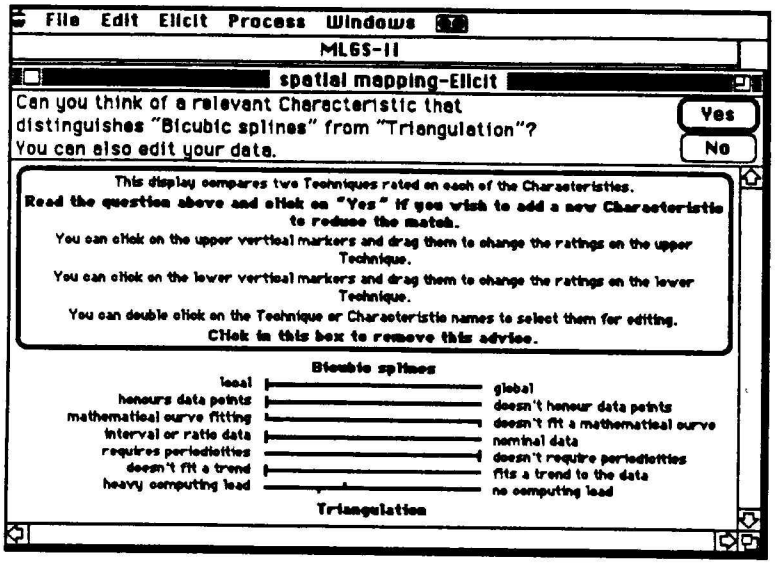


Figure 79: Answering question on horizontal attribute match scale

The matched window will contain a question that, when answered, will aid in breaking matches through the addition of a new entity or attribute word. The new entity word inserted will have the properties of both the attribute description from one side of the scale as well as the opposite end attribute description from the other side of the scale. This will allow you to input and rate an entity that has the opposite features to the matched words and will break apart the similarities and reduce the match areas. The new attribute pair word inserted for the question on the attribute matched screen is used to distinguish the difference between the two matched entities in the rating to break up the similarities through the newly rated attribute in order to reduce the match.

This method of similarity reduction provides a way to add new ideas on the subject matter and, at the same time, define the various components more distinctly to give the items a more specific position. This structures your thoughts into well defined patterns and areas of existence.

Also, you can edit the match scales themselves to change the position of matched ratings. You can edit any same entity rated in the same position on either side of the entity scale or matched positions of the attribute bars for the top and bottom sides of the attribute scale. This is done if you feel that the items have been positioned incorrectly in your first rating or have changed due to the circumstances implied by the new words added since that initial rating. It provides the opportunity to fine tune the positions on the scale to distinguish the slight differences between the two matched words.

Entity Match Breaking

- Click on the No button of the entity match screen if you can't think of this new entity word at the present time. This will take you back to the last listing screen to continue the interaction.

- Click on the Yes button if you know of an entity word that distinguishes between the two opposite poles to bring up an attribute rating screen, Figure 80.

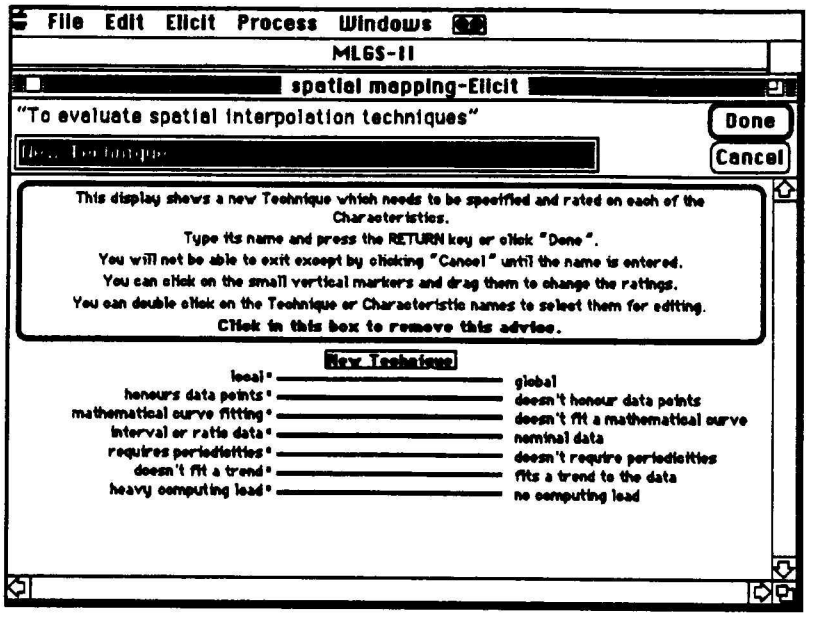


Figure 80: Adding entity name through the question region

- Type in new entity word and insert into program with Done command.
- Rate the various attribute scales relative to their influence on entity.
- Accept information into program with the Done command once you have finished rating to bring you back to the listing window with the control panel for further interaction.
- Click on Cancel button if you have reached this rating scale in error to bring you back to the last listing window.
- Edit the entity match screen instead of entity input by dragging any word(s) to its new position and accepting the changes with the Done command to bring you back to the last listing window.

Attribute Match Breaking

- Click on the No button of the attribute match screen if you can't think of this new attribute word at the present time. This will take you back to the last listing screen to continue the interaction.
- Click on the Yes button if you know of an attribute that distinguishes the difference between the two stated entities to bring up an entity rating scale, Figure 81.

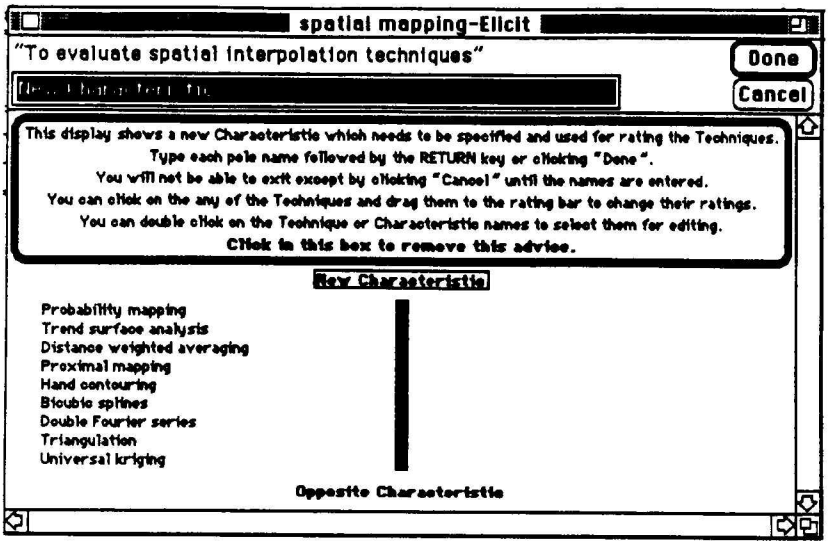


Figure 81: Adding attribute pole names through the question region

- Type in the first attribute pole name, insert into program with Done command, and repeat for the opposite attribute pole name.

- Rate the remaining entities onto the scale.

- Accept information into program with the Done command once you have finished rating to bring you back to the listing window with the control panel for further interaction.

- Click on Cancel button if you have reached this rating scale in error to bring you back to the last listing window.

- Edit the attribute match screen instead of attribute input by dragging any rating bar to its new position and accepting the changes with the Done command to bring you back to the last listing window.

5.6 Procedure For Input/Rate Of Entity/Attribute

Select one of the entity input methods of Add button on entity control panel or through attribute match break dialogue boxes on either entity or attribute input windows. This provides a window where you can insert the entity word and rate the existing attributes to that point onto a series of scales. Select one of the attribute input methods of Add on the attribute listing window, through entity match break dialogue boxes on either entity or attribute input windows, or by the Triple and Pair buttons on the entity listing window. This will bring up a window that allows you to insert the two attribute pole names onto a vertical scale and rate the entity words relative to the new attribute by positioning them onto the scale.

You can insert the entity or attribute words without rating their respective opposite feature onto the supplied scales. It is accomplished with a selection on the accept function twice to bring you back to the listing

window each time you add a new word. This allows you to insert a number of words and think about their relationships as a whole before attempting to define the individual components. Each word in the list window not rated will have a bullit in front of the entity word or inbetween the two attribute pole words for the attribute name as shown in Figure 82. Also, a dialogue box will appear on the window below the list stating that you have unrated screens. This also occurs for scales that are partially rated but are now incomplete as new words have been entered into the program or rating scales left incomplete during rating.

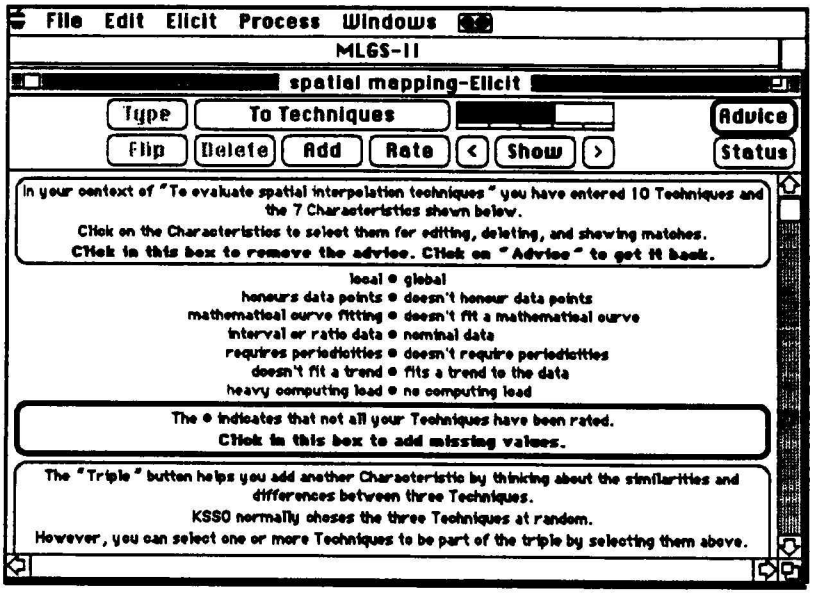


Figure 82: Bullits between attribute poles indicate an unrated attribute

The dialogue box acts as a button that can be used to access these unrated scales. Click on the dialogue box to access the first unrated word that appears in the window list on the screen, shown in Figure 83. When you have finished rating the items, insert the information into the program with the accept function which will return you to this list. Click on the dialogue box again to bring up the next unrated word in the list and so on until all words in the list are rated which will remove this dialogue box from the window. The bullits will disappear from the list one at a time for the entity list while the bullits transform to dashes between the attribute pole names. You can rate the items by selecting the desired word to highlight it and select the Rate button to move to the desired unrated scale.

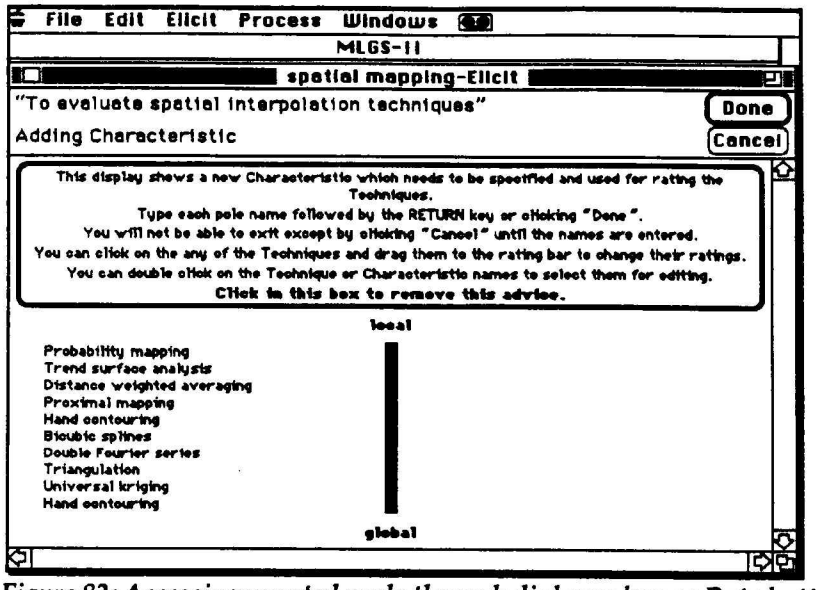


Figure 83: Accessing unrated scale through dialogue box or Rate button

5.7 Completing The Cycle

Repeat the cycle of inserting entity/attribute words and rating their respective counterparts onto the scale or editing the data to break apart any matches that may occur between existing words.

- View the process windows during the elicitation to see how the information is forming and edit the data by inserting new words or breaking matches to position the process information correctly.
- Continue this procedure until all entity and attribute words that you feel describes the subject matter to the extent desired are inserted into the program.
- Make sure all scales are rated as indicated by the absence of bullits in either entity or attribute lists.
- Break any and all matches to the best of your ability and edit the data to properly reflect the perception of this information.
- Move to both the entity and attribute insert areas to ensure that all information is complete.
- View and analyze each process window to determine your thought patterns and discuss with the Knowledge Engineer to ensure everything is complete and correct. Make any final changes as necessary.
- Exit the program through the quit command to terminate the procedure or Export the information onto the expert system shell. Test and edit the expert system as required.

6. DISPLAYING AND INTERPRETING RESULTS

This chapter will provide example process screens obtained during elicitations. It will show how these screens were obtained and provide a systematic approach to analyzing the results. A general description of the example results will be given to show the concepts and principles behind the analysis methods. Also, editing procedures to change any results that are incorrect will be discussed.

6.1 Displaying Output With Graphic/Text Features

- Select any desired process function from the buttons in the main control panel contained on certain windows or from the menu bar at the top of every screen.

- Select any desired text or graphic feature from each process format dialogue box. This is accomplished by clicking on the desired square or circle in front of the function to place an X mark or dot to select this function. Any previous dots will be removed automatically while you will have to click on any squares containing an X mark that you don't want selected. If you are not familiar with the items, do not change anything as it will default to the selected functions. Select the accept function by clicking on the OK button or depressing the RETURN key.

- Analyze each process window for agreement on general positions as they relate to the way you view the items in the domain. Any discrepancies should be analyzed further with the text components or discussed with the Knowledge Engineer to measure exact positions. Edit the data accordingly by adjusting items to the correct positions.

- Close each process window when done with a click on the close box and select the next process window until you have completed the analysis and editing cycle.

6.2 Novice Level of Interpretation

Example process windows are discussed to illustrate the procedures involved in analyzing the results and reveal the general principles and logic behind the results. Example cases are primarily of the graphical distance-based type and textual rule forms as this is what will appear on screen for the expert eliciters. The other more in-depth textual screens used by the Knowledge Engineer will be discussed briefly to reveal their relationship in the analysis process. Further details on these process results will be given in Section II, Chapter 5 at the level of the Knowledge Engineer with the complete analysis and theory underlying the methods.

6.2.1 Display Mode

Figure 84 is a Display output of a geography study in mapping techniques and their features. The entities (mapping techniques) are listed

on the bottom of the chart while the attribute poles are placed on either side of the chart. This chart is known as a repertory grid. Each number in the chart corresponds to the value assigned to the entity-attribute at their vertical and horizontal intersection on the chart. These numbers are the same values rated on the scales.

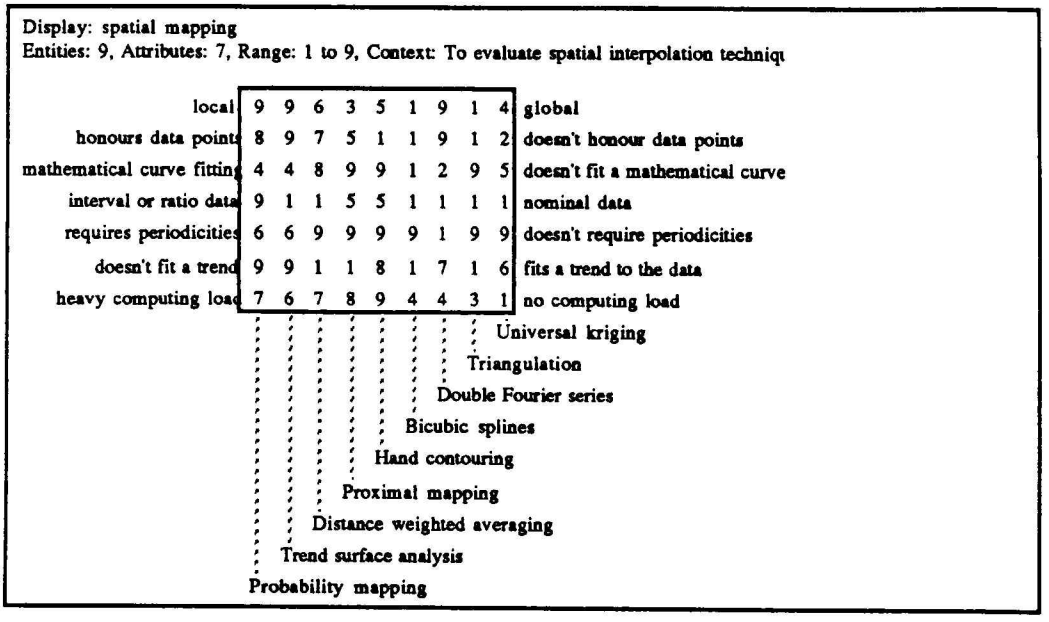


Figure 84: Display output for geography mapping techniques

For example, the entity "Triangulation" and the attribute "honours data points - doesn't honour data points" is given a rating of 1 since this entity is related very closely to the "honours data points" end of the attribute scale. The number 1 represents a high correlation to the left side attribute poles of the chart. Likewise, the entity "Probability Mapping" and attribute "interval or ratio data - nominal data" is given a rating of 9 suggesting that there is a very high correlation to the nominal data end of the attribute scale. Any other number shows the amount between these two extremes or grey area and provides a measure of qualitative features. A number in the middle indicates no preference for one end of the attribute over the other end. Any time you placed the words at the Any pole in the ratings, you will receive an "A" for that particular square. Any time you placed the words at the Neither pole in the ratings, you will receive an "N" for that particular square. Any areas not rated will be colored in black to signify that a rating of the items is required.

The information show the items that have similar correlations. For example, the entities "Probability mapping" and "Trend surface analysis" have very strong ties to "global", "doesn't honour data points", "fits a trend to the data", and "no computing load" but are in-between in "mathematical curve fitting" and "requires periodicities". The only distinguishable difference between the two is shown by one being very strong to the "nominal data" side while the other being very strong to the "interval or ratio data" side. This difference reveals the basis of distinction between the two entities and can be used to reveal the factors involved in the placement of

these items in the remaining process screens. The similarities can be readily seen with the Patterns function be used to divide the numbers into boxes with a high, medium, or low shade applied to its area signifying the range present for the number. This coloring will show what entities are closely related and by what attributes.

The Display graphic provides you with a quick overview of the items, their ratings and relationships, and the correlation of similar values. Also, you can obtain a textual output of the entity and attribute names along with the number and values of the ratings without having them placed in a repertory grid format. This may be beneficial if you only wish to quickly view the components of the list.

- View the chart to make sure the numbers correspond to the rating that you feel the items should be valued.
- Find the areas of high correlation to determine what makes them similar and what makes them different and by how much.
- Find the underlying cause and interrelationships between these correlations to see if they fit your perception and spacing of the items as well as reveal the factors behind the positions.
- Edit the values by moving back to the related scale and change the rating on the scale. This is done by moving to the particular entity or attribute list window, selecting the desired word to highlight it, and clicking on Edit button to move to that particular rating scale. You can change the names of these words to suit the adjustments at this location as well. You can change the word settings at the process window by holding down the mouse key at desired word to highlight it and obtain the text icon with the Settings function. Release the mouse key to obtain the settings dialogue box where you can adjust the font type and other word settings.

6.2.2 Focus Analysis

Figure 85 shows the Focus analysis window of the same geography study of mapping techniques. The repertory grid is augmented with cluster graphs that connect similar rated entities and attributes relative to each other and provides an actual percentage value of the correlation. The entities and attributes are rearranged in their listing to correspond to the clustering of similar values. The patterns function is in operation showing areas of similarities between the entity-attribute relationships.

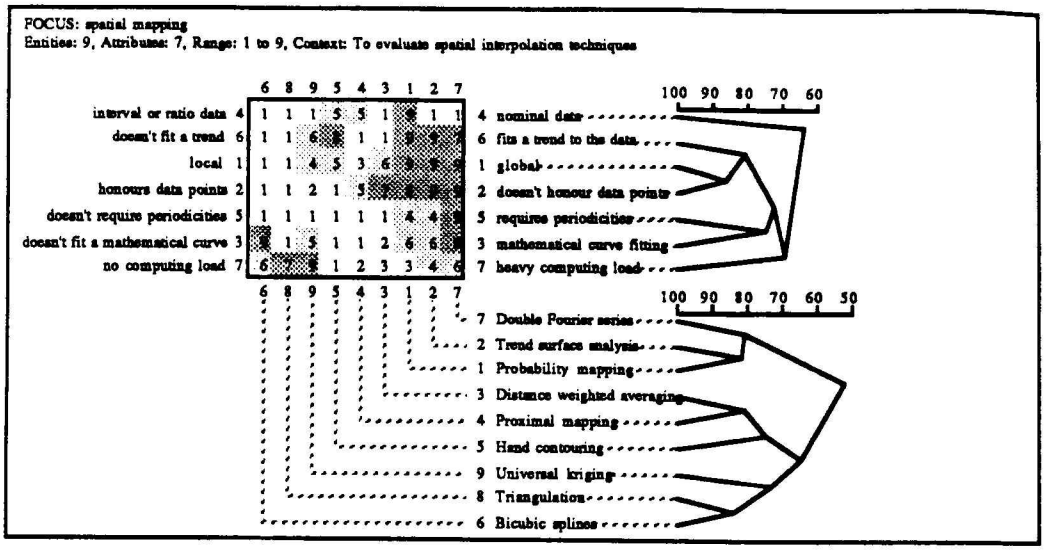


Figure 85: Focus analysis of geography mapping techniques

The attribute ends "global" and "doesn't honour data points" has a very high correlation rating of approximately 86% as shown by the connection point. This indicates that a high percentage of entities have very similar ratings of these two attribute areas. If you have a global point, you will more than likely find that it doesn't honour data points for a given mapping technique. As a result, it can be stated that a majority of mapping techniques have the common features of global values that don't honour the data points. Likewise, approximately 80% of these two features have also the common feature of fitting a trend to the data. It shows the amount of relationship between these two groups and what kind of affect they have on each other. This procedure is continued throughout the entity list. Because the cut-off range is at 60% for the list, all entities and their links can be represented in the graph. If there was any linkage below the stated 60%, the connection lines for that item would not link up to any of the other items.

The entity items are analyzed in the same manner. The "Distance weighted averaging" and "Proximal mapping" techniques have an 80% relationship because of that amount in similarities between the rating of their attributes. These entities are then related and linked to the other groups within the entity list to show the overall similarities and differences between them. The entity and attribute graphs are then compared to each other to find areas of linkage and relevancy between the items.

It can be found that the majority of entities have interval or ratio data because of the low relevancy percentage of the nominal data to the rest of the attribute names which are also linked to the entities. This may be a determining factor or distinction between the mapping techniques and thus reveals the way you perceive and formulate the knowledge. The Focus graphs also indicate that the techniques seem to be clustered into three separate groups containing three techniques each showing the areas of mapping trends.

You can obtain a listing in chart form of the entity and attribute points of correlation through the text format, with an example from another elicitation shown in Figure 86, with the E and number or R and number representing a particular entity or attribute respectively. It provide accurate values for the relationship between any two entity or attribute words, not just the linkage between correlation groups of the Focus graphs. You can obtain a chart of the linkages created between each attribute value which is the distinguishing connection to the entities. A listing of the highest and most significant entity and attribute linkage points is given with the L and number representing a specific linkage point.

```
   * E1  E2  E3  E4  E5  E6  E7  E8  E9 E10
      ********************************************
E1 * 100  59  70  50  42  57  58  49  48  84
E2 *  59 100  64  57  38  64  62  59  38  60
E3 *  70  64 100  59  42  64  49  47  43  64
E4 *  50  57  59 100  78  50  49  57  75  48

   * L1  L2  L3  L4  L5  L6  L7  L8  L9 L10 L11
      ************************************************
L1 * 100  76  56  65  66  49  45  48  49  69  54
L2 *  76 100  58  66  70  40  36  54  42  65  62
L3 *  56  58 100  54  55  72  76  56  80  48  70
L4 *  65  66  54 100  69  59  62  52  61  54  46

Entity  Links

 E5 linked to E9  at  88.6
 E1 linked to E10 at  84.1
 E4 linked to E5  at  78.4
 E7 linked to E8  at  77.3
```

Figure 86: Focus text output giving exact values and linkages

- Find the areas of high correlation in both entity and attribute graphs or patterns in repertory grid to locate the general linkages in each group and their relation to the rest of the items.
- Locate significant features that might distinguish the way you have separated and positioned the words to see if they match your understanding of the material.
- Find any connections between the entities and attributes to analyze what the prime factors are in your understanding of the subject matter.
- Edit the information, with the aid of the Knowledge Engineer if required, in the same manner as discussed previously in Display.
- If possible or desirable, find the exact linkage values through the text data and discuss with the Knowledge Engineer for further editing of data to represent your views on the matter more accurately.

6.2.3 PrinCom Analysis

Figure 87 illustrates the PrinCom analysis of the mapping techniques and their descriptive features. The attribute sets of descriptive mapping features form lines with the pole names at each end. The lines are spread around the surface to represent the affects that each attribute pair has in relation to the other pairs. The entity words of mapping techniques are represented by the X marks placed at varying positions within these attribute lines. The entity positions provide the third dimension in the spatial representation of the information in that they give a distance in or out of the page on that plane. PrinCom gives a further visual representation of the relationships between the entities and attributes amongst themselves and the interrelationships between the two word groups.

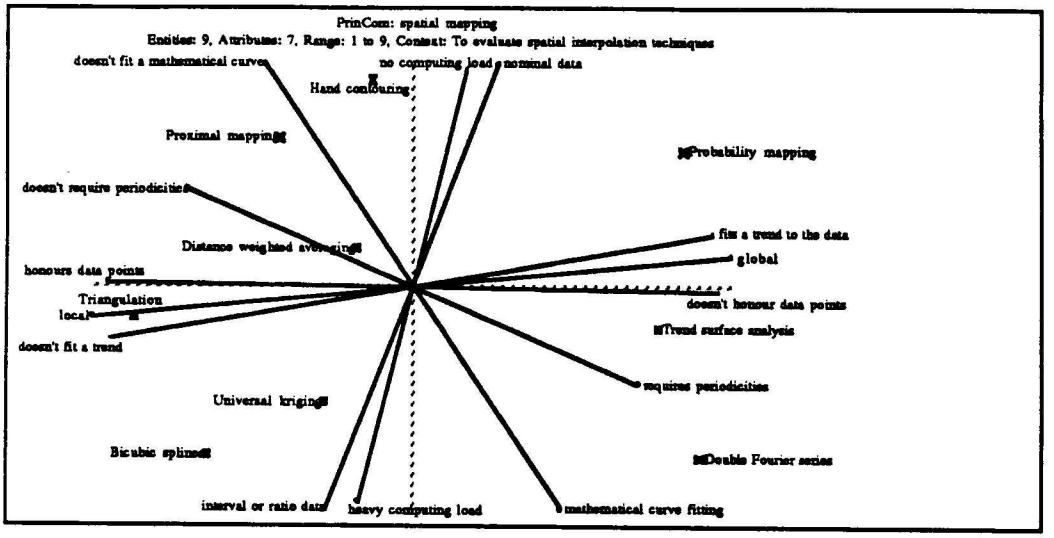


Figure 87: PrinCom analysis of mapping techniques showing spatial relationships

The high correlations between computing load and data types is prevalent by the close proximity of these two lines as well as the similar lengths in both the lines. This holds true for the close proximity for the trend fitting, local-global, and honouring data points. These similarities reveal what features of mapping techniques which have similar affects on the techniques themselves. It can be seen that the Triangulation method is based primarily on the local feature since its X mark is situated onto that attribute line near the "local" pole.

The Hand Contouring technique is influenced approximately in equal amounts from the "doesn't fit a mathematical curve" and "no computing load" attribute ends due to similar perpendicular distances to each of these lines in this quadrant of the spatial map. Very little computing load is applied to the Hand Contouring technique because the imaginary perpendicular line is very close to the "no computing load" pole. On the other hand, the technique is influenced less by the "doesn't fit a mathematical curve" pole because the distance on the attribute line from the perpendicular distance point of intersection to the pole end is at a further distance than the amount to "no computing load" pole. The technique is influenced to a lesser extent

from the "nominal data" attribute end as well as the other attribute lines that are intersecting by its perpendicular distance because of the further distance to those attribute lines.

The Double Fourier series technique is influenced by the curve fitting and periodicities attribute ends a large extent because the entity value is past the pole ends (thus extensions to the lines give the total influence to these pole values). The entity receives a lesser influence from honouring data points, global, trend fitting, computing load, and data type attributes because of the perpendicular distance to these lines but they still remain high for the first three because the intersection point of the perpendicular line is close to the pole ends. The remaining entities and attribute influences are analyzed in the same manner.

The spatial mapping in PrinCom lays out the items in a three dimensional space to visually distinguish the relationships and influences of all applicable attributes onto each entity. Therefore, all mapping techniques are positioned in a particular location due to the influences of various descriptive features that determine all aspects of mapping techniques. The descriptive features, in turn, are positioned due to the similarities and differences between their functions. Any individual can analyze and determine the structure of mapping techniques and quickly find all influences and by how much for any given technique.

You can also call up textual information that define these relationships with exact numbers to be used in the Knowledge Engineering analysis as shown in Figure 88 a and b with an example from another elicitation. The numbers represent the actual distance between various items in the spatial representation. These include a measurement of influences between attributes and thus their position, influential amount of the Principle Components, and amount of influence (loadings) of entities and attributes onto the Principle Components. A positive number represents a positive correlation or attraction between any two items while a negative number represents a repulsive correlation showing the differences any two items have towards each other. The desired measurement is found by finding the intersection point between the desired item in the top column with that of the desired item in the side row of the chart.

```
Attribute  Correlations
   *    A1    A2    A3    A4    A5    A6    A7    A8    A9   A10   A11
   ***************************************************************
A1 *  1.00  0.69 -0.20  0.18  0.50 -0.66 -0.54 -0.17 -0.34 -0.03  0.24
A2 *  0.69  1.00 -0.34  0.36  0.51 -0.80 -0.71 -0.11 -0.56  0.18  0.36
A3 * -0.20 -0.34  1.00 -0.14 -0.14  0.43  0.57 -0.16  0.61 -0.70  0.36
A4 *  0.18  0.36 -0.14  1.00  0.50  0.03  0.13  0.18  0.12 -0.29  0.37

Percentage  of  Variance  for  each  Component
   *    C1    C2    C3    C4    C5    C6    C7    C8    C9
   ***************************************************************
1 *  46.23  22.54  14.78  6.87  4.41  3.25  1.41  0.37  0.13
```

Figure 88a: PrinCom text showing correlation values and variance percentage

```
Attribute Loadings on each Component
  *    C1    C2    C3    C4    C5    C6    C7    C8    C9
   ***************************************************
 A1 * -4.999  3.346  0.134 -3.664 -2.064  2.513 -1.616  0.252  0.154
 A2 * -7.182  3.454  1.100 -1.104 -2.578 -1.956  1.851 -0.368  0.178
 A3 *  4.784  2.798 -4.419 -2.236  0.470 -2.875 -1.385 -0.525  0.266
 A4 * -0.559  6.083  3.498  4.568 -2.184 -0.242 -1.095 -0.235  0.056

Entity Loadings on each Component
  *    C1    C2    C3    C4    C5    C6    C7    C8    C9
   ***************************************************
E1 *  4.685  5.459  4.395 -1.982  0.960  1.499 -1.088 -0.887 -0.126
 E2 *  4.192 -2.062 -4.881 -2.280  3.367  1.785  0.733  0.472 -0.149
 E3 *  5.451  5.541 -4.199 -1.372 -4.107  0.008  0.250  0.315  0.064
 E4 * -6.231  3.140 -4.207  0.447  1.849 -2.716 -1.590 -0.090  0.188
```

Figure 88b: PrinCom text showing entity and attribute loading values

These measurements are used to define the relationships and positions in exact amounts so that you can refine the data to suit your perceptions by changing the position of items on the rating scales by an exact amount. This information is presented here to show what the Knowledge Engineer uses to accurately analyze the results in case you are required to assist in the mathematical analysis. These items will be discussed in more detail in Section II, Chapter 5 which explains the meaning and logic behind Principle Components and their analysis.

- Hold down the mouse key with the pointer on graphic words to highlight any desired entity or attribute word in PrinCom that you wish to move slightly so as to separate any words that overlap. Drag the word to the desired location by way of the mouse and release the mouse key to position it at that point. If you want to change print style of the words, hold down the mouse key with pointer on desired word to highlight it and move the pointer to its right hand to obtain Settings text icon. Release mouse key to obtain dialogue box where you can adjust these features. Accept the dialogue box information to take you back to the PrinCom window.

- View the PrinCom output to find the general placement of items within the spatial mapping. Try and visualize the components from a three dimensional stand-point with the entity words providing this additional dimension on either side of the attribute lines. This will show the structure of the topic material and how you relate the various items to each other. Check to see if all is correct in general terms.

- Find each entity word and visualize imaginary perpendicular lines to all attribute lines that can be intersected or possibly intersected through extension of the lines. Roughly interpret the amount of influence between various components and see if they match your understanding of the relationships and influences.

- If required, accurately measure the distances or use the text charts to obtain measurable influences and compare the results to see if they represent the information in the correct ratio.

- Edit the data in order to change positions of the items to reflect desired amount of influence. This is accomplished by moving back to the rating scales and adjusting any conflicting ratings. Then, view PrinCom again to see if the changes provide the proper visual and measurable results. Repeat this procedure a number of times until all items are properly adjusted.

6.2.4 Entail Analysis

Figure 89 gives the entail rules on mapping techniques. These are only part of the total possible set of rules. The number and form of rules generated in the entail process depends upon the areas of linkages selected as well as the cut-off value selected, both within the format window of the entail process. The cut-off value limits the amount of linkage desired to the rules with this percentage of correlation and higher. The top of the window will give you the date and time the computer performed the calculations as well as the time the information is placed onto the screen as output.

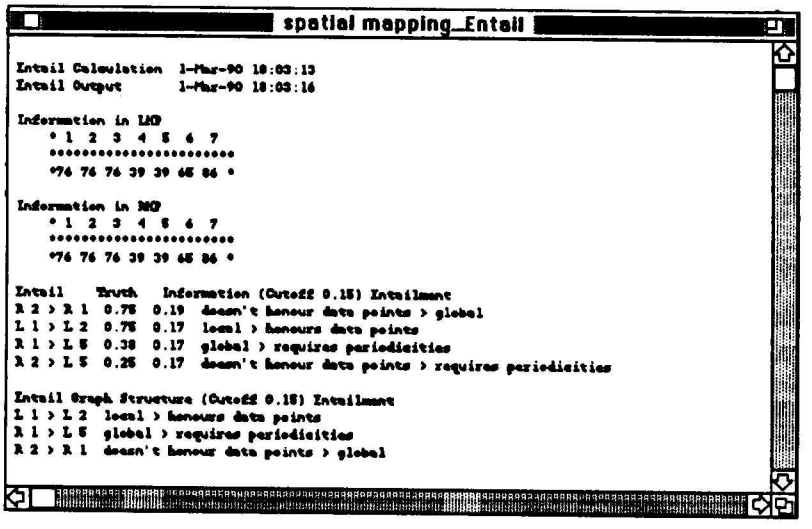


Figure 89: Entail rules on mapping techniques with probability values

The entailments (implied linkages) are based upon correlations between the attribute links. The two charts at the top of the entail window lists the seven numbers used as symbols for the seven attributes from the mapping techniques elicitation. The charts will only be used by the Knowledge Engineer in determining the accuracy of the results. One chart is for the attribute ends of the left-hand pole (LHP) while the other chart is for the right-hand pole (RHP).

The number under each attribute pole heading represents the percentage of correlation of all rating scales. The percentage of correlation

will be the same for both the left and right hand pole ends since they represent the same attribute. The values are then used within calculations to draw up the entailment links shown by the greater than sign between the attribute end symbols.

The symbol means "implies" to show the linkage between similar attribute ends. The symbol changes to an equal sign when there is an extremely high correlation between any two attribute ends. The equal symbol means that one attribute end always implies the occurrence of the other attribute end. The other side of the entailment link line lists the names of the attribute ends that make up the linkages to form a rule that might be used within an expert system. The other set of rules below the first set provides the "Graph" results which reduces the number of linkages to only those that are considered to have high correlations and linkages.

The line will also contain a combination of one or more relevancy values of truth, probability, and Information correlation percentages expressed in decimal form. These values are automatically calculated from a series of formulas . The truth value rates the rule in terms of its probability that it is true for all situations of this rule. The probability value rates the rule in terms of its probability that it will occur in reality. The Information value provides the percentage of correlation for the linkages between the two attribute ends and limited by the cut-off value selected.

A variety of information may be presented as output for analysis and editing by you and the Knowledge Engineer. The rules area can contain linkages for entailments discussed earlier or for an equivalence set of rules with each entailment or equivalence area possibly having a separate listing of rules with the condition of "Usually" added to it. These areas provide different viewpoints to the rules and will be of concern only to the Knowledge Engineer. The "Usually" category will provide a greater number of rules to be formed because it will also list rules generated below the correlation cut-off value. You can also obtain variations to the output in terms of charts giving the detail numbers used to derive the linkages. Again, this will only be of certain to the Knowledge Engineer who analyzes the data to find the correlations and linkages used to determine whether a rule is acceptable.

The mapping techniques results show that a technique that doesn't honour data points will usually mean that it is global in nature. This is true for 75% of the time with a correlation rating of 19%. The opposite attribute ends can also be linked as shown by the next rule which states that techniques local in nature implies that they then honour the data points but to a lesser extent than the first rule with the lesser Information value.

A link is made between global implying that the technique then requires periodicities which leads to the fourth implied rule connecting the fact that global means doesn't honour data points which then implies that it requires periodicities. The Graph results provide a reduction of information that allows you to graph the results on paper showing the correlations. The rules show how the mapping techniques are related and linked from the

attributes and provides the knowledge base for the techniques. The mapping techniques are defined on the basis of these attributes and show how you think and relate the subject matter. It provides information on the rules accurately and amount of linkage so you can edit the results to select only those rules that have a high degree of certainty.

- View the general understanding of the rules to see if they make sense in the way you perceive the domain.

- Analyze the truth, probability, and Information values to see if they provide an accurate description of what you feel their relevance should be portrayed.

- Edit the results by moving back to the rating screens and increase or decrease the relationships between desired matched attributes to change the amount of correlation and relevancy. This is done by working with the Knowledge Engineer to analyze linkage values and in finding the relationships with the desired amount of impact on the knowledge base as defined by the truth, probability, and information values.

6.2.5 Induct Analysis

Figure 90 is another generation of rules within the geography spatial mapping technique domain derived through the Induct process. This is only a small listing of the possible rules that can be analyzed through Induct and the number of rules depend upon the areas selected in the format window for analysis. The date and time of Induct generation and output of rules onto screen is given at the top of the window along with the Significance rating set within the Induct format window as well as the target attribute selected and the entities involved that have an influence on desired attribute.

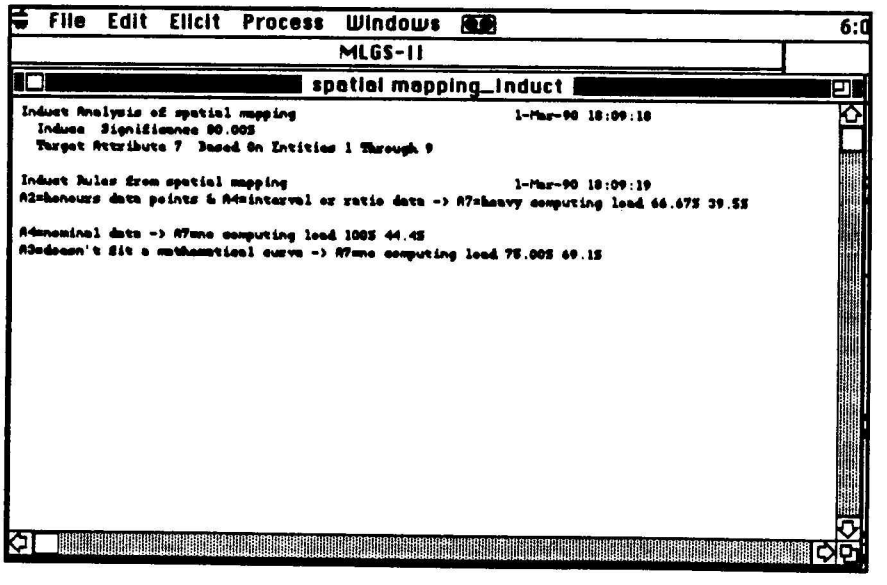


Figure 90: Induct rules on mapping techniques with correlations and probability values

In this case, the Significance factor has been set to 80% which is the bottom percentage value of the rule's significance within the realm of rules as derived in the PrinCom analysis. Any rule with a significance rating above this value will be included in the rule list on screen. The target attribute is a selection of the linkage area as defined in the format window. You may want to look at only one attribute name defined in the format window to find all rules based on it or you may want to look at all possible rules from all attributes within the domain. The target attribute number is the attribute number selected as the area of conclusions generated on all nine entities of the mapping techniques. In this case, attribute 7, which is "heavy computing load - no computing load", has one of this attribute pole ends as the conclusion or outcome of each rule created.

The Induct rules can be developed from a number of linkages between attributes as shown in the first group of rules or a singular linkage as shown in the second group of rules. The rule listing give the target attribute within a specified set of rules or a full listing of rules with all linkages derived from all attribute ends in the conclusion part of the rule. The and (&) symbol connects all attribute components within a rule while the arrow (->) symbol will give you the final outcome or conclusion of the linkages. The arrow symbol has the meaning of "implies", similar to the entailment rules.

In this example, one attribute end of the second and fourth attribute implies the heavy computing load end of the seventh attribute. The second group of rules give the fourth attribute end "nominal data" linkage or implication to seventh attribute end of "no computing". Likewise, the third attribute end of "doesn't fit a mathematical curve" implies the fact that there will likely be no computing load (attribute seven end). The Induct rules are similar in nature to the Entail rules except that they contain new and more complete linkage of attribute ends resulting from the derivation of rules based on the significance factor of the relative distances from the principle components. You can go back to the format window and select one target attribute at a time and view the rules that show its linkages to derive this attribute as a conclusion or view all rules at the same time.

You can receive a set of numbers beside each rule that are used to analyze the significance of the rule. The two percentage values used in the mapping techniques are used to show the correctness and probability factors respectively. The first value is a percentage of entities for which this rule of attribute linkages is correct. The second value is a percentage that the rule arrives by chance in terms of a probability.

Thus, for the first mapping technique induct rule, there is a 66.67% number of entities that this rule holds true while there is a 39.5% probability that this rule occurs by chance. This tells you that the rule is two thirds of the time correct but can happen about forty percent of the time by accident.

The second rule shows that it is correct 100% of the time for all entities which reveals that this rule is very significant in terms of all entities even though it occurs by chance in 44% of the cases.

The third rule shows that it has a fairly high rating of 75% correct for the entities present but it has a high probability value of 69.1% which means that this rule can occur quite often by chance.

The third rule has less effectiveness due to its possible existence through chance. The second rule would be considered a sure thing while the first rule may be borderline correct and the third rule may be borderline probability of chance. The third rule might be rejected outright because of its high occurrence of chance that may induce negative reactions to the rest of the rules.

You can obtain a series of truth, probability, and uncertainty values for each induct rule. These values are included in parenthesis to give the truth and probability value for each component of the rule as well as a percentage of uncertainty for the rule which gives the degree of inaccuracy or uncertainty concerning the rule's ability to be exact. An example would be (3/10:2/3 21.6%) with the 3/10 giving the truth value, the 2/3 giving the probability value, and the 21.6% giving the uncertainty value.

You can obtain Individual and Cumulative error percent values that provides error percentage involved for a single instance along as well as the error percentage for the cumulative effects from multiple instances along with its plus and minus range that the error value is considered relevant. The error values will have the truth and probability values for the rule along side these numbers relative to the individual or cumulative amounts. All these values are used by the Knowledge Engineer in the evaluation of the rules acceptability.

Other information that may be present for the evaluation is a listing of the attributes and their range values used. Another chart involves the listing of entity numbers and the corresponding attribute end numbers that affect that particular entity. Also, you can obtain a listing of the truth, probability, uncertainty, and error range values for the individual components involved in a rule. This involves each attribute end, for example, A3=1 and A3=3 for either end of the third attribute.

- View the general components of the listed rules to reveal your understanding of the domain and see if they relate to your concepts.
- Analyze the values beside the rules to evaluate the relevancy of the rules to determine if they are significant enough or in acceptable proportions to be placed into the knowledge base.
- Edit the data by going back to the desired rating scales of the influential attributes of a rule to rearrange the ratings to give the correct amounts or linkages as discussed with and directed by the Knowledge Engineer.
- Eliminate any rule that you feel has unacceptable risks involved by means of the editing process.

7. MULTIPLE PERSON ELICITATION AND EXCHANGE

A number of experts may be utilized in the elicitation process so that all relevant information is obtained and in the appropriate amount or proportion in regards to its conceptual position. This is done to reveal the agreement in ideas within the domain which can be transferred to the knowledge base of an expert system. The Socio process is used after the complete elicitation process of all experts is performed to reveal the common ideas that emerge and the use of different terminology to represent similar ideas. This will show high areas of agreement between words and their meanings which can then be used to develop the rules that will make up the knowledge base.

7.1 Justification of Multiple Viewpoints

Each expert within a domain will have his/her own interpretation and utilization of words that they understand or formulate to describe their field of interest. Each viewpoint is valuable in that it provides a unique aspect to the total picture of the domain. The objective of multiple elicitations from various experts is to find a common set of words that are utilized in a similar manner with the same meaning to accurately represent all consensus viewpoints. This will provide a selection of all common-ground words used in the domain with properly established definitions to formulate correct opinions and remove any contradictions and misrepresentations of ideas.

The accuracy of an expert system rises dramatically with an increase in the number of similar words and concepts used by experts within a particular field. It provides a much easier and accurate form of selecting proper words and concepts to represent the domain than by analyzing a singular elicitation from one expert and editing any discrepancies which can introduce biases.

The Socio process allows you to combine several separate elicitations from the different experts into graphical and textual information showing the areas of agreement or disagreement. The areas of agreement are used as the basis of information for the expert system while the areas of disagreement are refined, edited, or deleted so that no misrepresentations are added to the knowledge base. Experts differ in their use of terminology to represent similar or different understanding of concepts within their domain. This has resulted in four regions (quadrants) of similarity or difference based on the use of terminology including the following four terms:

Consensus when the same term is used for the same distinction
Correspondence when different terms are assigned to the same distinction
Conflict when a common term is assigned to different distinctions
Contrast when different terms are assigned to different concepts and meaning

These four regions are displayed in the graphical results of Socio, Figure 91, where the grey lines divide the charts up into four quadrants as determined by the components and set values for any differences. The top

left hand quadrant is the region of consensus while the top right hand quadrant is the region of correspondence. The bottom left hand quadrant is the region of conflict while the bottom right hand quadrant is the region of contrast.

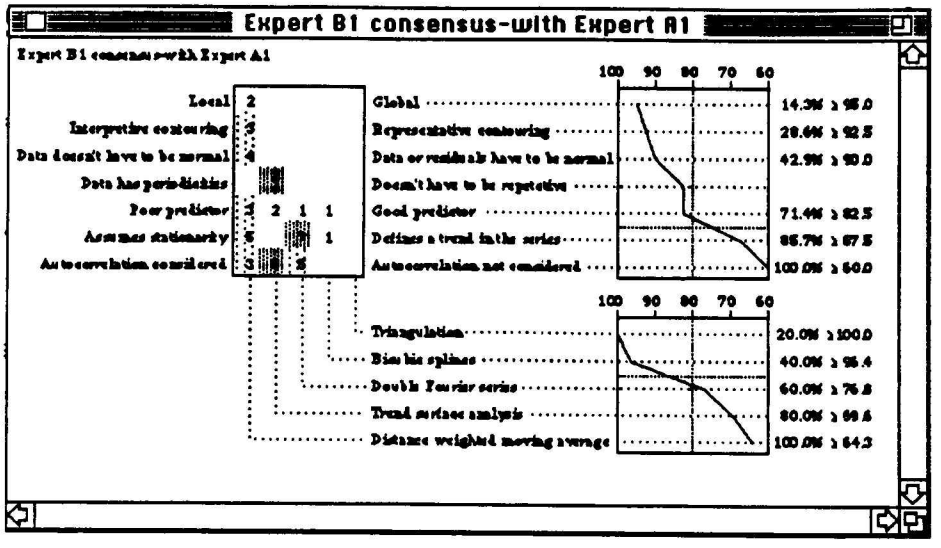


Figure 91: Socio results showing the four regions on both graphs

Any items having values that lie in the first quadrant have consensus between the majority of experts and are therefore acceptable. The correspondence and conflict regions show areas where the terminology is of concern but there is no confusion in the use of the concepts relative to these words. As a result, any items in these two regions are of concern but can be resolved by obtaining a common ground in the use of words. The contrast region reveals the serious problem of different words used for different ideas. Any item in this area will be difficult to resolve since it must involve the agreement of both the terminology and its use to the concepts. The items in the contrast region will have to be deleted from the system if the differences cannot be resolved. The objective of the Socio analysis is to find a common set of words and meanings between all experts involved so that no contradiction and misrepresentation occurs within the knowledge base.

Analysis within Socio can be performed on just the entities in an entity compare, just the attributes in an attribute compare, or on both the entities and attributes at the same time in an entity-attribute compare. This allows you to separate or combine the effects of either area to show the different terminology and influence. It reveals the affects an entity word onto an attribute word, an attribute word onto an entity word, or regions or conflict or consensus when both entities and attributes are used.

7.2 Procedural Steps Taken By The Group

The following points should be performed in their listed order by the members of the group that make up the panel of experts from a given area as directed and performed by the Knowledge Engineer:

- Identify a domain where a problem exists through discussions with the group and provide an introduction to KSS0.
- Obtain an elicitation on KSS0 from each member of the group who input and rate their own terms for the domain.
- Process the individual elicitation grids through Display, Focus, and PrinCom and provide a print out of each results screen. The Knowledge Engineer will explain the results individually to the members.
- Discuss with the group the content of the elicitations to obtain a common set of entities that all members of the group agree upon.
- Place the common entities onto a new elicitation file with no ratings and perform a Copy function for each of the experts involved in the elicitation process. The Copy function is done each time a new expert is to provide an elicitation of these common entities. Set up a common format for any of the elicitation and process screens.
- Obtain an elicitation with different attributes and ratings but with the common entities from each of the experts. Have them obtain a Display, Focus, and PrinCom print out of the process results. Discuss the results with each person individually.
- Combine the results through the Socio process and identify the regions of correspondence and contrast with the group through the match grids.
- Exchange all elicitations between the experts and have them perform a Copy command and new elicitation rating on that individual's entities and attributes. Repeat the exchange procedure until all individuals have rated everyone else's elicitation.
- Combine the new results through the Socio process and identify the regions of consensus and conflict with the group through the match, difference grids, and compare analysis.
- Produce a mode grid through the Socio analysis of these combined results to find the common threads between the distinctions made by each expert.
- Produce a socionet through the Socio analysis of these combined results to identify the groups of experts who view the domain in a similar or different manner and the individual(s) who stand out as having the greatest influence and consensus of their opinions.
- Produce an entail process of the combined results to list the selected rules with a set of rules from each of four major significant regions. Have the experts rate the rules from a range of one (correct) to four (incorrect). This is used along with the entail analysis to check the accuracy and significance of the rules created through Induct process.

The Induct rules are the only rules used to create the knowledge base of an expert system.

- Generate the rules through the Induct process and check their accuracy by means of the entail ratings from the experts and through the Induct analysis procedures. Edit the induct rules as necessary to show the true and desired levels of relevancy.

- Select the export process command and format it to transform the induct rules into the proper format and place them into the desired expert system shell.

- Review the rules, classes, and/or objects created in the export function to see if they conform to the desired level. Test the newly formed expert system for all forms of normal and abnormal data. Confer with the experts and obtain their opinion on the operation and performance of the expert system.

7.3 Procedural Steps Within KSS0

The following are individual steps taken by the Knowledge Engineer in the setting up of the Socio analysis and the experts in the elicitation procedures.

Knowledge Engineer

- Set up the formats for the elicitation and process screens including type styles, attribute settings, and output process formats as outlined in Section II, Chapter 2.

- Explain the procedural steps involved in the elicitation and multiple exchange process with all members of the group.

- Have the expert name the elicitation file with all of the relevant information at the beginning of every elicitation. This will tag the results so that the information can be referenced and filed away for viewing at a later date. Also, tag the rules created with the names and relationships of the experts involved in their development by writing down the information on the rule print-outs.

- For multiple exchange, select the Copy command and have the expert re-name the elicitation file with their own desired name for each different elicitation. Make sure the file name of the basic elicitation is selected along with multiple function and names of the desired elicitation files. Have the areas of input and positioning accessed with X marks. Double click on any desired files and select Open along with Cancel button to access multiple elicitation window. The required file names on window have to be highlighted in order to obtain the results in Socio with these files. Double click on any file name in elicitation window to highlight and access Socio function button in the Socio analysis. Click on name to obtain enclosed box for editing.

- For Socio analysis, select the Socio command and choose the output parameters desired from the process format window for that time in the exchange process.

- Export rules onto shell and validate results with the experts.

Elicitation From Experts

- Type in desired file name and any personal format requirements for each of the elicitations presented.

- Input your own entity and attribute words, rate their relationships, and view the appropriate process windows.

- Re-name elicitation file in the exchange process and input attribute and rating values with the consensus entities.

- Exchange and rate each other's unrated elicitation files through the Copy command. Make sure to re-name the file with your own desired name.

- Edit the results as required and test the rules generated in KSS0 and the expert system for validity and relevancy.

7.4 Displaying Results And Novice Level Of Interpretation

Figure 92 displays the Socio difference grid graphical results between two experts in the geography mapping techniques in which there are 5 entities and 7 attributes with high correlations in common as stated in the Socio format window. This will often be presented as the Socio results to the expert eliciters because it is in graphical form and easily shows the areas of similarities and differences that occurs between two experts and the common bonds from the high correlation entity and attribute words.

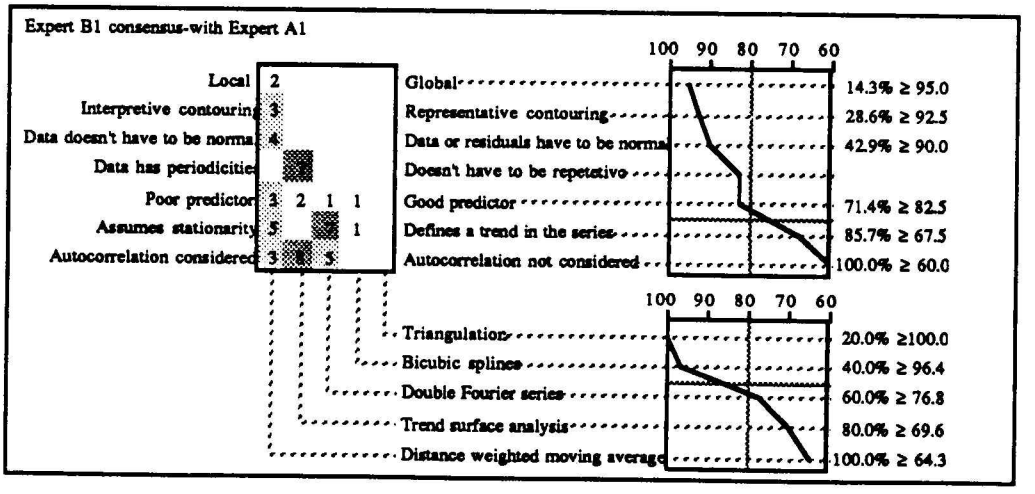


Figure 92: Socio difference grids along with repertory grid showing difference values

The repertory grid shows that the "local - global" attribute is common only to the "Distance weighted moving average" technique with a difference rating of 2 off the standard medium. On the other hand, the attribute "poor predictor - good predictor" has a common rating with "Distance weighted moving average" entity for a difference rating of 3 off the medium, a common rating with "Trend surface analysis" entity for a difference rating of 2 off the medium, a common rating with "Double Fourier series" entity for a difference rating of 1 off the medium, and a common rating with "Bicubic splines" entity for a difference rating of 1 off the medium.

Also, it can be shown that the Triangulation has no difference values indicating that there is complete consensus on this method as displayed in the difference grid graph with the line at the 100% mark. The different shadings for the numbers in the grid chart shows the areas of low, medium, or high range difference values indicating regions of common differences between pole ends and the mapping techniques. For example, the Bicubic splines technique have similar difference values from the medium for the predictor and stationarity attributes. This shows that both these areas are similar for the technique since they are both off by one point.

The difference grid graphical results show the areas of high consensus and areas where there is correspondence, conflict, or contrast. The first five attributes have relatively high percentages of similarities with the first attribute having the highest value at 95%. The others are rated in descending order. These five attribute percentages are within the first quadrant of the grey lines division revealing that they are in consensus with each other even though there is a high difference between the fourth attribute relative to the second last listed entity.

The fourth attribute has a high percentage because no other entity has a difference in rating of this attribute. The last two attributes lie in the fourth quadrant with 67.5% and 60% respectively showing an area of contrast where the experts differ in both terminology and concepts. This is shown too by the high numbers in these two attributes especially for the last three listed techniques relative to the last attribute. None of the attribute percentages lie in the second or third quadrants indicating that no attributes have any regions of correspondence or conflict.

The values to the side of the graph indicate the percentage line that the attribute lies on and its consensus rating. For example, the first attribute is one of seven total thus its line is stationed at 1/7 or 14.3% of the scale distance. The greater than or equal sign shows the percentage of attribute values that are at or above the consensus rating. The 95.0 is the consensus rating for this attribute.

The difference grid for the entities shows that there is 100% agreement between the individuals on the rating of the attributes relative to this technique. The Bicubic splines technique has a high agreement percentage at 96.4%. Both of these entities have percentages that lie in the first quadrant, and therefore, are in consensus or agreement in their terminology and meaning. The remaining three entities have percentages

that lie in the fourth quadrant showing contrast in the way the experts have defined and rated these techniques. Again, there are no entity percentages within the second and third quadrants. The numbers on the side of the graph again represent the percentage of attributes that are at or above the consensus rating as shown by the first entity out of five being 1/5 or 20% of attributes that are at the 100% consensus rating.

From the two difference grids, it can be concluded that the Triangulation and Bicubic splines techniques have very high consensus ratings with only slight differences for the fifth and sixth attribute ratings relative to the Bicubic splines technique. The five top attributes in the list have high correlation due to high similarities in the first three entities in the list. A large amount of contrast occurs from the high difference ratings of the last two attributes relative to the last three listed entities with only modest differences in the ratings for the other attributes. There is too high of contrast for these three entities and the last two attributes. They should be discussed with all experts to see if any changes in terminology or ideals can be invoked to rearrange the data so that these items are now in consensus. If the ratings or terminology cannot be changed, these two attributes relative to the three entities will have to be removed from the program.

Other information to be obtained from the Socio analysis includes textual data used by the Knowledge Engineer to accurately define and locate the regions of agreement or disagreement for editing in conjunction with the experts. This includes the entity and attribute correspondence, Figure 93, and consensus relationships, Figure 94, between the two experts A1 and B1 for the two grids generated, G1 and G2. The entities, E with a number, and attributes, A with a number, are listed with their linkages and percentages as defined in the difference grids. The analysis is performed for both the entities and attributes.

```
G1<:G3 50.0% over 80.0 (Expert C attribute-correspondence-from Expert A)
  1:  12.5% ≥ 96.4     G1A1: local - global
                       G3A1: local - global
  2:  25.0% ≥ 91.1     G1A2:      nominal - interval
                       G3A4: nominal data - interval or ratio data
  3:  37.5% ≥ 87.5     G1A7:                  deterministic - stochastic
                       G3A5: doesn't require periodicities - requires
periodicities
  4:  50.0% ≥ 80.4     G1A3:                      non-continuous - continuous
                       G3A3: doesn't fit a mathematical curve - mathematical
curve fitting
  5:  62.5% ≥ 76.8     G1A6: low computer cost - high computer cost
                       G3A7: no computing load - heavy computing load
  6:          75.0     G1A4:          periodicity - non-periodicity
                       G3A7: heavy computing load - no computing load
  7:  87.5% ≥ 75.0     G1A5:                very smooth - non-smooth data
                       G3A3: mathematical curve fitting - doesn't fit a
mathematical curve
  8: 100.0% ≥ 71.4     G1A8:         non-linear surface - linear surface
                       G3A3: mathematical curve fitting - doesn't fit a
mathematical curve
```

Figure 93: Correspondence values between attributes of two experts

```
G1:G2 40.0% over 80.0 (Expert B1 entity-consensus-with Expert A1)
  1:  20.0% ≥100.0   E2: Triangulation
  2:  40.0% ≥ 96.4   E4: Bicubic splines
  3:  60.0% ≥ 76.8   E5: Double Fourier series
  4:  80.0% ≥ 69.6   E1: Trend surface analysis
  5: 100.0% ≥ 64.3   E3: Distance weighted moving average

Entity Links between Datasets
 G1:3G2  40.0% over  80.0 (Expert B1 entity-consensus-with Expert A1)
```

Figure 94: Consensus textual data between entities of two experts and their linkages

Figure 94 includes the linkages between the datasets. You will obtain the percentage values and linkages for both the consensus and correspondence areas with new connections being established. This is also performed for attributes.

You can obtain a Mode or Socionet output from Socio analysis which lists the connections of the percentages to the words (Mode) in order to link the information and provide the connections as shown in Figure 95 for Mode analysis. This will indicate the affects of words or a given expert on the decisional outcome. As well, you can obtain a listing of the entities and attributes in each of the textual information for easy reference. Figure 96 gives the Socionet analysis to show the relationships between the experts involved in the decisions in order to provide information on the experts' influences. This will define which experts are dominant in their opinions.

```
Mode Attribute 1: 11 attributes in 3 datasets at 80.0
  G1A1:                          local - global
  G1A3:                non-continuous - continuous
  G1A7:                 deterministic - stochastic
  G2A1:             Honours data points - Does not honour data points
  G2A2:                          Local - Global
  G2A5:                 Discontinuous - Continuous
  G3A1:                          local - global
  G3A2:             honours data points - doesn't honour data points
  G3A3: doesn't fit a mathematical curve - mathematical curve fitting
  G3A5:    doesn't require periodicities - requires periodicities
  G3A6:             doesn't fit a trend - fits a trend to the data

Mode Attribute 2: 3 attributes in 3 datasets at 80.0
  G1A2:        nominal - interval
  G2A3: Low level data - High level data
  G3A4:   nominal data - interval or ratio data

Mode Attribute 3: 3 attributes in 2 datasets at 80.0
  G1A4:          periodicity - non-periodicity
  G1A8:   non-linear surface - linear surface
  G2A6: Assumes stationarity - Models the stationarity
```

Figure 95: Mode analysis showing linkages of attribute words to experts

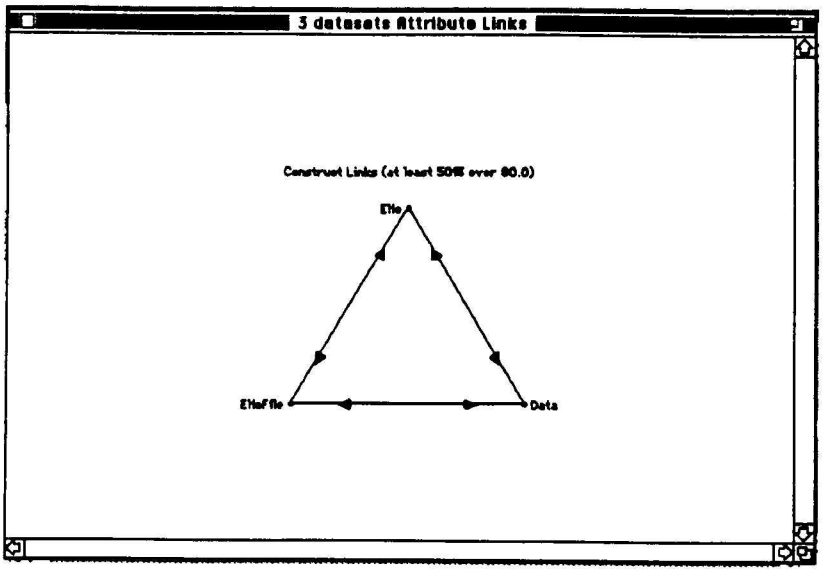


Figure 96: Socionet analysis showing the influences from each expert

The following procedures should be taken in the analysis of the Socio results to find common areas of agreement between a number of experts:

- View the repertory grid to find the general regions of none to low numbers showing consensus and high showing disagreement.
- View the difference grids for both the entities and attributes to find the areas of consensus, correspondence, conflict, and contrast which then relates to agreements or disagreements on terminology and ideas based on the location of the item in one of four quadrants.
- Find the connections between the percentage values (or regions) and the difference values in the repertory grid to reveal the items that affect the the position of the correlation percentage values.
- Discuss with the Knowledge Engineer the reasons behind the positions to reveal whether there is a difference in the use of terminology or concepts.
- Discuss with the group on ways to reach an agreement between words or concepts and change the data to suit the outcome.
- Edit the data by going back to the responsible elicitation file and change the conflicting word or its rating to provide the desired consensus. If no compromise can be reached, remove the words along with its ratings from the program.
- If required, discuss the other textual outputs with the Knowledge Engineer to find further linkages and analysis that provide clues to the patterns of group domain structuring. You can edit the textual data by selecting the data to highlight it and select the desired edit function from the menu bar.

8. THE ON-GOING PROCESS OF REFINEMENT

This chapter will provide an overview of the procedures involved with the elicitation results once you, the expert, have completed the process of inserting, rating, and analyzing the data. It will indicate what happens to the results in the transformation to an expert system. The chapter will provide information on the involvement of the expert(s) in the implementation and adjustments of the expert system.

8.1 The Editing Cycle

You will work with the Knowledge Engineer in determining the way you perceive the items in your domain and by what extent. This will occur with all the process results including the rules developed and the Socio results if more than one expert is involved. The Knowledge Engineer will point out areas where an incorrect linkage of information, either stated or implied, has been made or an incorrect amount of linkage has been applied. These are based upon your input and judgement of the results as well as inconsistencies revealed by the Knowledge Engineer in the analysis of the calculated measurements between the linkages. Then, the Knowledge Engineer will suggest ways in which you can eliminate, increase, or decrease the relationships and the procedures involved in performing the edits to the data.

This process is qualitative in nature and requires that you change the data by a given amount and check the process windows again to see if the changes have provided the desired corrections. If not, you will have to return to the elicitation windows and perform further edits with the resultant viewing of the process results. The changes on one area may result in inconsistencies on another area which have to be changed as well. The editing cycle may occur several times in order to obtain the correct results from all required changes in order to obtain accurate information that can be used as a knowledge base.

8.2 What Happens To Your Results

Once all information is correct within KSS0, the Knowledge Engineer will export the rules onto an expert system shell which transforms the rules into a knowledge base of a newly formed expert system. When the Export function is selected from the process menu or control panel, a format window will appear so that you can select what form of rules and what shell will be used. This will bring up a window that lists the information in a particular computer format and syntax that is acceptable to the selected shell as shown in Figure 97.

```
(@PROPERTY=    object_orientated     @TYPE=Boolean;)
(@PROPERTY=    data_processing       @TYPE=Boolean;)
(@PROPERTY=    system_programming    @TYPE=Boolean;)
(@PROPERTY=    number_crunching      @TYPE=Boolean;)
(@PROPERTY=    knowledge_representation     @TYPE=Boolean;)
(@PROPERTY=    not_suited_to_AI      @TYPE=Boolean;)
(@PROPERTY=    suited_to_AI   @TYPE=Boolean;)

(@CLASS=       languages
       (@PROPERTIES=
              object_orientated
              data_processing
              system_programming
              number_crunching
              knowledge_representation
              not_suited_to_AI
              suited_to_AI
       )
)
(@OBJECT=      Lisp    (@CLASSES=     languages))

(@SLOT=        Lisp.object_orientated       (@INITVAL=     False))
(@SLOT=        Lisp.data_processing  (@INITVAL=     True))
(@SLOT=        Lisp.system_programming      (@INITVAL=     False))
(@SLOT=        Lisp.number_crunching        (@INITVAL=     False))
(@SLOT=        Lisp.knowledge_representation       (@INITVAL=     True))
(@SLOT=        Lisp.not_suited_to_AI        (@INITVAL=     False))
(@SLOT=        Lisp.suited_to_AI     (@INITVAL=     True))
 (@RULE=       Ind2
       (@LHS=
              (No     (<languages>.suited_to_AI))
       )
       (@HYPO=        algorithmic)
       (@RHS=
              (Let    (<languages>.algorithmic)     (True))
       )
)

(@RULE=        Ind3
       (@LHS=
              (Yes    (<languages>.scientific))
              (No     (<languages>.number_crunching))
       )
       (@HYPO=        logical)
       (@RHS=
              (Let    (<languages>.logical)        (True))
       )
)
```

Figure 97: Export object and class definition with proper syntax rules

The information will be divided into groups defining the property, class, object, and rule areas. This allows the results to be classified in order to position and label the information within the shell. The shell and rules that make up the knowledge base become the expert system. This system can place part of this information onto a computer screen when certain conditions (components of the information) are met or become true. As a result, the system can be used to provide answers on issues relevant to the domain knowledge within the shell. This provides the transferability of an expert's knowledge in the way he/she perceives the domain, applies it to situations, and goes about solving problems. It also links large volumes of information to come up with an end result.

The expert system can be developed to provide an interface onto the computer screen that allows you to easily access the information required. With this new interface, the system might ask you to input or select answers to questions or situations that are developing. These answers are then checked at the appropriate location within the expert system to see if they match the conditions laid out within the rules. If all conditions in the first part of the rule are met, the conclusion part of the rule becomes true. This rule then "fires" and places the result onto the screen as an answer or it causes a chain reaction of rules to be "fired" which results in a final answer when all the links have been connected. The final outcome can be used to cause something to occur such as turning on a device or adjusting its setting.

8.3 Upgrading Information

During the life of an expert system, you may be called upon to adjust or edit the knowledge base due to changing conditions or ways of analyzing the domain based upon new or changing concepts. This may entail the editing of existing knowledge base or revising the whole system by performing a completely new elicitation in the development of new rules. You may also want to add to the existing knowledge base any information that you feel will provide better understanding and correlation of the data. This can incur at any time during the life cycle due to new information being made available and problems being identified through the operation of the system to varying conditions. Any additions, deletions, or changes of any kind should be performed under the management and supervision of a Knowledge Engineer if the individual is not able to analyze the results fully. Any changes require the expert system to be tested again for any inconsistencies.

8.4 Testing, Implementation, And Management Of Expert System

Any or all experts involved in the development of the expert system will be required to work with the Knowledge Engineer in the testing of the system to ensure that all aspects of the domain have been covered and the results are accurate. The accuracy depends upon their appropriate responses to normal and abnormal conditions as well as the proper interpretation of information as dictated by the structure of the language used. The Knowledge Engineer will assist in determining the parameters and test situations to be used in the analysis of the system's operation. Normal situations will be tested along with extreme results to test the boundaries of the system's ability to distinguish these results. Also, erroneous conditions will be tested to verify the system's ability to handle such data and provide a correct response to these conditions. The system could be tested several times in order to remove any problem results and provide the data in the desired format onto the screen.

The expert system is transferred to the work environment and implemented into normal use with any accessories and design considerations taken into account. There will be on-going support from the developers and knowledge engineers should any problems arise in the operation and management of the system.

SECTION II:

Administration And Analysis of KSSO

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   2.2 Attribute Type Specifications
   2.3 Display Mode Output Specifications
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APPENDICES

A: Selected Research Papers on Knowledge Acquisition
B: Technical Information Specific to KSS0
C: Operating Information For Related Expert Systems

1. ROLE OF THE KNOWLEDGE ENGINEER

The Knowledge Engineer performs all administrative, analysis, testing, and implementation functions in the building of an expert system. As this person, you will utilize KSS0 to develop the knowledge base of the expert system. You will provide duties in setting up KSS0 in the particular format, style, and screen image required. You will provide the design and integration of media systems to KSS0 and state the purpose, location, and operation to the clients.

The role requires that you administer KSS0 to the clients for the elicitation of their expert knowledge with explanations and assistance when necessary. This includes explaining the purpose of their elicitation in KSS0 at the beginning of the session along with the development of expert systems and the role that KSS0 plays in building the knowledge base. You are to explain the operational procedures of the Macintosh computer and a general overview of KSS0 functions used to insert, rate, and analyze the information. Once, they you finished the elicitation, have the clients obtain a print out of their process results. Explain the general operation and meaning of the results and receive input from the clients on how they feel about their formulated thoughts with their stated and implied linkages.

Analyze the process results by the mathematical and correlative data to quantitatively describe the relationships and linkages. Find any areas where the relationships don't match the mathematical correlations and implications. Discuss all relationships and inconsistencies with the client and have them edit any possible errors. Confirm the accuracy of the rules along with the measure of their relevancy and usefulness.

Export all relative and accurate rules to an expert system shell and test the system for any inconsistencies in the results. Work with the clients in determining the accuracies of the expert system and the development of an interface that conveys the information in a manner suitable to the client and working environment. Provide on-going service and upgrades to the system through its life cycle.

2. SETTING UP DEFAULT PARAMETERS

The information in this chapter will provide instructions on how to set up the format windows for the various specification regions. It will give details on what the options will provide in the way of information or styles onto the screen. It will state the purpose and times the options should be selected. The instructions will give details on what format should be selected as default parameters at the beginning of an elicitation session. This will provide settings for the elicitation and process screens that produce only the required data useful to the client in the initial stages of the elicitation.

2.1 Setting Up Textual And Picture Parameters

The format window for the Settings function is illustrated in Figure 1. The Dialog format window will contain the same color setting buttons as shown in the bottom of the Settings format window but will not contain the type style settings. The adjustment of the Dialog format will be performed in the same manner as that component in the Settings format window. You can change the type style or color settings at the beginning of an elicitation to suit your own taste or any desired requires from the clients. Also, you can select any format type for the development of media screens to be inserted into KSS0 before the elicitation takes place.

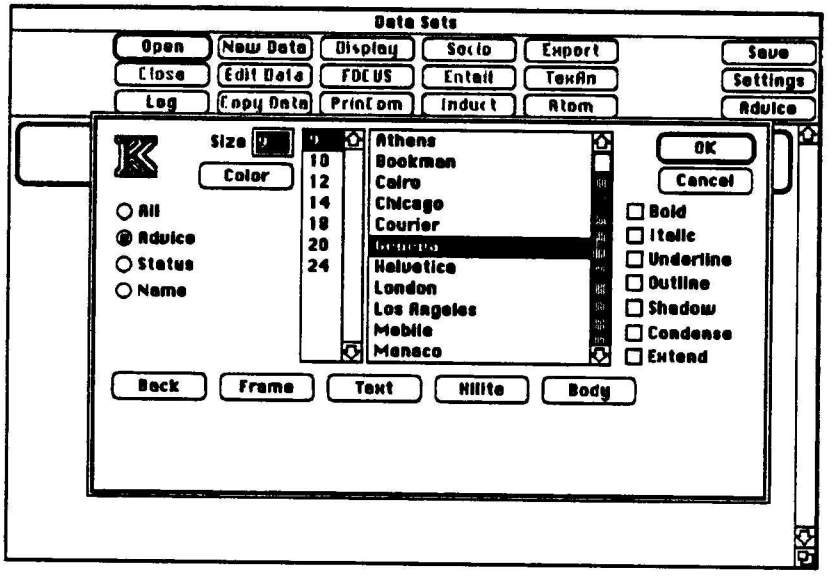

Figure 1: Setting dialogue box for adjustment of styles

You can select the type of information to be changed by choosing one of All, Advice, Status, or Name areas in the lower left-hand corner of the window. This will change all the information presented on the screens or selected areas within KSS0. Default value is to "All".

- Change the selection by clicking in the appropriate radio button to the left of the name. This will de-select and remove the dot in the radio button of a past selection and insert it in the new radio button area. The dot in the radio button signifies that this area is the active change site for text or graphic styles. Any change in area is accomplished by clicking on the desired radio button of the new area.

The Size box is highlighted showing that you can type in any number listed in the column to its right to adjust the size of any text within the elicitation screens including input text and text that already exists.

- Type the number directly from the keyboard or hold down the mouse button and drag the pointer down the size number listing to highlight the desired number and then release the mouse button. Either method will place the number into size box and activate this setting.

Also, you can change the style of print for the text by selecting the name of a type style from the list of names beside size number listing.

- Hold down the mouse button and move down the list to highlight the desired name. Release the mouse button to select and change the style of desired text to this format.

The selection of type style depends on the way you want to present the information and is based on past use of the various styles, the area and meaning presented in the text as well as your own personal judgement on its appeal. The selection is also limited by the styles you have on your computer.

You can select special format styles used to change the shape or spacing between the lettering in text from the list with square boxes in front of the names. The features include changing the text to bold, italic, underline, outline, shadow, condense, and extend. Any combination and any number of style features can be chosen.

- Click the pointer in any of the boxes to place an X mark inside. The X mark signifies that this feature is turned on and will change the desired text to this style. De-selection of a particular feature is accomplished by clicking the pointer a second time on the box to remove the X mark. The selection of styles depends upon the image you want to portray.

The bottom of the dialogue window contains a series of buttons that access a dialogue box containing adjustment features for the different areas of the screen image. These adjustment features are used to change the color and intensity settings for color monitors.

- Click on the Color button for whole screen or any one of the desired area buttons to access a dialogue box shown in Figure 2.

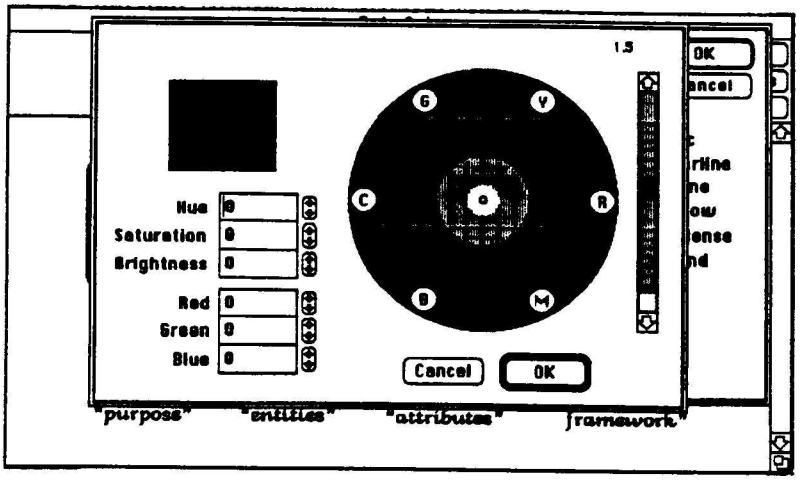

Figure 2: Color adjustments for whole screen or selected regions

Each button will access a similar type dialogue box but each dialogue box allows you to set the image adjustments for each particular area of the screen. The areas include the back, frame, text, hilite, and body components. Access to the areas is related to the following points:

Click on Back to adjust the background color features of the whole screen.
Click on Frame to adjust color and image qualities of the window framework.
Click on Text to adjust color & image qualities of written material in window.
Click on Hilite to adjust darkened area that hilites an active interaction zone.
Click on Body to adjust color & image qualities of remaining pictorial areas.

The color dialogue box contains a series of color selection and image adjustment boxes with numbers inside. These values are the settings for the Hue, Saturation, and Brightness of the image along with the amounts of Red, Green, and Blue are used to give the color spectrum and its proportions. The numbers will all be zero and no further adjustment is required for black and white monitors while color monitors will have values of varying amounts.

- Adjust the values by clicking on either end of the double pointing arrows beside the boxes. This will move the values up or down to your taste.

A series of concentric rings to the right of these boxes shows the color spectrum of that particular screen. When the pointer is moved into this area, it changes to a small concentric ring.

- Click anywhere within the concentric rings with this symbol to select a particular area you wish to adjust.

- Adjust the image and color values collectively by clicking on the arrows of the scroll bar section to move the box inside the scroll bar

and thus change the numbers.

- Change the values individually by using the double pointing arrows of the adjustment boxes.

- Click on OK button once you have adjusted the settings to your liking or click on the Cancel button if you do not wish to adjust any of the values. Either button will take you back to the screen you were at in the program to reveal the new color adjustments.

2.2 Attribute Type Specifications

Click on the Type button at the attribute list control panel any time you wish to change the parameters on a selected attribute to specify their range and areas of active influence. The specifications are to be set at the end of the elicitation when all attributes are inserted but can be changed during an elicitation by the eliciter if the individual wishes to define and adjust the output parameters. The Type button will bring up the format window shown in Figure 3. The letter A and number designates the particular attribute you have selected to adjust. You will have to adjust all attributes individually if a common setting is required. Otherwise, adjust a specified attribute that you wish to define differently from the others in order to make the distinction in its significance.

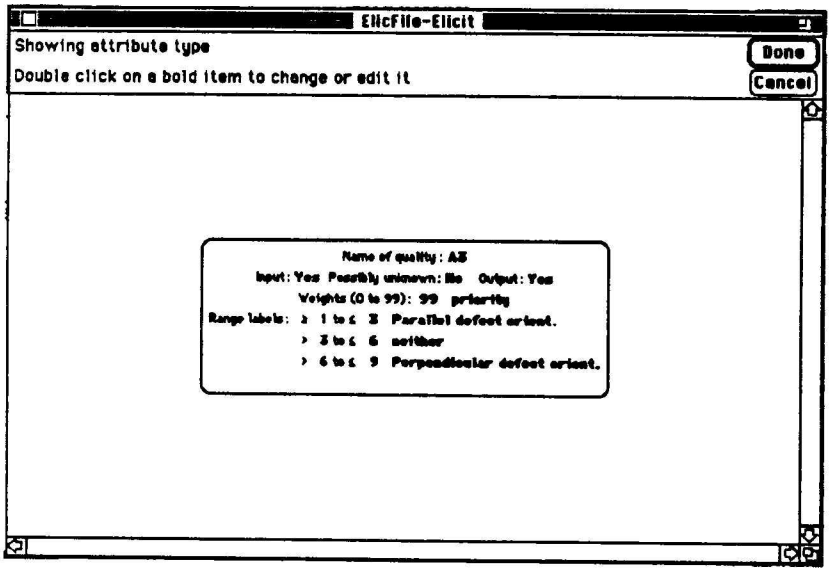

Figure 3: Attribute type format window

- Double click on the attribute number to create a box around it for input of a new attribute name if you wish to change it to a more suitable word. Also, you can change it to a new attribute number if you wish one of the other attributes instead of the one you selected. Type the new name into the highlight region and select the accept function (Done button or RETURN key) to input it into the region.

- Click on the Yes/No value of the Input region to toggle its opposite value if you wish to switch the input function on or off.

The default value is Yes in order that KSS0 accepts the attribute value as part of the elicitation input process and acceptance as data for the final knowledge base rules generated in Induct and Export. It should only be changed to No if you wish to see the affects on the elicitation with the absence of the attribute.

- Click on the Yes/No value of Possibly Unknown region to toggle its opposite value if you wish to switch this function on or off.

The default value is No because we usually want the attributes to be registered at an exact rating rather than being unknown. It should only be switched to Yes if you want the attribute to have the characteristic of being unknown or not distinguishable in its traits. This occurs when you find it hard to describe the amount the attribute affects have on the entities. This is done for the final knowledge base rules generated through the Induct and Export functions.

- Click on the Yes/No value of Output region to toggle its opposite value if you wish to switch the output function on or off.

The default value is Yes in order for KSS0 to accept the attribute as part of the output graphics and calculated distances or measurements in order to generate the final knowledge base rules through Induct or Export. The value has to be Yes in order to obtain any form of process output screens. Thus, the value should be switched to No only if you do not want the client to view the results before you adjust the setting to allow output.

- Click on the number in the Weights region to obtain a box around it for input of a new weighting on the attribute if you wish to adjust the significance of the attribute's affects relative to the other attributes. Type the new value and accept with the Done or RETURN function.

The number can be changed to any whole number between 0 and 99 with 0 representing no affects from the attribute while 99 representing the full affects of the attribute relative to the others. The default value is 99 and should remain in this position unless you wish to reduce the affects of one or more attributes in their affects on the order of the rules. For example, you may want to reduce this attribute's affects on the resultant rules in order to provide an order to the firing of the rules in the running of the expert system. Therefore, you would type a number like 50 into the region to provide the new weighting and lower its priority.

The weighting provides a priority rating to the attributes so that rules with the attribute are fired at a certain time according to the value of weighting. Attributes and thus rules with a 99 weighting are given top

priority and are fired first within the sequence of events within the knowledge base. Rules with the same value are fired at the same time within the sequence.

Prioritization of rules provides you with a means of controlling the order and thus gives a more efficient method of selecting rules to be fired that have a direct bearing first and secondary rules to be fired later if they are required. If the rules are not top priority and are not required in the process, the rules will not be fired. This could be due to one of the outcomes from the priority rules by-passing these rules due to its path eliminating the requirement of these rules.

- Double click on the priority word to the right of the weight value to select and position a box around it if you wish to change the name for the value.

The default name is "priority" which applies to the default weight value of 99. If you change the weight value to 98, you may want to call it "less priority" while a change to 50 may require a name something like "medium".

- Click on either the two bold numbers within the Range labels region if you wish to change the zones of attribute areas. Type the new values to adjust the range and accept into program with the accept function.

The new values will automatically change the left end values to reflect these new ratings. The range numbers divide the ratings into three regions to reduce the number of variations from the original rating numbers. All ratings will now fit into one of these three categories. This allows you to adjust the regions in order to change the affects and significance on the entities that change from one region to another. This change in regions provides a difference in the position on the process screens and their affects on the other entities and attributes. It gives the ability to change the relationships between the words and thus provides a method of editing results to form the desired correlations.

- Double click on any one of the range labels that describe the attribute pole names as well as the middle region if you wish to change the names. Type the new word in and select the accept function to insert the word into the region.

The middle region is defaulted to "neither" which will omit any affects of entities in this region from this attribute. Change the name if you wish to include these affects within the process results including the rules generated. This provides a form of editing results to change the relationships and correlations.

- Click on the Done button or press on the RETURN key to accept any changes into the program and return you back to the attribute listing window. Repeat these procedures for any other attribute you wish to adjust. Click on the Cancel button if you do not wish to change any of the settings in order to return to the attribute listings.

3.3 Display Mode Output Specifications

Selection of the Display process will bring up its format window shown in Figure 4. The output of the results can be adjusted to provide the listing of attribute rating values on the repertory grid relative to the left hand pole name or from the right hand pole name as set by the Values region in window. The left side of the grid will have the top pole name while the right side will have the bottom pole name.

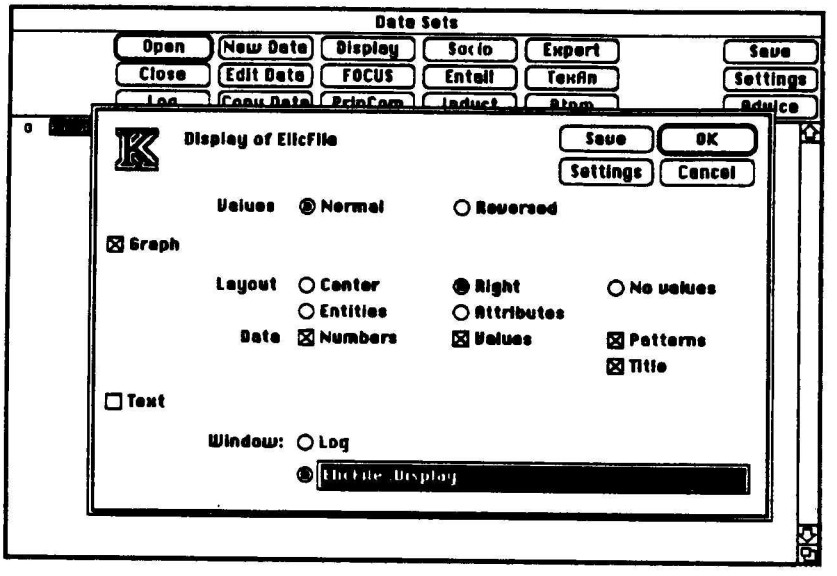

Figure 4: Display format window

In the normal setting, the numbers are arranged with a one being considered the left hand side and a nine being considered the right hand side. In the reversed setting, the names are reversed from one side of the grid to the other. This results in a change of numbers with a one now representing the right hand side and a nine representing the left hand side. The change in the position of values has no affect other than provides two ways of viewing the results. You might be able to see the relationships easier from one direction over the other. The choice depends on your own preference for viewing the correlations. The default value is set to "Normal" and should be changed only during the viewing of Display results for a second time.

- Click on the *Normal* or *Reversed* radio button in Value region to change attribute rating positions if your desired entry has not been selected. This will de-select the previous function.

You must select the form of results to be displayed with the choice between Graph, Text, or both areas. The Graph selection provides the repertory grid within a box image while the Text selection provides the same repertory grid and related information except that it is enclosed in textual form instead. The Graph section allows you to select the position, format, and types of information to be presented.

The Text section allows you to select the area where the textual information is to be placed and includes the Log window, the Display process window for the particular file of information, or any other window or file name within the computer or inserted floppy disk. Only one format of text information is allowed and includes the names of the entities and attributes along with the rating values in chart form. The graphical results are selected to view the information and find the correlations while the textual results are used to store the information in specified textual areas in order to log and file the results.

- Click on *Graph* box to place an X mark for selection if you want the graphical results on screen. Click on the X mark to remove it and de-select this function.

- Select one of the five radio buttons in the *Layout* region which will de-select any previous default button. Select Center if you want the entity names listed on the bottom of the grid to be placed at an angle down the middle. Select Right if you want the entities listed in line to the right of the bottom end of grid with the connection lines drawn at right angles. Select No Values if you do not want the repertory grid to be present but only provide the listing of entities and attributes. Select Entities if you only want the entity names listed as output or select Attributes if you only want the attribute names listed as output.

- Click on any of the boxes for the functions listed in the *Data* section to place an X mark and select its operation. Click on the X mark to remove and de-select it. You can have any number or combination of functions.

- Select *Numbers* if you want the entity and attribute names to be listed with numbers representing the order they were inserted as well as providing the name in numerical form.

- Select *Values* if you want the rating values to be presented on the grid to show the position and rating of the entities and attributes.

- Select *Patterns* if you want the different shadings of the rating values to be illustrated in the grid to show the regional areas.

- Select *Title* if you want the name of the file for the process mode along with a listing of the entity-attribute numbers, range of values, and context of elicitation for purposes of labeling the information.

The default values are a Right layout with Numbers, Values, Patterns, and Title selected for the Data region. Change these values before the elicitation or after the initial Display process output to change the format to your desired style or level of information for the desired method of analysis. The new format values will last for only one output and then change back to the default values.

- Click on the *Text* box to obtain an X mark if you want to select the output information in this form. Click on the X mark to remove and de-select this function. Select Text if you wish to store the information into the desired location.

- Click on either *Log* or defined output window radio button to select the desired location. Selection of one will de-select the other.

- For defined output window, type any desired file name or window directly from the keyboard to change the highlighted name to the desired location.

The Text region is defaulted to non-active status and should be turned on only to provide a recording of the event in the log window or a back-up copy of results. The text area is defaulted to the defined output window section with the Display window of the active program being listed. Change this listing if you want to place the information into a more appropriate location or select Log to keep an account of the information. Any changes will revert to the default values assigned.

- Click on Settings button to adjust the style of Display results.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

3.4 Focus Analysis Output Specifications

Selection of Focus process will bring up its format window displayed in Figure 5. You can select the arrangement and form of the visual linkages through the Cluster section. The Edges area will provide the Focus results in the original form and provide only the clusters with the linkage lines from the edges of the graphic clustering scale being considered in the analysis of results. The Interior area extents the analysis of clusters to those linkages in the middle of the graphical clustering scale as well. This results in a rearrangement of the linkage lines so that some of the edge clusters are now lined up in their proper correlation order. The default value is the Edges Cluster as this will reduce the amount of information used in the analysis to the general overall linkages. Select Interior when you want to provide more in-depth analysis that will include the inside linkages.

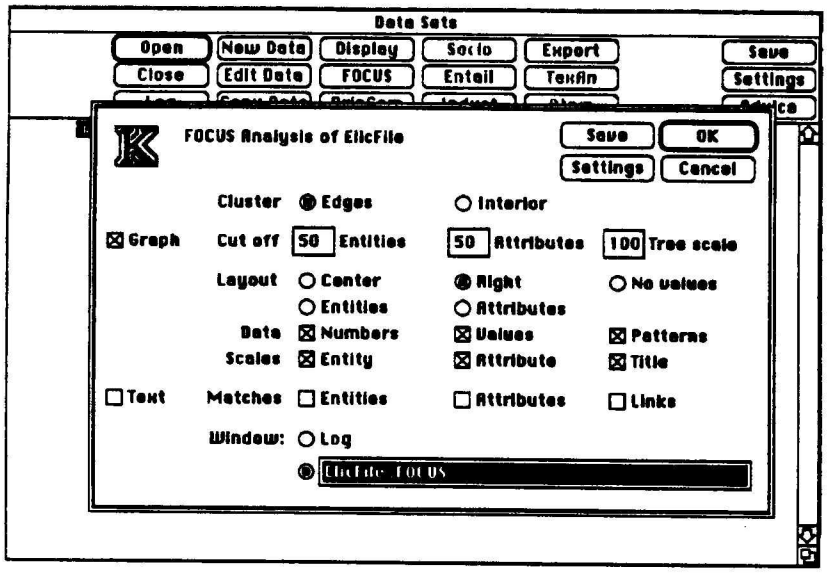

Figure 5: Focus format window

- Click on either *Edges* or *Interior* radio button if the desired function has not already been selected. This will automatically de-select the other value. The selection depends upon the level and extent of analysis you desire.

The results can be displayed in either graphical or textual form. The Graph format allows you to set up the linkages scales, provide the format for the position of information, and gives access to the different forms of information to be presented. The Graph results are are to display the results in visual terms. As a result, The Graph function is defaulted to the on position so you can display the graphical results to the clients. The Text format is defaulted to the off position because it provides information used in the analysis of the results to give precise values and should only be selected to store results as well as exact analysis performed by the

Knowledge Engineer. The Text function provides selection of the focus points and their linkages.

- Click on *Graph* box to insert an X mark if it has not already been selected and you wish its output. Click on the X mark to remove and de-select it.

The Cut Off values are the numerical percentage values used to limit the amount of correlation or clustering affects. This is provided for both the entity and attribute cluster graphs. The numbers provide the start and end points of the clusters. The Tree Scale provides to upper value of the graph and is defaulted to 100 which gives the linkage to the 100% start point. The Entities and Attributes have defaulted values of 50 in their boxes which means the end point of the clusters are located at the 50% mark. All linkages that have a connection point between 100 and 50 percent will be included on the graph. Any connection below the 50% mark will not be shown.

The values can be changed to reflect the desired cut off point of information in the graphical display and in the analysis of the results. Desired values depend upon the amount of information present and the correlations that form. It may require several trials to adjust and view the results in order to obtain the correct amount. Any changes to the default values should be made by the Knowledge Engineer after the process has been displayed by the client.

- Type the number directly from the keyboard if the desired area is highlighted to replace the existing value. Double click the cursor into the next desired area that you wish to change in order to obtain the highlight region. Type the new value into this region.

The Layout region provides the options that position and limit the form of information presented on screen. You are only able to select one of these variables by clicking on the radio button.

- Select one of the five radio buttons in the *Layout* region which will de-select any previous default button. Select Center if you want the entity names listed on the bottom of the grid to be placed at an angle down the middle with the graph placed on its side above the grid and the scale positioned beside this graph. Select Right if you want the entities and graph listed in line to the right of the bottom end of grid with the connection lines drawn at right angles. Select No Values if you do not want the repertory grid to be present but only provide the listing of entities and attributes with their cluster graphs. Select Entities if you only want the entity names listed for output or select Attributes if you only want the attribute names listed for output.

The Data section allows access to the type of information desired within the grid. Any one or a combination of items can be selected. The default values for the items are left to the one position but can be changed to suit your purpose and desired affects for the client. Click on the box to insert an X mark to select the function or click on the X mark to remove and de-select it.

- Select *Numbers* if you want the entity and attribute names to be listed with numbers representing the order they were inserted as well as providing the name in numerical form.

- Select *Values* if you want the rating values to be presented on the grid to show the position and rating of the entities and attributes.

- Select *Patterns* if you want the different shadings of the rating values to be illustrated in the grid to show the regional areas.

The Scales region allows you to select whether to have numerical scales present to show the approximate percentages of the cluster points as well as provide the title information for the process window. The scales are positioned above either cluster graph or both while the title information is placed at the top of the window. Any one or a combination of the items can be chosen. Click on the box to insert an X mark to select the function or click on the X mark to remove and de-select it.

- Select *Entity* if you want a scale positioned with the entity list.

- Select *Attribute* if you want a scale positioned with the attribute list.

- Select *Title* if you wish to have the name and type of process window along with the number and range of entities and attributes relative to the context definition.

The Text format section allows you to select any one or combination of textual data that lists the matches between common items along with the percentage values of their connection points. The information is used in the analysis of the general results from the graphic information. They are placed in the log file or any other file for a record of the results as well as the Focus window to view the output for analysis. None of the Match items are selected by default because the Text area is not selected by default. The Focus window is selected by default in order to position the information on screen for immediate viewing.

- Select *Entities* in Matches area if you want the entity names and their percent linkage values for each correlation of this field.

- Select *Attributes* in Matches area if you want the attribute names and their percent linkage values for each correlation of this field.

- Select *Links* in Matches area if you want the linkages and their values for the selected entities or attributes, as outlined above, into a chart form. The entity names are listed with an E and a number while the attributes are listed with an R or an L and a number depending upon whether it is a right or left attribute.

- Select either the *Log* or listed window by clicking on the radio button to select it with a dot which automatically de-selects the other area. Select the Log window if you want to store the information in a common place with the rest of the results or provide a record of these results with the time and date. Type the new name of file or window directly from the keyboard if the highlighted window is selected and you want to change it to a new area.

- Click on Settings button to adjust the style of Display results.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

3.5 PrinCom Analysis Output Specifications

Selection of the PrinCom process brings up its format window illustrated in Figure 6. You can obtain either graphical or textual results. The Graph format is selected by default to give the information in visual form for inspection by the client and for simple analysis. The Text format is not selected by default since this output provides measurements and correlations in the complete analysis by the Knowledge Engineer.

- Click on the *Graph* and/or *Text* box to insert an X mark for selection of Graph results for visual analysis or Text for complete data analysis. Click on the X marks to remove and de-select the function.

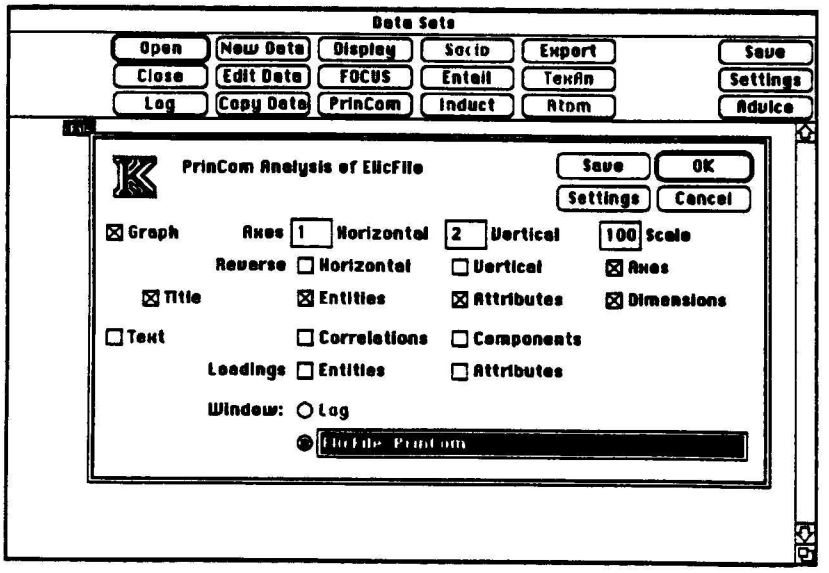

Figure 6: PrinCom format window

The Graph area allows you to select the position and size of results along with the option to insert selected information onto the graph. The Axes region allows you to indicate what axis, either horizontal or vertical, should represent a particular plane in the spatial configuration. It gives you the ability to change the position of the graphical results by defining a number to each of the axes. This will indicate how the entity and attribute values are positioned relative to the defined axis. The default values are a 1 for the horizontal axis and a 2 for the vertical axis.

You would change these values only if you feel that the information presented through the rearrangement provides a better view of the correlations. Try the axis shift when you are analyzing the results for a second time after the initial client analysis. Also, you can change the size of the graphical display if you wish to view an enlarged version for more in-depth analysis of one section or reduced version to obtain all information onto the desired window size. The default value is 100% which provides the complete image within the normal window size.

- Double click on the desired *axis* box to highlight it if the area is not already highlighted and you want to change the value. Type the opposite number number from the keyboard to replace this number, eg. the 2 for the 1 and the 1 for the 2. Repeat the process for the other box. Do not type any other number into either axis box or have the same number in both boxes.

- Double click on the *Scale* box to highlight it if you want to change the value. Type the new percentage value, either above or below 100, which will replace the old value. You may have to view results and change the value several times in order to obtain the desired results.

The Reverse region includes the Horizontal and Vertical check boxes. This allows you to reverse the position of the information from one side of a given axis line to the other side. As a result, the information is flipped from one side to the other for the Horizontal axis while the Vertical axis flips the top-bottom information. The reverse function is performed to arrange the information to form any and all combination of new correlations for complete analysis of the visual relationships.

- Click on either or both *Horizontal* or *Vertical* boxes to insert an X mark and select the reverse (flipping of information) for the desired axis. Click on the X mark to remove and de-select its function.

The areas of Axes, Title, Entities, Attributes, or Dimensions allow you to select any desired combination of information to be present on the graphic. The default value is to have all items selected so that all relevant information can be present for the client to understand the relationships and meaning of the information points. De-select any of these items if you feel the information is redundant or clutters the region when you perform an in-depth analysis of the graphical data.

- Click on the *Axes* box to place an X mark in its region if you want the outline of the vertical and horizontal axis lines present with the data. Click on the X mark if you wish to de-select this function.

- Click on the *Title* box to place an X mark in its region if you want the window heading with the process name, the number and range of entities and attributes, and the context of the elicitated data. Click on the X mark if you wish to de-select this function.

- Click on the *Entities* box to place an X mark in its region if you want the entity position points to be labeled by the entity names. Click on the X mark if you wish to de-select this function.

- Click on the *Attributes* box to place an X mark in its region if you want the attribute pole position points to be labeled by the attribute pole names. Click on the X mark if you wish to de-select this function.

- Click on the *Dimensions* box to place an X mark in its region if you want the lines that connect the attribute pole names to be displayed on the graph. Click on X mark if you wish to de-select this function.

Select the Text region to provide detailed numerical results on the relative positions between the items. They are placed in the log file or any other file for a record of the results as well as the PrinCom window to view the output for analysis. The PrinCom window is selected by default in order to position the information on screen for immediate viewing. You can select any combination of mathematical results for the Correlations, Components, or Loadings on the entities or attributes. These values are selected depending on the form of analysis you wish to perform.

- Click on the *Correlations* box to place an X mark and select this function if you wish to view the numerical values measured between the various combinations of attributes. Click on the X mark if you wish to de-select this function.

- Click on the *Components* box to place an X mark in it if you wish to view the percentage values for the Principle Components showing the degree of variation for each component. Click on the X mark if you wish to de-select this function.

- Click on either one or both the *Entities/Attributes* boxes to place an X mark in their regions if you wish to view the numerical measurements between the Principle Components and the various entity or attribute combination values to give the loading values on the items. Click on X mark if you wish to de-select this function.

- Select either the *Log* or listed window by clicking on the radio button to select it with a dot which automatically de-selects the other area. Select the Log window if you want to store the information in a common place with the rest of the results or provide a record of these results with the time and date. Type the new name of file or window directly from the keyboard if the highlighted window is selected and you want to change it to a new area.

- Click on Settings button to adjust the style of Display results.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

3.6 Entail Analysis Output Specifications

Selection of the Entail process brings up its information window displayed in Figure 7. You will obtain the entail rules that show the implied linkages between attribute names/numbers or you can select the Text region to obtain various charts showing the numerical entailments between the attribute poles.

The amount of rules obtained depend upon the Cut-off value that is present in its box. This percentage value depicts the lowest correlation value that is accepted for output which limits the rules to high end entailments. The default value is 15% and can be changed to any desired value in the analysis stage based on a trail and error basis with the results being viewed to find the entailments that you desire.

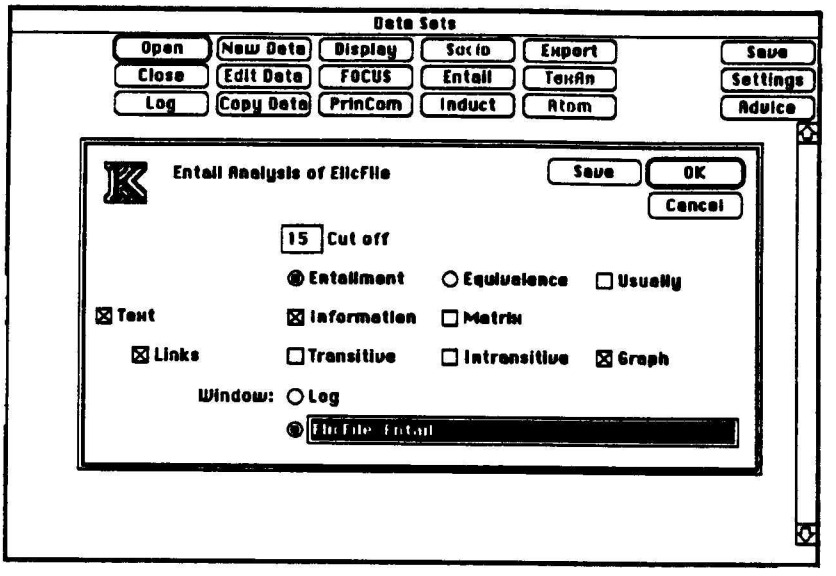

Figure 7: Entail analysis format window

- Click on the *Cut-off* box to highlight if it is not already and type the desired value in percentage form up to 100 which will replace the old value. This is performed if you wish to change the default.

You can obtain various areas of rules with the different correlations depending upon Entailment or Equivalence considerations and whether they are based on the factor that the rules occur Usually. The Entailment section shows the correlation linkages from only one side or direction of entailment. The Equivalency section shows the correlation linkages from entailments obtained from both sides that gives an equivalency with the entailments coming from both directions.

The Usually factor allows you to output the mathematical relationships for either Entailments or Equivalencies based upon probability studies that the rule occurs usually rather than a definite statement of occurrence for all instances. The Entailment region with no probability factors (Usually) is selected by default to provide the rules in their simple form without the analysis numbers so the client can view and interpret the general information. Change the selection when you go to analyze the results depending upon what form of linkages you wish to view.

- Click on *Entailment* radio button which will automatically de-select the other value if you wish to view only linkages developed in one direction. Click on the Usually box to insert an X mark if you wish to obtain the probability values for these rules. Click on the X mark to de-select this function.

- Click on *Equivalence* radio button which will automatically de-select the other value if you wish to view only linkages developed in both directions. Click on the Usually box to insert an X mark if you wish to obtain the probability values for these rules. Click on the X mark to de-select this function.

Select the Text region to provide detailed numerical results on the relative positions between the items. They are placed in the log file or any other file for a record of the results as well as the Entail window to view the output for analysis. The Entail window is selected by default in order to position the information on screen for immediate viewing. The Text region with the Information, Links, and Graph are selected by default to show the relationships in general terms for analysis with the client. The remaining text options of Matrix, Transitive, and Intransitive are defaulted to non-functional since they are used in conjunction with the other text options in the complete analysis of entailments by the Knowledge Engineer.

- Click on the *Information* box to place an X mark within it if you wish to obtain the Information numbers on combined ratings for all attributes of the left and right hand poles. Click on the X mark to de-select this function.

- Click on the *Matrix* box to place an X mark within it if you wish to obtain all mathematical correlations and entailment values for each of the pole regions for the various attribute combinations provided in chart form. Click on the X mark to de-select this function.

- Click on the *Links* box to place an X mark within it if you wish to obtain the correlations (linkages) for the rules into actual written sentence form that is used as the transferable rules for the knowledge base. Click on the X mark to de-select this function.

- Click on the *Transitive* box to place an X mark within it if you wish to obtain any entailment analysis data that takes on or is a result of a direct link to an object. Click on the X mark to de-select this function.

- Click on the *Intransitive* box to place an X mark within it if you wish to obtain any entailment analysis data that is not a direct link to an object. This is done by the computer taking the transitive results and reversing the information to obtain all other entailments that does not fit the transitive form. Click on the X mark to de-select this function.

- Click on the *Graph* box to place an X mark within it if you wish to obtain the entailment results that just provides the basic correlations without any repeat linkages. This is done to obtain data that can be used to graph the results on paper to view the correlations. Click on the X mark to de-select this function.

- Select either the *Log* or listed window by clicking on the radio button to select it with a dot which automatically de-selects the other area. Select the Log window if you want to store the information in a common place with the rest of the results or provide a record of these results with the time and date. Type the new name of file or window directly from the keyboard if the highlighted window is selected and you want to change it to a new area.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

2.7 Induct Analysis Output Specifications

Selection of the Input process will bring up its format window as shown in Figure 8. You are able to obtain the induct rules with a study of probability ratings or a breakdown of the probability and accuracy ratings for the rules through the Text area.

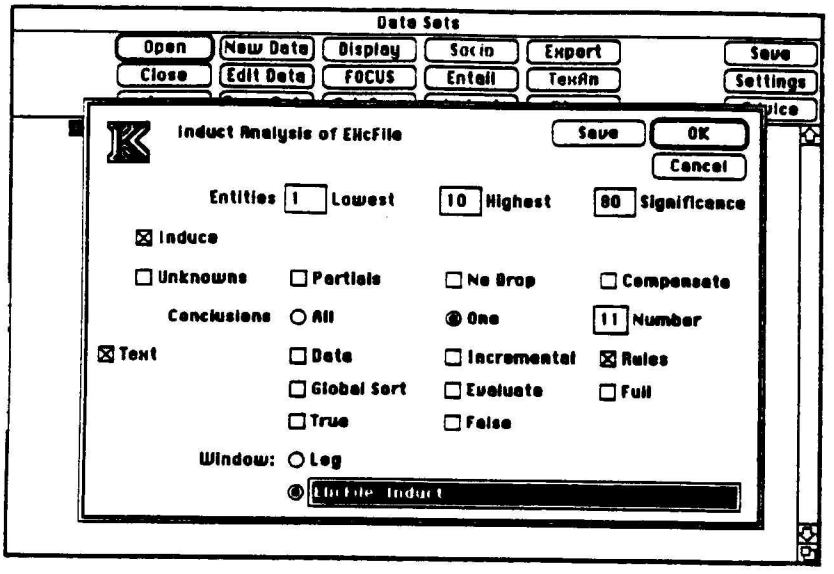

Figure 8: Induct analysis format window

The top area of the window allows you to select the range of entities you wish to form the induct rules and the minimum percentage of significance that influences these rules. The significance value is the distance measurement of correlation from the PrinCom analysis with any rating at or higher than the stated value being included in the program to form the related rules.

The Lowest and Highest values defaulted in the Entities area are the lowest and highest number of entities inserted from the elicitation to give all relevant rules possible. You would change these numbers if you wish to limit the range of entities and thus limit the rules to a particular area of interest. The Significance value is defaulted to 80% which provides a good range and accuracy to the rules with relevant correlations being drawn from the results.

- Double click on the *Lowest* and/or *Highest* boxes to highlight its region if it is not already present and you wish to change its value. Type the desired numbers in the regions that reflect the lower and upper limit of numbers that represent the numbers assigned to the names.

- Double click on the *Significance* box to highlight its region if it is not already present and you wish to change its value. Type the desired number corresponding to the percentage you wish to limit the inducement of rules. This may involve trial and error methods of selecting a number to obtain desired results.

The Induce box provides a form of on/off switch to allow you to output the induct rules onto the process window or provide an empty rule area when it is not selected. A flashing text cursor appears onto the window for

input of your own desired information. The Induce function is defaulted to the on position so that formed rules can be displayed for client observation.

- Click on the *Induce* box to insert and X mark to obtain induced rules onto the screen. Click on the X mark to de-select this function and provide an empty rule area for your own input.

The area below the Induce region allows you to select the factors involved in the influence of these induced rules to expand the relationships formed to less qualified regions of influence. The factors include Unknowns, Partials, No Drop, and Compensate with none of the factors being selected by default. This default provides the rules placed onto the screen for client observation to be restricted to the certain correlations formed from the correlations. You can select any of these factors in the formation of new results to extend any desired relationships and consider these less qualified correlations that you and the client feel are acceptable for the knowledge base.

- Click on the *Unknowns* box to insert an X mark if you wish to include the unknown rules generated when the primary attribute used in the forming of the induct rules to be eliminated or made unknown. The analysis is repeated with this attribute excluded to form rules that are not influenced by this attribute factor. Click on the X mark to de-select its function.

- Click on *Partials* box to place an X mark and select the function to accept rules into the window that are only partially correlated. This can happen only if there is supporting information to back up this linkage. Click on the X mark to de-select this function.

- Click on *No Drop* box to place and X mark and select this function so that no rules are placed in the output area which has their level of support drop for any form of complete or partial correlation. This drop in support can come from individual components that affect the overall influence occuring under the different combination of results. Click on the X mark to de-select this function.

- Click on the *Compensate* box to place an X mark and select this function to provide an influencing factor that compensates the amount of error caused by the unknowns and partials. This will give a balance to all rules affected in order to reduce the probability of errors and incorrect rules formed. Click on the X mark to de-select this function.

The Conclusions region allows you to limit the number of rules formed as output to produce the conclusion or end result component from the designated attribute end linkage. You can list the rules from one attribute pole or have all rules listed by all the combination of attribute poles. The areas include a selection of All poles or One pole with the

Number box indicating the number representing the attribute pole name that you wish to be output. The default value One rule is selected with the default pole number being the number of the last pole generated. This provides interpretation and editing of each attribute area one at a time by the client with the aid of the Knowledge Engineer.

- Click on either *All* or *One* radio button to select the particular function and automatically de-select the other function. This depends upon the attribute area or attribute combinations you wish to analyze.

- For the One Conclusion, double click on the *Number* box to highlight, if it is not already. This allows you to change the attribute pole number each time you go back and establish the next desired attribute area for output. Type the number in the box to remove the old value and insert a new number in decreasing order from the original top value.

The Text area is selected by default to provide access to the Rules aspect of textual results so that you can obtain the rules in Text format for placement into selected windows or files. They are placed in the log file or any other file for a record of the results as well as the Induct window to view the output for analysis. The Induct window is selected by default in order to position the information on screen for immediate viewing. The remaining functions for setting up the text format are not selected by default so that the client does not have to see the detailed mathematical values and attribute information. These items are selected in the complete analysis of the rules before they are exported to the knowledge base.

- Click on *Data* box to insert an X mark and select this function if you wish to show the data and other forms of information used to establish the rules including the Title information on selected functions and entity-attribute information along with charts stating the attribute range names and the reduced rating values for each attribute. Click on the X mark to de-select this function.

- Click on *Incremental* box to insert an X mark in order to select this function which will provide the rules onto the screen as they are generated thus giving you the ability to incrementally view the results. Click on the X mark to de-select this function.

- Click on the *Rules* box to insert an X mark and select it to output the rules into the text region for viewing onto the screen or recording them in another window or file. Click on X mark to de-select function.

- Click on the *Global Sort* box to insert an X mark and select its function to provide the rules into a sorted order onto the screen that places the most probable and correct rule first with the remaining rules in decending order of correlation. Click on the X mark to de-select this function.

- Click on the *Evaluate* box to insert an X mark in order to select the mathematical relationships on individual and cumulative errors on each output rule. Click on this X mark to de-select this function.

- Click on the *Full* box to insert an X mark in order to obtain the full mathematical probability and correctness values for each attribute end including the primary attribute end that forms the conclusion part of the rule. Click on the X mark to de-select this function.

- Click on the *True* box to insert an X mark in order to obtain the probability values that the rule is correct as defined by the truth and chance values beside the rules.. Click on the X mark to de-select this function.

- Click on *False* box to insert an X mark in order to obtain the probability values that the rule is incorrect as defined by the values in brackets beside the true values. Click on the X mark to de-select this function.

- Select either the *Log* or listed window by clicking on the radio button to select it with a dot which automatically de-selects the other area. Select the Log window if you want to store the information in a common place with the rest of the results or provide a record of these results with the time and date. Type the new name of file or window directly from the keyboard if the highlighted window is selected and you want to change it to a new area.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

2.8 Socio Analysis Output Specifications

Selection of the Socio analysis will bring up one of two format windows depending upon whether the analysis is a between different elicitations in Socio as shown in Figure 9 or between the same elicitation information performed in an Exchange as shown in Figure 10. The only difference between these two format windows is the top region in which you can select the area that is Common between the elicitated information in the Exchange analysis. The default value is the selection of Both entity and attribute common areas being considered in the exchange to provide information analysis for all related linkages.

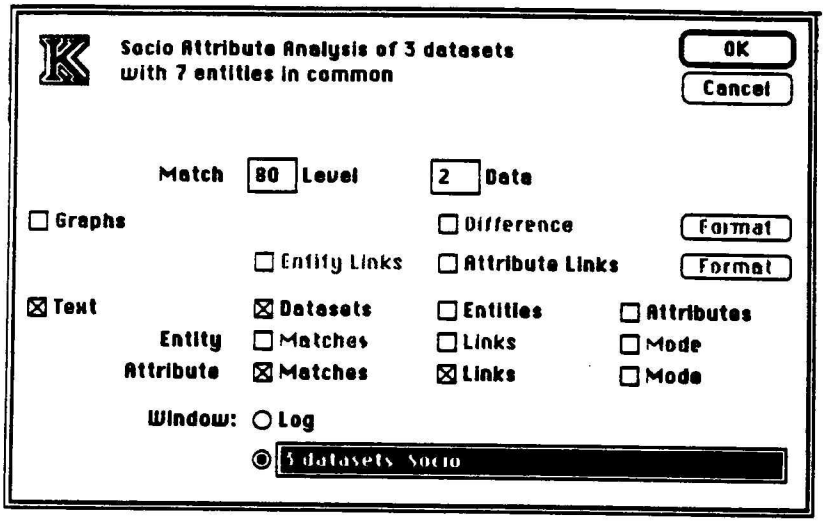

Figure 9: Socio analysis format window for different elicitations

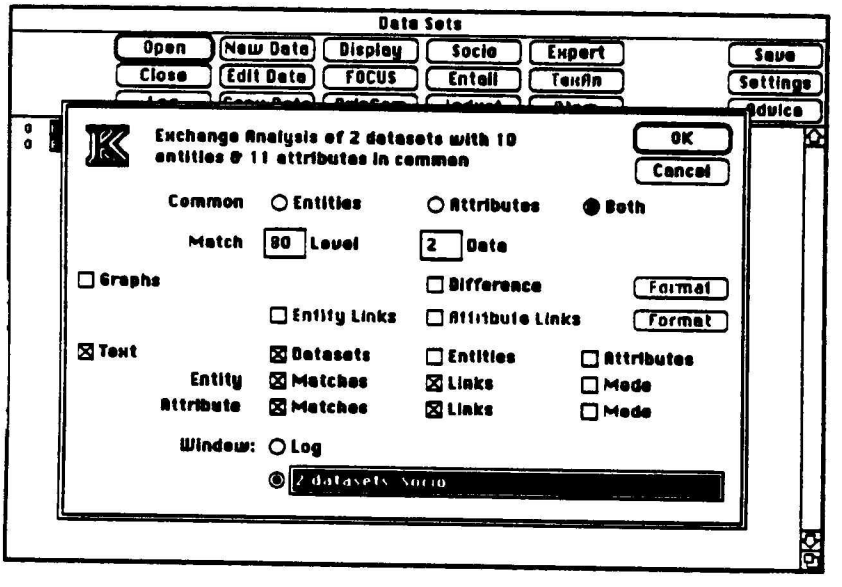

Figure 10: Socio analysis format window for an exchange

- Click on the Entities radio button to select only common entity names in the analysis. Click on the Attributes radio button to select only attribute common names in the analysis. Click on the Both radio button to select common region for both entities and attributes in the analysis. The selection of one radio button will automatically de-select the others.

You can select the percentage of match between the linkages and the number of elicitated datasets to be used in the match analysis. Any correlation at or above this percentage value will be accepted as relevant data to be placed into the analysis results. The Match Level is defaulted to 80% which provides an overall good combination of proper correlation to ensure accuracy while providing a reasonable number and form of correlations.

Change this value when you wish to obtain an expanded or reduced set of correlations with the resultant change in acceptable standards. The default value for the Data box is the same number of elicitation files (datasets) you have selected in the Socio or Exchange analysis. This value is changed if you want the analysis performed on only part of the selected datasets.

- Double click on the *Level* box to highlight it if you want to change its value. Type in the new number which will replace the old number directly. You may have to change the number and check the results several times in order to obtain the desired level of information and correlations.

- Double click on the *Data* box to highlight it if you wish to change its value. Type in the new number of datasets to be involved in the analysis making sure that it is in-between one and the number of possible datasets. This will randomly select a given set of elicitation results.

The next region provides the selection of graphical and grid results that relate the results in visual terms showing the different regions of consensus, correspondence, conflict, and contrast. This is obtained through the Graphs and Difference section. The default selection is to have these items selected in order to present the relationships to the client. The two items have to be selected together in order to obtain the results onto the screen. The Graphs selection alone will do not provide any results. The selection of Difference will automatically select the Graphs region.

- Click on both the boxes for the *Graphs* and *Differences* or simply click on the Difference box to select the difference grid along with the repertory grid of difference values.

When the Difference grid is selected, its format button beside it becomes active and allows you to obtain another format window that is

used to set up the information for the difference grid as shown in Figure 11. This format window provides access to the bottom and top ranges of the scale along with the information selected as output onto the graphic.

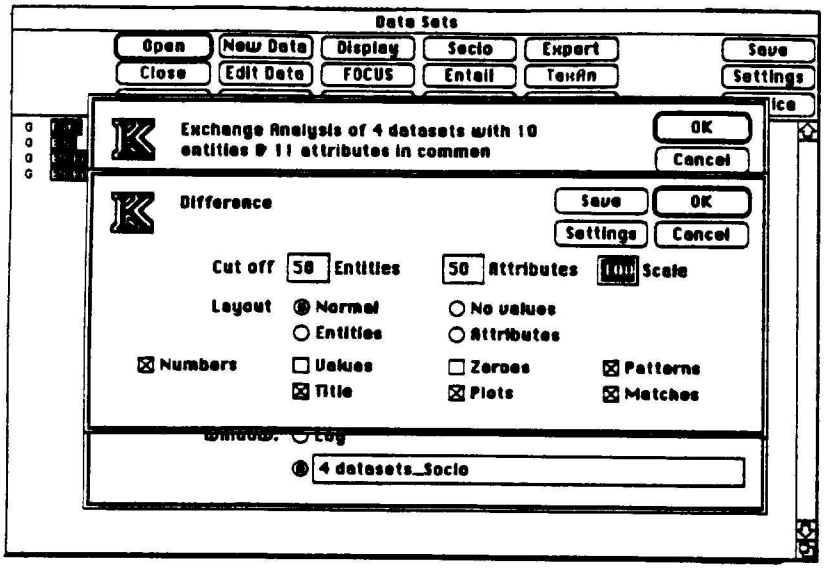

Figure 11: Format window for Socio difference grid

The Cut-off region allows you to select the lower percentage value of differences between either the entities or attributes. Any value at or above this percentage will be considered as relevant data for output onto the grid and as results in the analysis. The Scale box allows you to select the upper boundary of percent difference on the entity or attribute difference grid. The default values are zero for both the entities and attributes with 100% for the Scale value indicating that all possible difference values are to be included on the grid. The last percentage value obtained in the analysis will be the last percentage value shown on the grid. You can change these values to restrict the relevant difference values placed as output onto the grid.

- Double click on any desired *Cut-off* box for entities, attributes, or scale to highlight it if you wish to change its value. Type the new value that is between 0 and 100 which will directly replace the old value. This may have to be done, along with viewing the results, several times in order to obtain desired difference results that you wish to be included in the analysis.

You can select the layout of information presented onto the graph by selecting one of Normal, No values, Entities, or Attributes. The selection of one layout function will automatically de-select the other functions. The Normal function is selected by default which will place the entity and attribute names along with the percentage values of information correlation and position within the grid. Change the selection if you wish to restrict the amount of information present on screen.

- Click on *Normal* radio button if you wish to have all relevant information presented onto the screen.

- Click on *No Values* radio button if you do not wish to have the percentage values listed onto the grid.

- Click on the *Entities* radio button if you only want the entity names listed onto the grid region.

- Click on the *Attributes* radio button if you only want the attribute names listed onto the grid region.

The square box selection region below the Layout region provides access to the layout format functions for the repertory grid. These include Numbers, Values, Zeroes, Patterns, Title, Plots, and Matches. You can select any number or combination of these functions. The default parameter is to have the Values, Patterns, Title, Plots, and Matches selected but this can be changed to your own preferential view of the results in order for you and the client to accurately interpret the data.

- Click on the *Numbers* box to insert an X mark if you wish to obtain the relevant numbers that represent the entities and attributes onto the repertory grid. Click on the X mark to de-select this function.

- Click on the *Values* box to insert an X mark if you wish to obtain the values of difference onto the repertory grid. Click on the X mark to de-select this function.

- Click on the *Zeroes* box to place an X mark if you wish to represent the regions on the repertory grid where there is no difference by the 0 digit to signify regions of agreement. Click on the X mark to de-select this function.

- Click on the *Patterns* box to place an X mark within it if you wish to have the difference values represented by different shades in order to show general areas of difference. Click on the X mark to de-select this function.

- Click on the *Title* to insert an X mark if you wish to obtain the title information of file names from which the consensus is formed. Click on the X mark to de-select this function.

- Click on the *Plots* box to insert an X mark if you wish to obtain the drawing of the consensus lines onto the difference grid as a plotting of the results. Click on the X mark to de-select this function.

- Click on the *Matches* box to insert an X mark if you wish to have the information rearranged to show the regions of similar difference

relationships to reveal the areas of match difference ratings. Click on the X mark to de-select this function.

- Click on Settings button if you wish to format the information style.
- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.
- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.
- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

This will return you back to the Socio or Socio Exchange format window with an example shown in Figure 12. You can obtain the construct links that are developed between the experts as shown by graphical line drawings between the connections to reveal the amount of linkage by their dimension. You can obtain the links between the entities or attributes. You can select any number or combination of links but their access depends upon Socio and Exchange formats along with the Common region selected in the Exchange format.

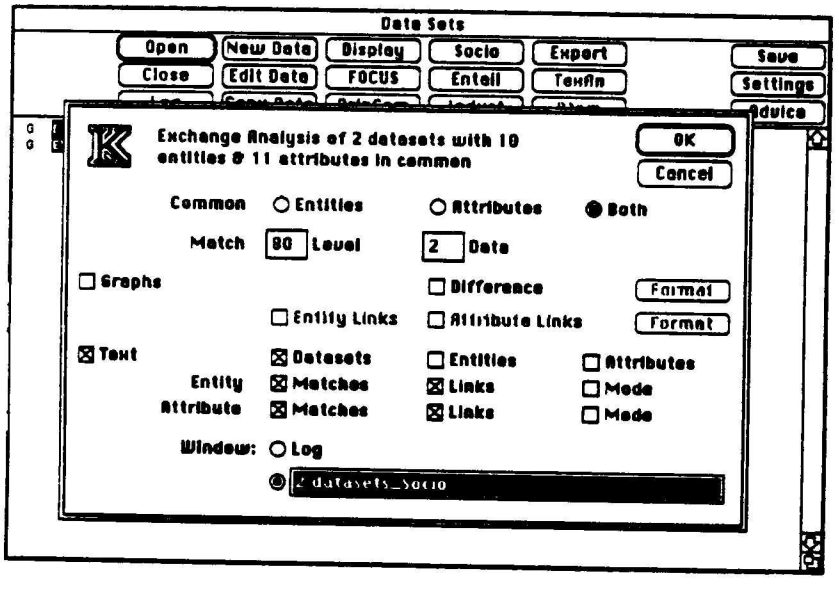

Figure 12: Socio Exchange format window

The Socio format will only allow the Attribute links to be selected. It is not selected by default because it provides extraneous information that is used in the complete analysis of the information. The Exchange format automatically selects the links when either the entities or attributes is

selected in the Common region. The Common Entities selection will give you the Attribute links while the Common Attributes selection will give you the Entity Links. The Common Both selection does not select or allow you to select either the Entity or Attribute Links because the area becomes greyed out even though X marks may be present in the boxes.

- Click on the desired box for the *Entity or Attribute Links* if it is possible and you wish to obtain the graphical links as output for analysis of Socionet influential correlations. This will place an X mark to select this function. Click on X mark to de-select function.

Selection of either or both the Entity-Attribute Links will provide access to its format window, illustrated in Figure 13, by clicking on the Format button beside the Links region. The Links format window will be the same for either entity or attribute selection. This format window allows you to select the cut-off lower percentage value of linkage as well as the upper percentage value given by the Scale setting. Any linkage percent value at or above the cut-off and between the cut-off and scale percent value will be considered as linkage information suitable for output.

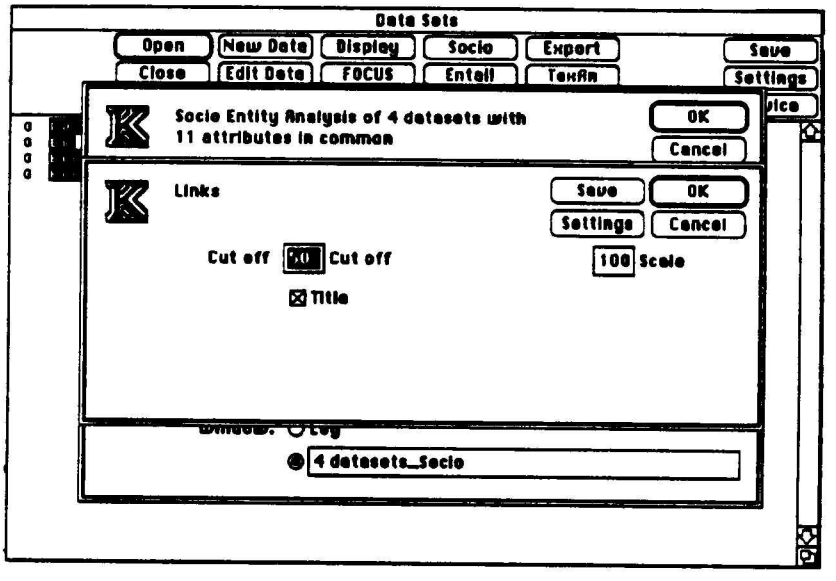

Figure 13: Entity or Attribute Link format window

Also, you can obtain the Title information onto the screen that provides the name and components within the construct link as well as the mathematical linkage percent values. The default values of a 50% cut-off rating to a scale maximum value of 100% provides an acceptable percentage range that gives adequate linkage correlations. You can expand or limit the number of linkage correlations depending upon the amount of correlations that can provide the relationships between the elicitations. The Title information is selected by default to provide helpful data on what linkages are formed and by how much.

- Double click on the *Cut-off* box to highlight it if you wish to change the lower percent value. Type the new percentage directly from the keyboard which will change the old value to the new value. Make sure the number is between 0 and 100.

- Double click on the *Scale* box to highlight it if you wish to change the upper percent value. Type the new percentage directly from the keyboard which will change the old value. Make sure the value is between 0 and 100.

- Click on the *Title* box to insert an X mark if you wish to obtain the title information onto the screen. Click on the X mark to de-select this function.

- Click on Settings button if you wish to format the information style.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

This brings you back to the Socio or Socio Exchange format window with an example shown in Figure 14. The Text region allows you to select the output analysis information with the mathematical relationships and linkages for either the Entity or Attribute areas. The Text area is selected to provide output information on correlated rules and obtain the rules in Text format for placement into selected windows or files. They are placed in the log file or any other file for a record of the results as well as the Socio window to view the output for analysis. The Socio window is selected by default in order to position the information on screen for immediate viewing.

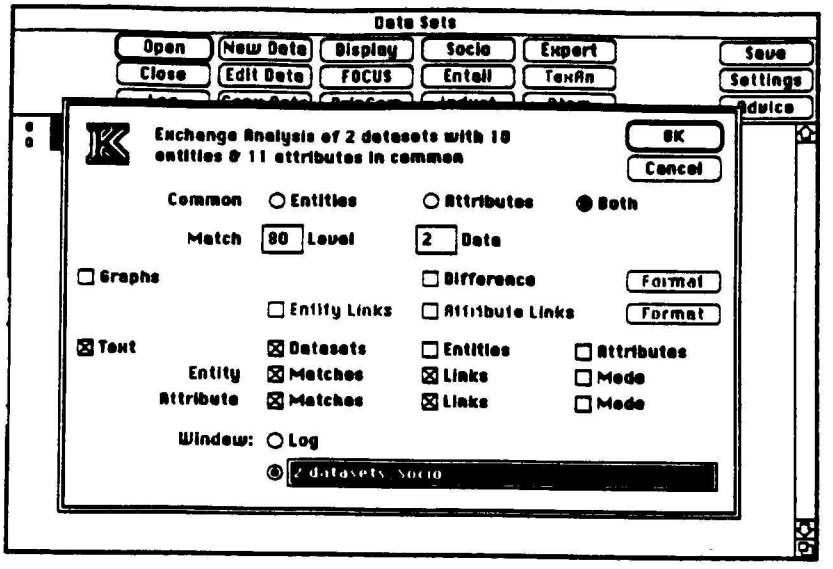

Figure 14: Socio Exchange format window

- Click on *Text* box to insert an X mark within it for output of desired information onto the selected output window. Click on X mark to de-select this function.

The area of Datasets, Entities, and Attributes at the beginning of the Text region allows you to output information on the names of data files used along with the listing of entities and attributes used in the Socio analysis. The Datasets area is defaulted to the on position since it provides information used to show the files involved. You can select any one or a combination of these functions to obtain desired information for the naming and filing of data in the storage of results.

- Click on the *Datasets* box to insert an X mark if you want to obtain the experts numerical names, number of entities and attributes involved, as well as the elicitated data file names used in the Socio analysis. Click on the X mark to de-select this function.

- Click on the *Entities* box to insert an X mark if you wish to obtain the listing of entities involved in the Socio analysis. Click on the X mark to de-select this function.

- Click on the *Attributes* box to insert an X mark if you wish to obtain the listing of attributes involved in the Socio analysis. Click on the X mark to de-select this function.

The Entity and Attribute regions provide access to the selection of correlation analysis information in the form of Matches, Links, and Mode data for both regions. The default values depend on what you desire as output information in the analysis of a particular area. You are able to

obtain any number or combination of selected functions in either/both entity and/or attribute regions. The selection procedures apply to either entity or attribute regions.

- Click on the *Matches* box to insert an X mark if you wish to obtain the entity or attribute names and mathematical results which are in consensus or agreement between the experts involved. This gives the match regions between items. Click on the X mark to de-select this function.

- Click on the *Links* box to insert an X mark if you wish to obtain the textual and mathematical results showing the links between elicitation files and thus the experts. Click on the X mark to de-select this function.

- Click on the *Mode* box to insert an X mark if you wish to obtain the listing of experts with their linkage to a particular entity/attribute to provide the correlations between the experts and the roles they have played. Click on the X mark to de-select this function.

- Select either the Log or listed window by clicking on the radio button to select it with a dot which automatically de-selects the other area. Select the Log window if you want to store the information in a common place with the rest of the results or provide a record of these results with the time and date. Type the new name of file or window directly from the keyboard if the highlighted window is selected and you want to change it to a new area.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.

2.9 Export Parameter Selection

Selection of the Export function will bring up its format window, illustrated in Figure 15. You are able to output the exported information onto screen before it is sent to the expert shell. You can select the desired shell you wish to use from a choice of three common shells. You can determine what kind of information is to be included with the exported data such as a Heading to label the data and selection of Class, Objects, or Rules as output components. You can select the mathematical values, set-up, and restrictions for the rules through the areas of Object, Unknown, Reset, Expert, and Values.

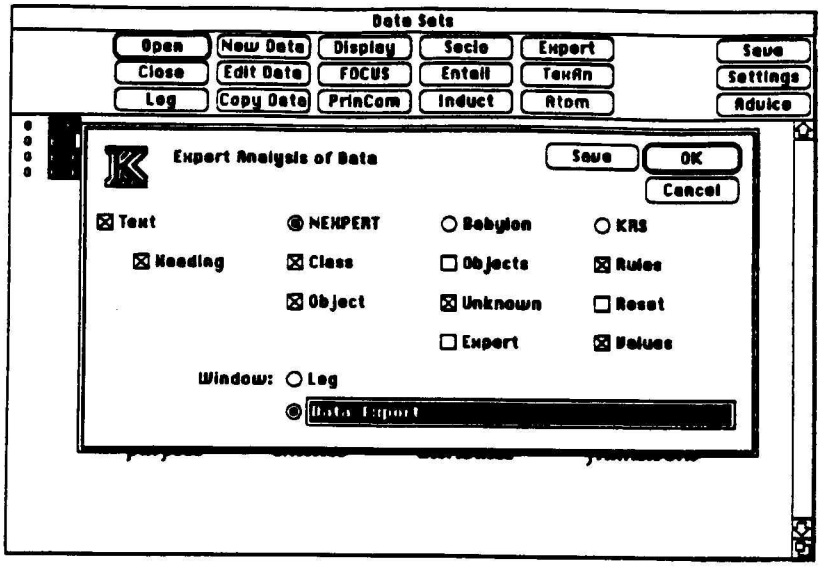

Figure 15: Export function format window

The defaulted values are to have the information selected as text output onto the Nexpert shell since this is a very common shell used with KSS0. You can select any one of the three shells as a default value depending on the shell you will be using. The heading, class, and rules are selected by default to provide sufficient information in the interpretation of rules and rule components for final approval. The objects information component is not selected by default because it only provides extraneous information that you can choose if you wish to view initial values assigned to the rules. The Object, Unknown, and Values are selected by default to turn on the initial values, inclusion of unknown rules generated, and the insertion of the rule's probability values. The Reset and Expert functions are not selected by default since they provide the ability to change the rule set based upon using another expert's results with the Reset control clearing the old information. This is performed only when you want to use another set of results and compare the two expert systems.

- Click on *Text* box to insert an X mark within it for output of desired information onto the shell and within selected output window. Click on X mark to de-select this function.

- Click on the desired *expert shell* radio button for Nexpert, Babylon, or KRS to select this shell which will automatically de-select all other shells.

- Click on *Heading* box to insert an X mark which will select file title information on the version of KSS0, definition of the domain, the experts involved, and a list of entity-attribute names with the pole names and their weighting. Click on the X mark to de-select this function.

- Click on the *Class* box to insert an X mark in order to obtain the class definitions of the nature behind the entities that group them together. Click on the X mark to de-select this function.

- Click on the *Objects* box to insert an X mark in order to obtain the object definitions for each of the entity names. This will provide the set initial value of the entity which will be defined as either True or False listed in the slot region for the class description. Click on the X mark to de-select this function.

- Click on the *Rules* box to insert an X mark in order to obtain the listing of Rules from the Induct analysis onto the screen and into the expert shell. Click on the X mark to de-select this function.

- Click on the *Object* box to insert an X mark in order to initialize and set the True or False values for the objects within the system so you can obtain the rules based on these initial control values. Click on the X mark to de-select this function.

- Click on *Unknown* box to insert an X mark in order to place the additional rules generated by the primary attribute being removed from the analysis as defined in the Induct region. Click on the X mark to de-select this function.

- Click on *Reset* box to insert an X mark in order to clear the rules from any previous insertion into the knowledge base so that you can place another set of results. Click on the X mark to de-select this function.

- Click on *Expert* box to insert an X mark in order to select another set of elicitation results and Induct rules from another expert in order to compare the results generated from the expert system. Click on the X mark to de-select this function.

- Click on the *Values* box to insert an X mark if you wish to have the probability values for each rule listed in the exported results in order to determine the acceptability of the rule in terms of its definite occurrence and correctness. Click on the X mark to de-select this function.

The Text area is selected to provide output of rules onto the shell and obtain the rules in Text format for placement into selected windows or files. They are placed in the log file or any other file for a record of the results as well as the Export window to view the output for analysis. The Export window is selected by default in order to position the information on screen for immediate viewing. The remaining functions for setting up the text format are not selected by default so that the client does not have to see the detailed mathematical values and attribute information. These

items are selected in the complete analysis of the rules before they are exported to the knowledge base.

- Select either the *Log* or listed window by clicking on the radio button to select it with a dot which automatically de-selects the other area. Select the Log window if you want to store the information in a common place with the rest of the results or provide a record of these results with the time and date. Type the new name of file or window directly from the keyboard if the highlighted window is selected and you want to change it to a new area.

- Click on Save button if you wish the computer to accept the changes of settings to the new default values that will not revert back to the old settings.

- Click on Cancel button to exit this format window back to the last screen presented without having to view the output or accept any changes to the settings.

- Accept the information settings and bring up the process window through the accept function by clicking on OK button or pressing RETURN key.