RepGrid & RepNet

Rep IV

Manual for *Research* Version 1.12

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1 What is *Rep IV*?

Rep IV is a suite of tools supporting research into, and applications of, a range of conversational constructivist methodologies based on George Kelly's (1955) *Personal Construct Psychology* (PCP—see also Fransella (2003)). In its various versions, it aims to provide personal, professional and research support for promoting understanding of individual and communal psychological and social processes. It provides conversational tools for constructing and analyzing *grids* (*RepGrid*), and *nets* (*RepNet*). Grids are a generalization of Kelly's *repertory grids* for eliciting construct networks through examples of their application, and nets are a generalization of visual syntactic structures used for representing construct networks directly in visual languages. It supports the use of grid and net tools separately and in combination, including integration between those tools and other applications such as text editors.

The *RepGrid* tool is the most recent in a series of grid tools originating in 1975 on the PDP12 as part of Mildred Shaw's research on repertory grid elicitation and analysis through conversational interaction with personal computers. Previous versions of the software include *PLANET, RepGrid 2, KSS0, NEXTRA* and *WebGrid*. The *RepNet* tool is the most recent in a series of programs for drawing the nodes and arcs of networks originating in 1965 on the PDP7 as part of Brian Gaines' research on interactive automata simulation and its application to modeling and emulating human skills. Previous versions of the software include the inductive modelers, *MA CHERIE* and *ATOM*, the semantic network systems, *KMap* and *KNet,* and various other visual language tools. These tools have been widely used in areas such as education, psychology, management studies, artificial intelligence, knowledge acquisition, market research and personnel assessment.

1.1 The Research version of Rep IV (see Section 13 for information on other versions)

The Centre for Person-Computer Studies (CPCS) was formed in the UK in 1968 as a not-for-profit organization to support research and development in interactive computers and their application. One objective of CPCS is to promote understanding and application of personal construct psychology by making constructivist psychological techniques as widely available as possible. We have made repertory grid elicitation and analysis available for the last decade as interactive web services through a freely accessible *WebGrid* server at the University of Calgary (http://tiger.cpsc.ucalgary.ca). This has been used by tens of thousands of colleagues world-wide, most of whom we do not know, and has supported research resulting in numerous graduate theses and research papers as well as classroom and personal studies.

The *Research* version of *Rep IV* furthers this endeavor by making professional grid and net tools, available for professional use. We have included a range of standard elicitation and analysis techniques for repertory grids, and made them extensible through scripts so that the user community can add additional capabilities to them without reprogramming Rep IV. We have made available a powerful, open-architecture tool for defining, developing, editing and applying representation nets, and again made it extensible through scripts so that it can be integrated with other applications. We have made a simplified *Personal* version of Rep IV freely available for student use, data collection, and so on, so that Rep IV may be incorporated in classes and field studies.

This manual is an introduction to the *Rep IV Research* version functionality. It does not cover how to apply grids and nets—a list of useful materials is provided at the end of the manual.

2 What you need to run *Rep IV*

There are two programs implementing the *Research* version of *Rep IV*, one running on the Macintosh under OS X 10.3 (and 10.2, but *not* OS9), and the other under Windows XP (and to a large extent under 2000, NT and 98, but *not* 95).

Increasingly users move back and forth between machines using different operating systems, concerned only to use whatever is available to perform a task. We have attempted to make the Mac and Windows versions of *Rep IV* as similar as possible while respecting the look-and-feel of the different operating systems. Fortunately Microsoft and Apple have already done much to make this possible and reasonable.

Rep IV supports use of a two-button mouse (designed originally for Windows) on a Mac if available. Otherwise the "control" key may be used as in other applications to mimic a right-button click if the cursor has a menu icon appended showing that a popup menu is available.

Two of the modifier keys are named slightly differently between Windows and Mac, but modern keyboards are double-labeling them to overcome this problem. This manual uses the prefix: "ALT" to indicate that the "alt" key (Windows) or "option" key (Mac) should be depressed at the same time as another key; "CMD" to indicate that the command (or apple) key (Mac) or control key (Windows) should be used in this way.

2.1 Getting started

Windows: *Rep IV* is distributed as a "setup.exe" file for Windows XP which contains an installer program. Download this file and an installer wizard will take you through a conventional installation sequence and install the *Rep IV* program files in your "Program Files" directory, and a "Rep IV Support" directory containing example data and the manual in your "MyDocuments" directory. It also installs an uninstaller that can be used to remove the files it has installed.

The *Rep IV* application may be started in the usual way from the "Rep IV" directory under the Windows "Start" menu, by double-clicking on the "Rep IV" shortcut on the desktop or by dragging a data file to it, or by clicking on a grid or net file.

Macintosh: *Rep IV* is distributed as a "installer.dmg.gz" compressed disk image file for OS X 10.3. Download this file and run the installer from your downloads folder. The installer wizard will take you through a conventional installation sequence and install the *Rep IV* program files in your "Applications" folder, and a "Rep IV Support" directory containing example data and the manual in your "Documents" directory. It also installs an uninstaller that can be used to remove the files it has installed.

The *Rep IV* application may be started in the usual way by double-clicking on it, by dragging a data file to it or by double-clicking on a grid or net data file.

Registration: A license key is required to activate all the features of the *Research* version, and this should be entered when *Rep IV* is first run. Section 3.2 illustrates the procedure.

2.2 Data compatibility

Rep IV recognizes and supports all the data formats we have used in previous grid and net programs. It will read the files generated by *PLANET, RepGrid 1,2* and *3, KSS0, NEXTRA,*

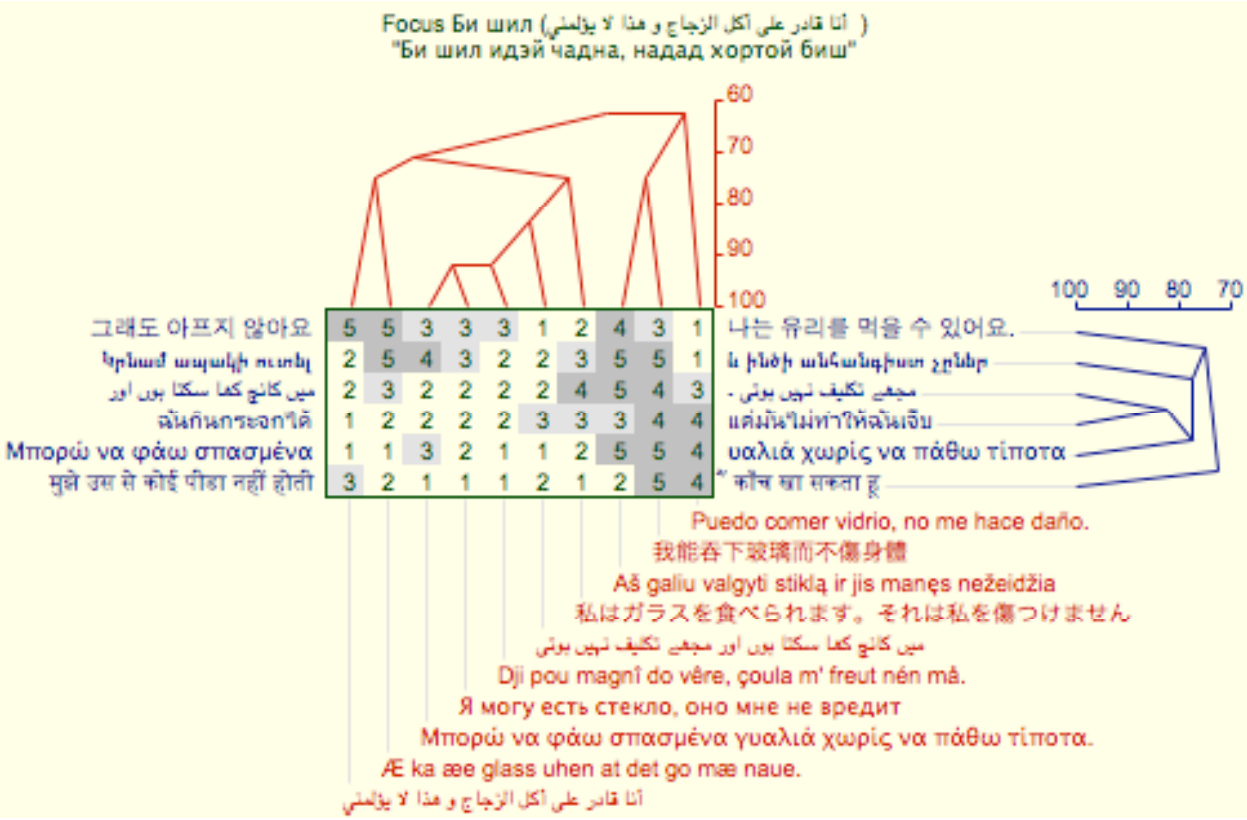
WebGrid, and *KMap*, as well as importing data from spreadsheets in the format we defined for *Repgrid 2*.

Since *PLANET* source code was distributed widely and its data format was adopted in other repertory grid analysis packages, *Rep IV* may also read data prepared for some of them. The simple format used is one of the most rapid ways of coding manually elicited grids as datasets for computer analysis, and *Rep IV* supports it being pasted or dragged from a text editor (including the built-in text editor) into RepGrid.

A scripting facility with full access to RepGrid and RepNet internal data structures enables scripts to be written that can import data from, and export data to, other applications. *Rep IV* includes an integrated script language compiler so that users may develop new scripts for import, export and data analysis, and add them to extend *Rep IV* functionality at any time.

2.3 Unicode and the support of the language scripts of the world

Rep IV manages data in both grids and nets in Unicode (UTF-8) representation so that it will support their use in the wide range of language scripts of the world available in Unicode (provided your computer has been configured to do so). An illustration of grid analysis with element and construct labels pasted in from samples of non-English languages is shown below.



Unicode support illustration

The extent of Unicode support depends on the operating system and the fonts installed. The Windows XP operating system has comprehensive support, and Microsoft Office 2003 installs the font Arial Unicode MS which has the most comprehensive coverage of the Unicode character

set that is available. The Macintosh OS X operating system has some errors in the supplied Unicode fonts and there are some problems in printing the full Unicode character set. Under both operating systems some applications do not support Unicode, or only partially support it. Rep IV provides the capability to paste bitmap images based on its own Unicode support into such applications.

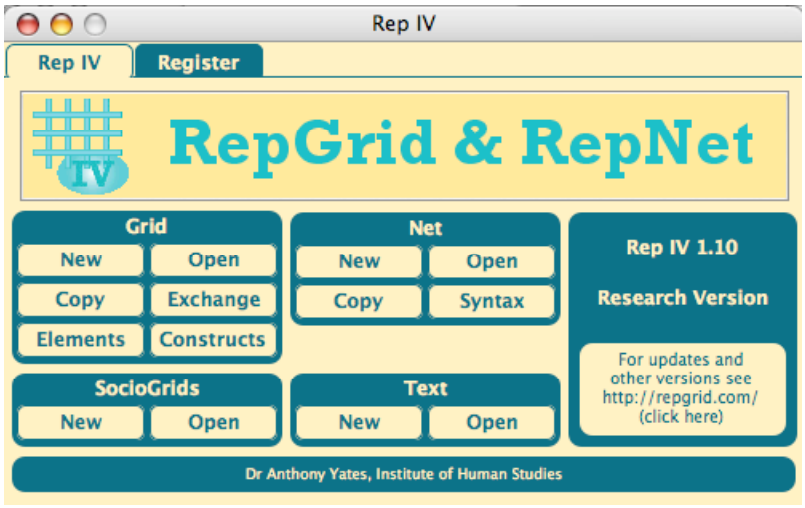
2.4 Integration with other applications

All *Rep IV* files are text files that are distinguished in type by their contents not by operating system conventions. This makes them portable across platforms and also readily generated or opened by other applications.

Rep IV also supports cut-and-paste and drag-and-drop between its own components and other applications, so that grids and nets can be developed from a variety of sources with the minimum of typing.

3 The *Rep IV* manager window

When you start *Rep IV* by clicking on its icon you will first see the *Rep IV* manager window shown below. This window may be closed at any time, and reopened as needed from the "Window" menu or by keying CMD-R.



The *Rep IV* manager window

Files and text may be dragged to the *Rep IV* manager window and will open in appropriate *Rep IV* windows as if they had been opened through the "Open" command in the "File" menu. Section 11 illustrates this and describes some of the file formats in greater detail.

The tab ribbon along the top allows you to select one of the panes: "Rep IV" or "Register." The *Rep IV* manager window opens with the "Rep IV" pane showing, and clicking on one of the other tabs brings its pane into view. The following sections describe the functions of each pane.

3.1 The Rep IV *pane*

The buttons on this pane, in various groupings, may be used to activate all the major functionality of *Rep IV*. Some of this can also be done from the "File" menu but the panel is usually more convenient.

Grid functions: The group of six buttons on the upper left allows you to create a new grid (see Section 3.3), open an existing one in a file for editing, copy an existing one as a new version, or copy it without ratings for exchange grid studies, or with only elements or only constructs. An error message is shown if the file selected is not a grid. All of the copy functions set the "Note" fields of elements and constructs to be an asterisk, "*", so that if additional items are added it is possible to distinguish them from the initial ones. The "Note" field of the copied grid is also annotated to indicate how the grid was derived.

SocioGrids functions: The group of two buttons on the lower left allows you to create a new empty SocioGrids window, or to open all the grid files in a directory in a SocioGrids window.

Net functions: The group of four buttons in the upper center allows you to create a new net (see Section 3.3), open an existing one in a file for editing, copy of an existing one as a new version, or copy just its syntactical structure of node and line types. An error message is shown if the file selected is not a net.

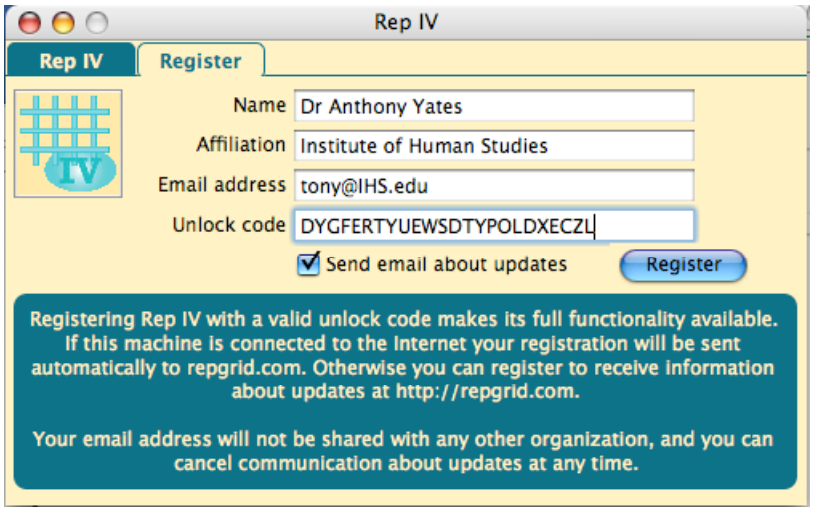
Text functions: The group of two buttons in the lower center allows you to create a new text editing window or open any existing file for editing in a text editing window (including grids and nets which can be useful if you wish to look at the file formats).

Version information: The large button on the right shows you the version of *Rep IV* that you are using. If your computer is connected to the Internet then clicking on this button will cause your web browser to access the page at http://repgrid.com covering *Rep IV*, its versions and updates.

3.2 The Register pane

When you install *Rep IV* initially you need to register it using the license key supplied to you in the process of acquiring a *Rep IV* license. Clicking on the "Register" tab brings up the pane shown below. This provides a form with fields for the name, affiliation and email address of the person owning *Rep IV*, the unlock code, and a checkbox to indicate whether you want update notices sent to the email address. Fill in the fields in the form appropriately and click on the "Register" button to register your copy of Rep IV and unlock its full functionality.

The name and affiliation will appear at the bottom of the "Rep IV" pane. The information supplied will be used only to communicate about *Rep IV* updates if requested and will not be shared with third parties.



The *Rep IV* registration pane

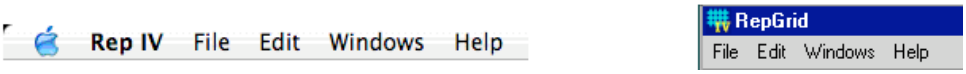
3.3 Default new grid and net files

When you click on the "New" button under the Grid or Net functions, *Rep IV* checks whether there is a file in the "Rep IV" directory called "Default.rgrid" or "Default.rnet" respectively and, if so, opens a copy of this as the new grid or net file rather than using its own defaults. This enables a facilitator to use the "New" buttons to create initial grids or net preset to their own preferences. *Rep IV* looks for a directory named "Rep IV" in the "Documents" directory of the current user under OS X, and in the "My Documents" directory of the current user under Windows XP.

You can set up such default files by saving a grid or net under the name "Default" in your "Rep IV" directory, creating such a directory in your "Documents" or "My Documents" directory if one does not already exist.

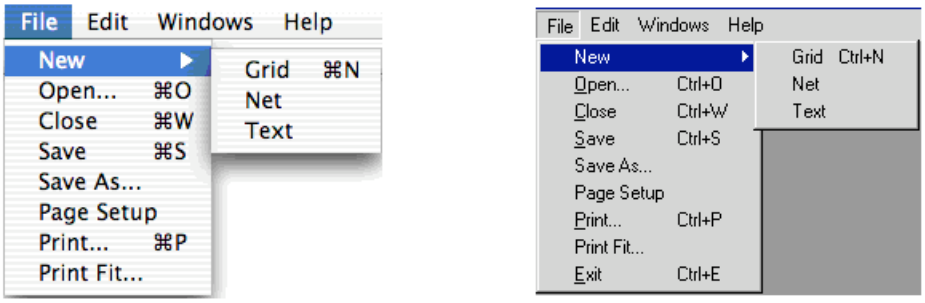
4 The *Rep IV* menus

Below is shown the *Rep IV* menu bar with menus: “File,” “Edit,” “Windows,” “Help.”



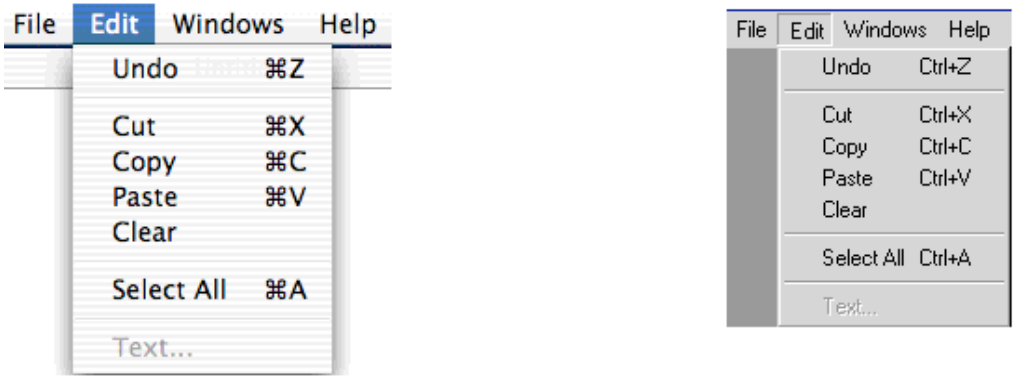
***Rep IV* menu bar on Mac and Windows**

Below is shown the *Rep IV* “File” menu with the “New” sub-menu to the right that can be used to create new grid, net or text files. The “Open…” command, or CMD-O, will open any grid, net or text file, treating an unrecognized file as if it were text.



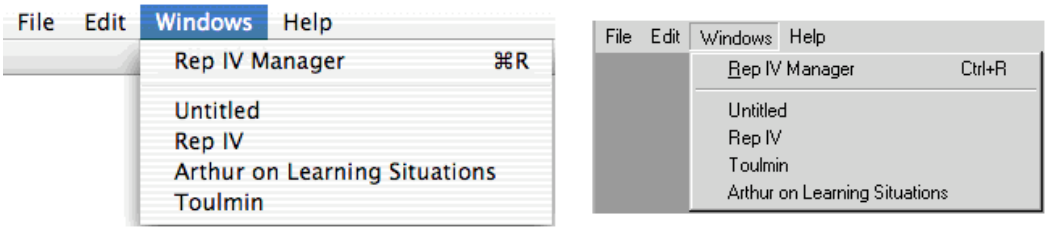
***Rep IV* “File” menu on Mac and Windows (with “New” clicked)**

Below is shown the *Rep IV* “Edit” menu. “Text” opens a font/style dialog for text windows.



***Rep IV* “Edit” menu on Mac and Windows**

Below is shown the *Rep IV* “Windows” menu. At the top “Rep IV Manager” opens the “Rep IV” Window as shown in Section 3. The open windows are listed below and each may be selected to bring it to the front.



***Rep IV* “Windows” menu on Mac and Windows**

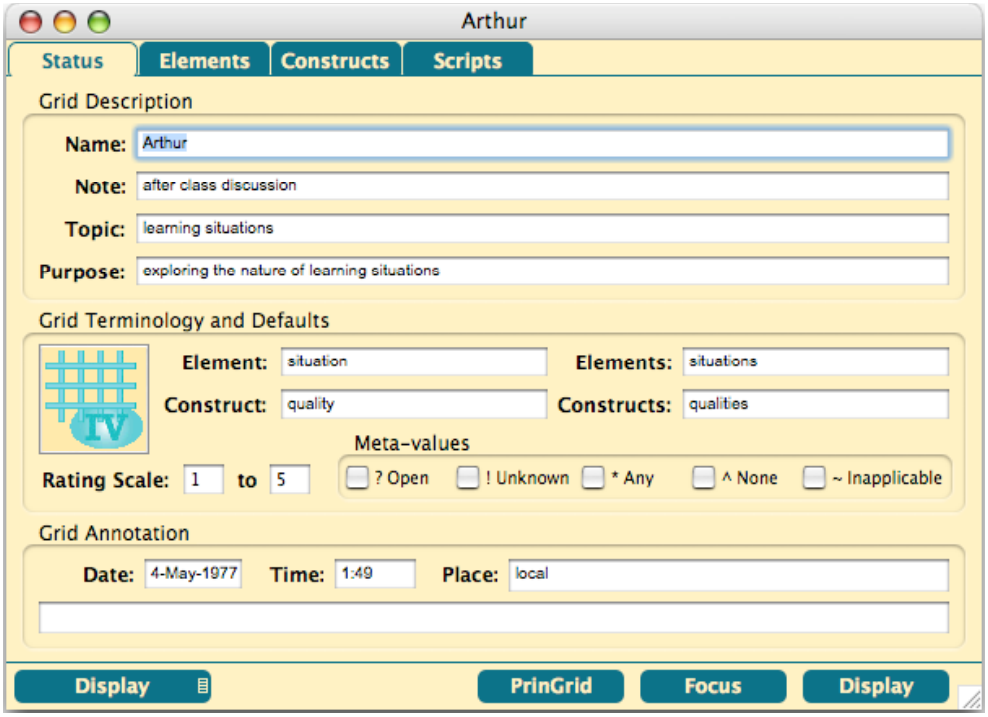
5 Grid editing and analysis: RepGrid

The RepGrid tool in *Rep IV* provides the capability to enter, edit and elicit repertory grid data, and to reflect back the underlying psychological processes in graphic form. It includes scripts for conversational elicitation (Shaw, 1980), and for the entry of grids that have been elicited through interviews (Jankowicz, 2003; Fransella, Bell and Bannister, 2004; Fromm, 2004). The analyses present grids in a way that reflects their meaning to promote discussion, understanding, decision-making, conflict mediation, and further elicitation.

We will first show the RepGrid tool in operation with an existing file and then discuss how to enter your own data or elicit it through conversational interaction with RepGrid. Clicking on the "Open Grid" button in the *Rep IV Manager* window brings up the dialog for opening a file, if a file is selected RepGrid will attempt to open it as a grid, reporting an error if it cannot.

5.1 RepGrid window

Below is the RepGrid window that appears when the grid selected is opened. The tab ribbon along the top lets you select any one of the the panes: "Status," "Elements," "Constructs," and "Scripts." The button/popup menu at the lower left provides full access to the analysis tools, and the "PrinGrid," "Focus," and "Display" buttons at the lower right provide immediate PrinGrid, Focus and Display analyses respectively (Section 7).



RepGrid window with "Status" pane showing

When the data in a RepGrid window is changed the "Save" item in the "File" menu becomes active as does the "Undo" item in the "Edit" menu. You can save the changed data under its original name through the "Save" command. The "Save As…" command in the "File" menu is always active and lets you save the grid in a different file. RepGrid supports multi-level undo through the "Undo" command at the top of the "Edit" menu (or CMD-Z).

The RepGrid window opens with the "Status" pane showing, and clicking on one of the other tabs brings its pane into view. The following sections describe the functions of each pane.

5.2 Status pane

The "Status" pane shows some overall features of the grid and allows them to be entered or edited. It has three sub-panels: "Grid Description," "Grid Terminology and Defaults," and "Grid Annotation."

The "Grid Description" panel comprises four items. The "Name" field is intended to identify the person from whom the grid was elicited. This is used to identify the grid in the titles of the analyses, but since several grids might be elicited from the same person, a "Note" field is provided to allow further identification. You will see in the various analyses that RepGrid entitles this grid, "Arthur (after class discussion)."

The "Topic" field is used to identify the topic area or domain for the grid. Unlike the "Note" field, this field is not shown in any of the current analyses, and it can be used as one sees fit to store additional information about the grid.

The "Purpose" field is used to express the purpose or context for eliciting the grid. Computer-based elicitation tools use this field to remind the user of the reason why they are developing a grid, and the analysis tools put it in the title to show the purpose or context of the elicitation.

The "Grid Terminology and Defaults" panel comprises six items. In grids the entities being construed are termed "elements" and the dimensions of construing, their perceived characteristics, are termed "constructs." These are somewhat technical terms, and it is often better for users to substitute more colloquial terms appropriate to the domain or topic under consideration. In this grid Arthur, or the person facilitating the elicitation, has chosen to use the term "situation" for "element" and "quality" for "construct."

The rating scale in the *Research* version of *Rep IV* may be set to range over a set of integers from a minimum of –99 to a maximum of +99. Scales of 1 to 5, 7 or 9 are commonly used. A two-valued rating scale of 1 to 2 forces the user to make binary distinctions without "shades of gray." Using 1 to 3 provides a middle option that allows a user to express neutrality between the two poles of a construct. However, users often prefer to have the further gradations of a 1 to 5, 1 to 7 or 1 to 9 scale available to them. In the literature you will also find a variety of other scales used, such as a –7 to +7 scale or a 1 to 11 scale.

You may change the rating scale as you add constructs, and thus have constructs with different rating scales in the same grid. RepGrid will analyze such grids correctly since it rescales the constructs to a common range as part of its analyses. However, having different rating scales for different constructs is not a common usage of grids, and we do not recommend that this feature be used except in special circumstances.

RepGrid also supports the analysis of grids having *meta-values* for some of the ratings. The "Meta-values" panel controls what meta-values will appear on the rating scale popup menus made available to users for grid data entry. The possible meta-values are:-

? Open: indicating that a rating has not been entered;
*** Any**: indicating that any of the available ratings is applicable;
~ Not applicable: indicating that the construct is not applicable to the element;
^ None: indicating none of the available ratings is applicable to the element;
! Unknown: indicating that the rating is unknown.

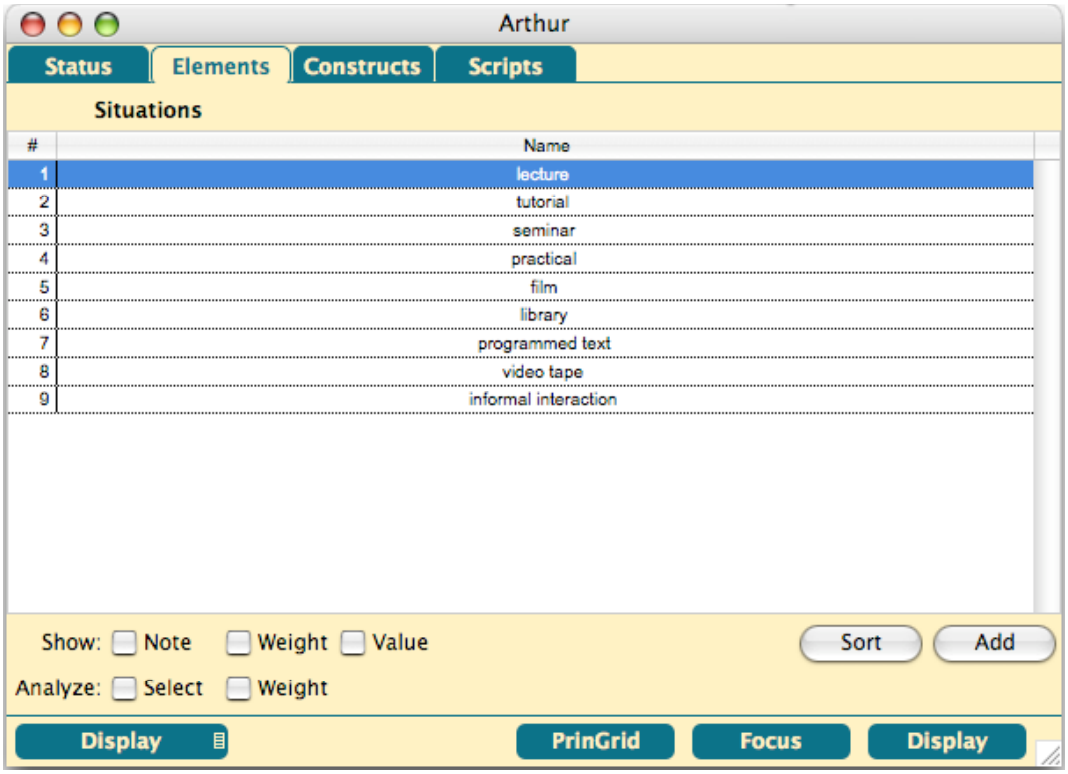
In most conventional grid elicitation, the only meta-value used is "?" to indicate that a rating has not yet been entered. However, sometimes clients are given options such as "any" or "none," and RepGrid supports such meta-values.

The "Grid Annotation" panel comprises four items. The "Date," "Time," and "Place" fields record the time and internet location when the grid was initiated. RepGrid fills them in automatically but they can be edited, typically to keep track of the coordinates of grid data from other sources entered in RepGrid for analysis.

The bottom field is a multi-line field to store any annotation that may be useful. It is not shown in any of the analyses and may be used to help keep track of any data relevant to the grid. If there is extensive annotation the window may be enlarged to display it.

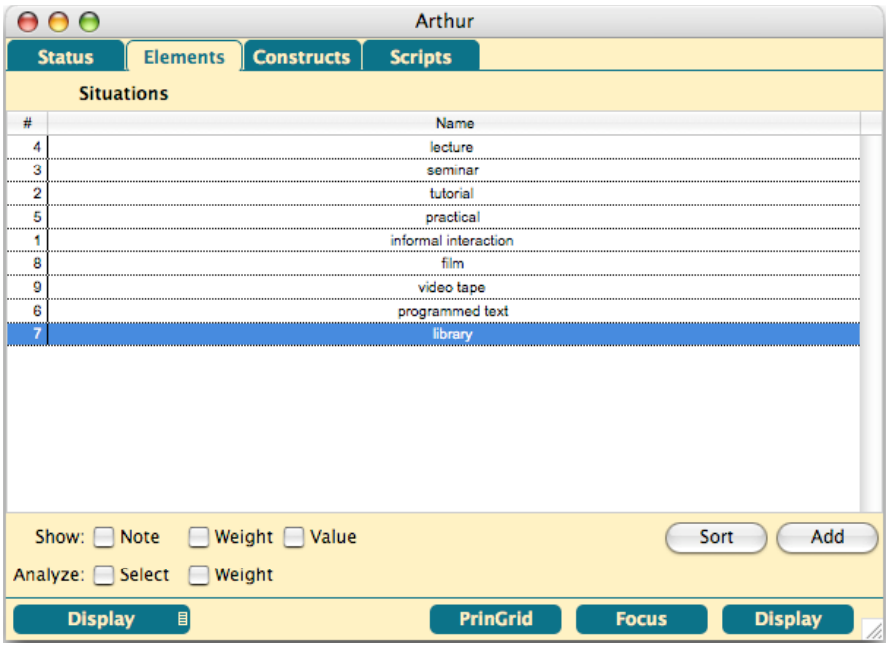
5.3 Elements pane

Clicking on the "Elements" tab brings up the pane shown below. This lists the numerical order of the elements in the grid in the column on the left, and their names in the next column. The "Add" button at the bottom right adds an additional element row.



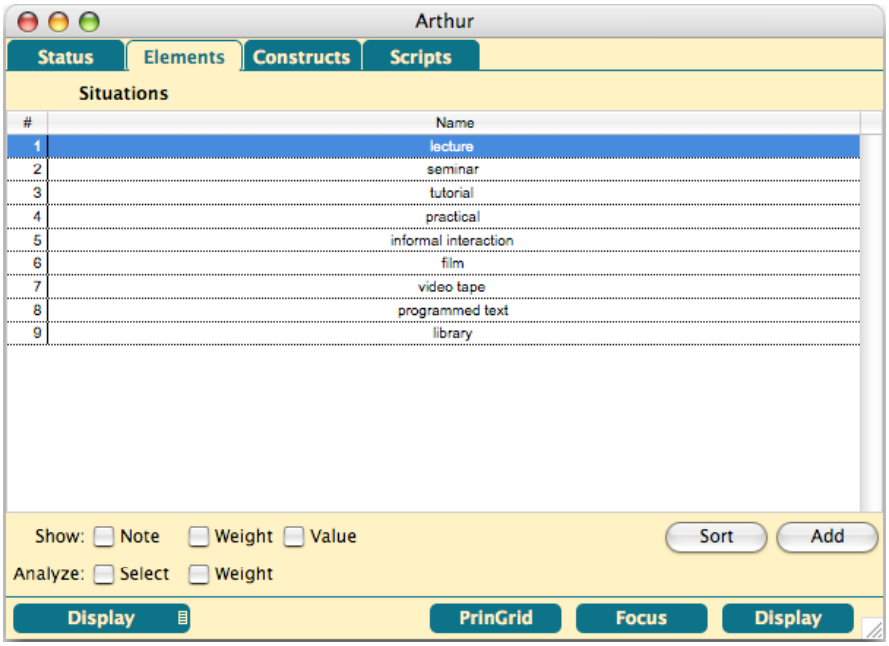
RepGrid "Elements" pane showing element numbers and names

Rows may be selected by clicking in the number column on the left which selects and highlights the row clicked. Multiple rows may be selected by holding down the "shift" key for contiguous selections and the CMD key for non-contiguous selections, consistent with the normal conventions of the Mac and Windows operating systems. The main purpose of selecting rows is to allow them to be **deleted by pressing the "delete" or "backspace" key**. It also allows the selection of only part of a grid for display and analysis (Section 7), for rows to be dragged into a different order, and for the data in them to be dragged to another application (Section 10). For example, the screen below shows the elements having been dragged into a different order.



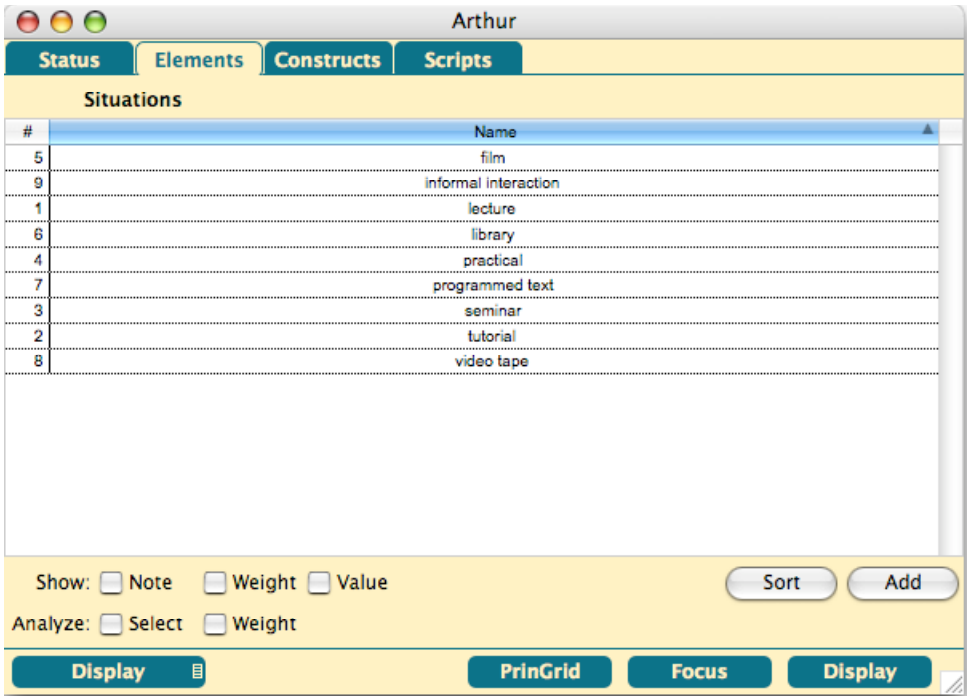
RepGrid "Elements" pane after the elements have been dragged into a new order

If the "Display" button is used to display the grid the elements will be in the new order. Note, however, that the element numbers are unchanged as is the grid data. To make the new order permanent the "Sort" button must be clicked. This renumbers the elements as shown below.



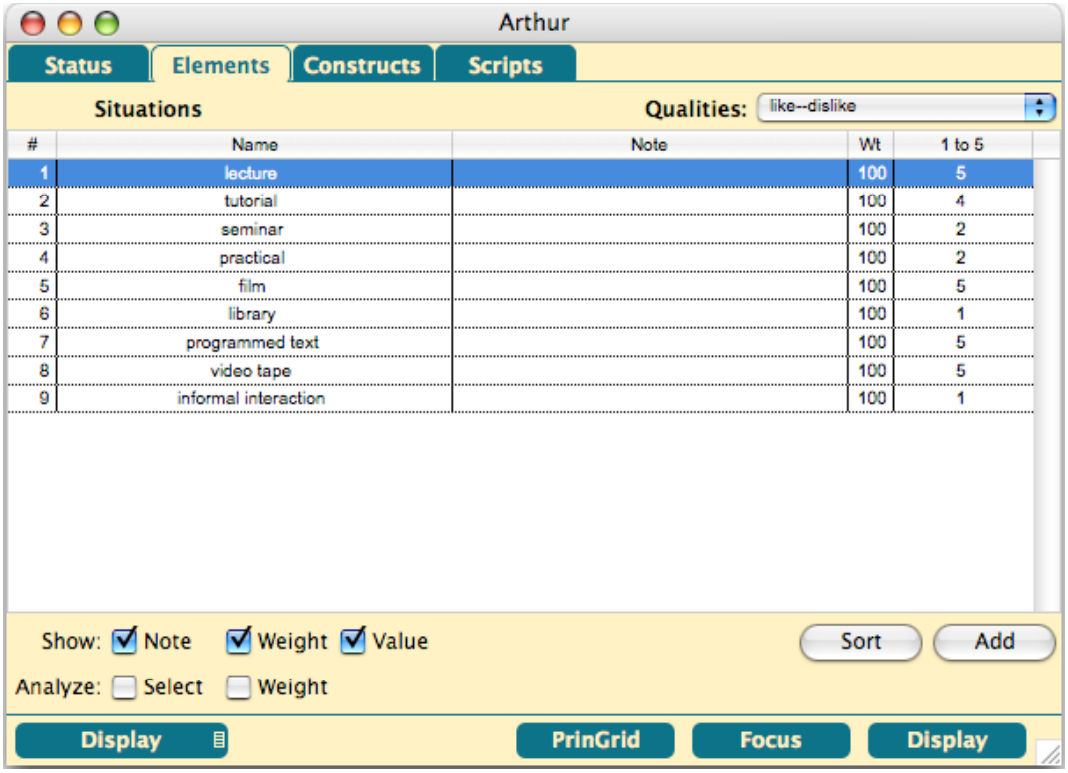
RepGrid "Elements" pane after the "Sort" button has made the new order permanent

The elements may also be sorted alphabetically by clicking on the "Name" header as shown below. Again the "Sort" but may be used to make this order permanent if desired. Otherwise, clicking on the "#" header will restore the numeric sort. In general, elements and constructs may be sorted by dragging or by clicking on the appropriate header in all the following screens.



RepGrid "Elements" pane with elements sorted by clicking the "Name" header

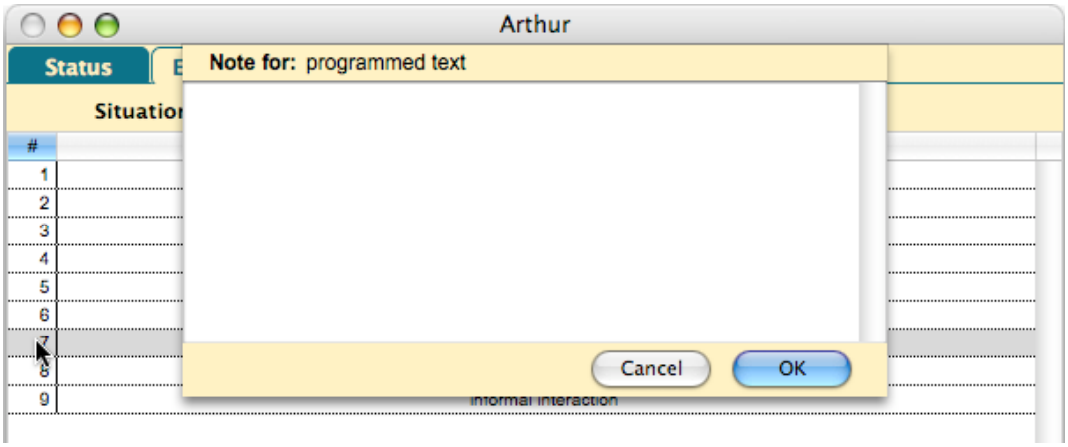
The element names are always shown, and the associated note, weight and value fields may also be shown dependent on which boxes are checked in the row on the left under the data. Below is shown the "Elements" pane with all the fields activated.



RepGrid "Elements" pane showing all fields

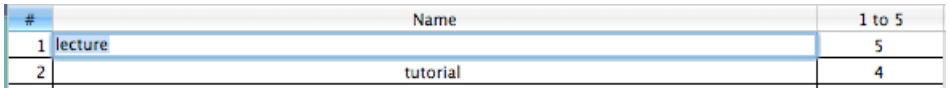
The rating values on a selected construct are shown in the column on the right. The construct to which these ratings apply is selected through the popup menu at the top right.

If the annotation in the note field is long it may be best to edit is separately by double-clicking on the element number to open its note field in an edit pane as shown below.



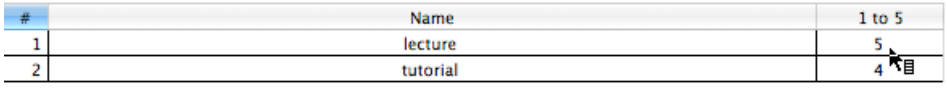
RepGrid "Elements" pane note field opened by double-clicking on number field

Any fields may be edited by clicking on it, which selects it for editing. The effect of clicking on the first element name is shown below. When the name has been edited, pressing the "return" or "enter" key or clicking elsewhere deselects it for editing and re-centers the name. Pressing the "tab" key makes next visible field editable, stepping from name to note and weight if these are visible, and then to the name in the next row, creating a new row if at the end of the table. This supports rapid entry of whatever fields are being used for a particular grid.



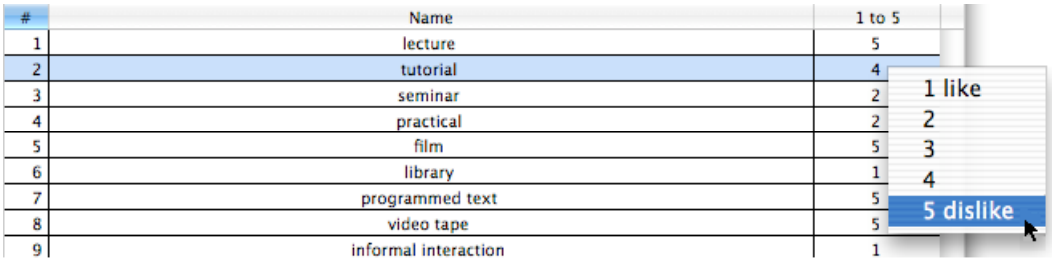
Clicking on an element name selects it for editing

Ratings may be edited in the same way as other fields by clicking on them to make then editable and typing in a new rating. The "tab" key now sequences down through the ratings, and has no effect if pressed in the last one. Ratings may also be edited by bringing up the popup menu indicated by the changed cursor shape as one mouses over a rating, as shown below.



Mouse cursor changes to indicate a popup menu is available to edit a rating

Popup menus are activated on a Mac by CTL-click and on Windows (or a Mac with a two-button mouse) by a right-click. Below is shown a rating being edited through a popup menu. This may be done even if the rating value has not been made editable for keyboard editing.



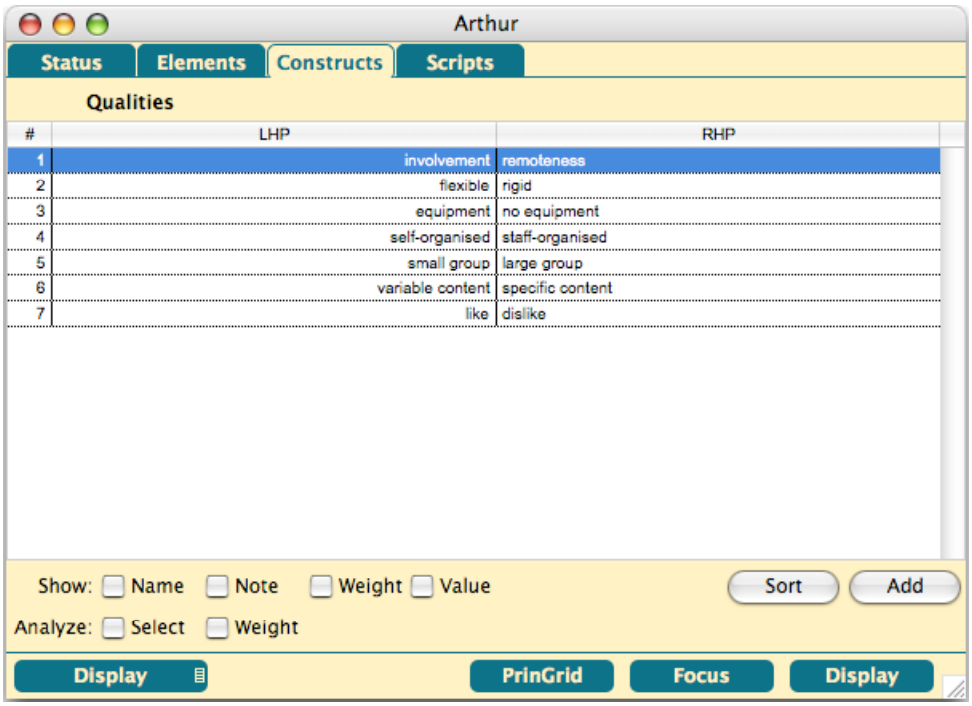
Popup menu editing a rating

5.4 Constructs pane

Clicking on the "Constructs" tab in the RepGrid window brings up the pane shown below. This lists the numerical order of the constructs in the grid in the column on the left, their left hand pole (LHP) names in the next column, and their right hand pole (RHP) names in the next column.

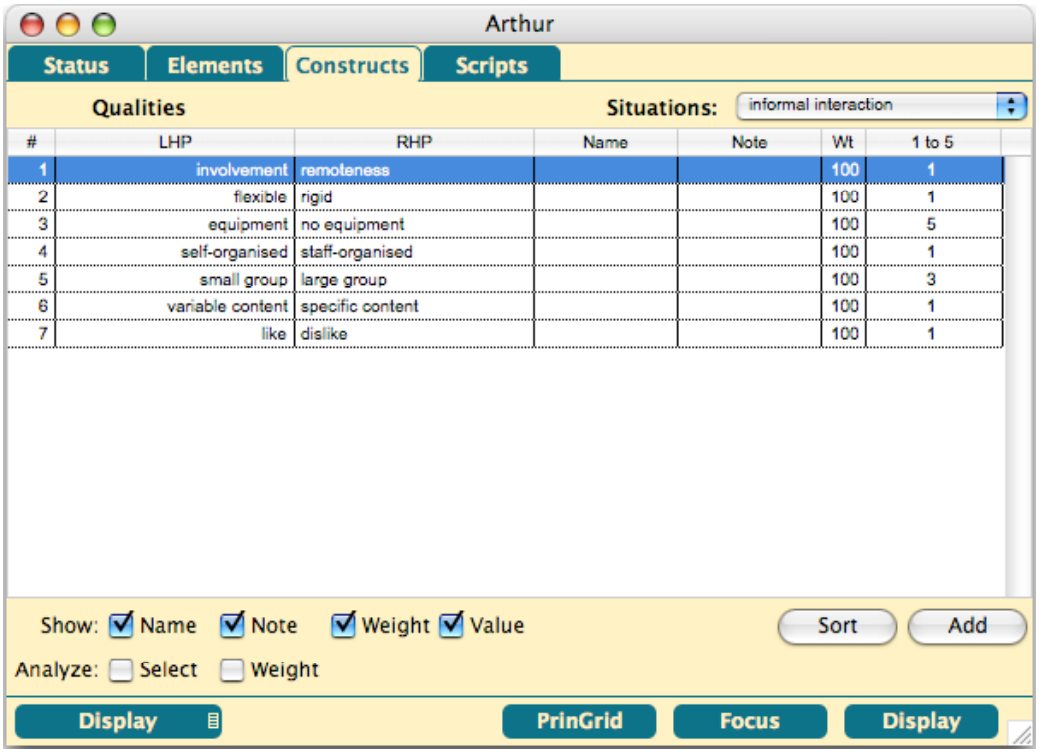
Editing constructs in this pane is much the same as for elements described above. **Rows may be selected for deletion with the "delete" or "backspace" key** by clicking in the number field, and added by clicking the "Add" button or keying "tab" when the last (non-value) field of a construct is editable. The rows in the "Constructs" pane may be sorted by dragging or by clicking on a header in the same way as for the "Elements" pane, and the "Sort" key may be used to make the new order permanent.

In addition to options to display the construct notes, weights and values, there is also one to display a construct name. Construct names are uncommon in normal grid data but can be useful in some applications where the pole names are insufficient to identify the construct, e.g. with "Q-sort" (Stephenson, 1953) data where the elements are statements, all the constructs are "agree-disagree," and the name field is used to identify the person responsible for rating that construct.



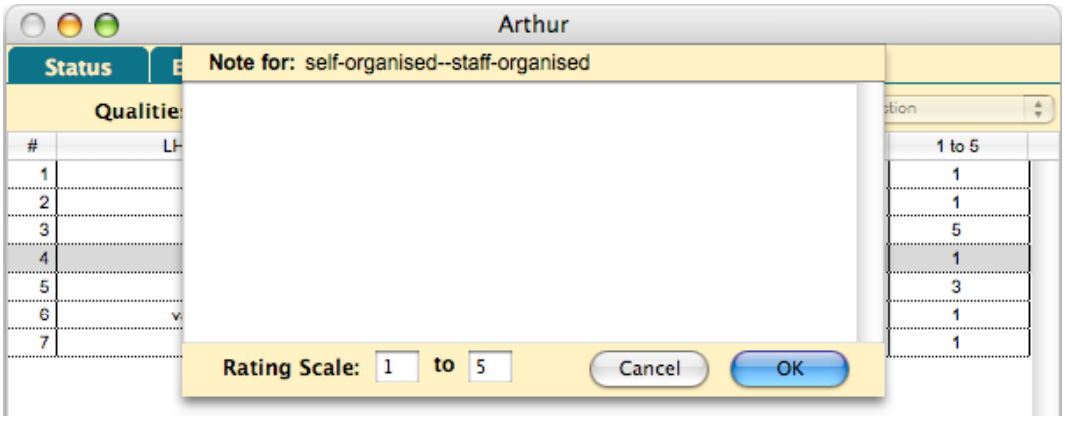
RepGrid "Constructs" pane showing construct numbers and poles

Ratings may be edited through the keyboard or popup menu as for elements, and the "tab" key behavior is the same as for elements. Below is a "Constructs" pane with all the fields showing.



RepGrid "Constructs" pane showing all fields

Double-clicking on a construct number opens up the note field of a construct for lengthier annotation as it does for an element. As shown below, it also makes the construct's rating scale range available for editing in case it does not correspond to the default range given in the "Status" pane. *Rep IV* fully supports the editing and analysis of grids containing constructs with differing rating scales.

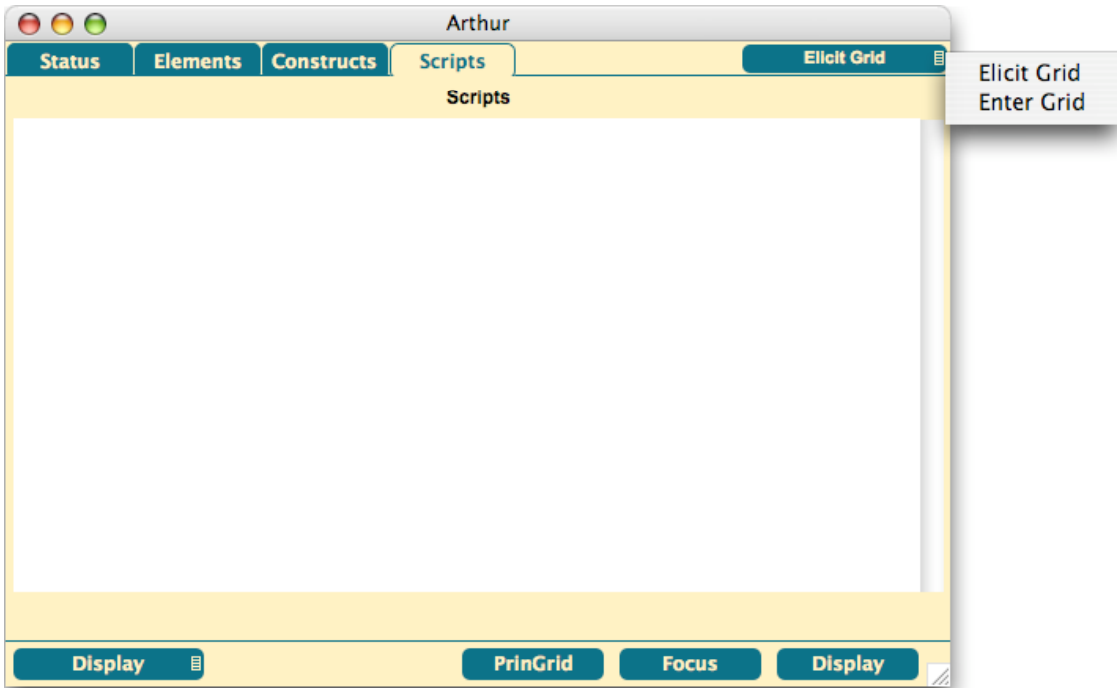


RepGrid "Constructs" pane note field opened by double-clicking on number field

5.5 Scripts pane

Clicking on the "Scripts" tab in the RepGrid window brings up the pane shown below with the script button/popup menu at the top right clicked to bring up a popup menu of available scripts.

This button is dual-purpose in that clicking in the menu symbol on the right (or right-clicking anywhere in the button) brings up a menu which enables one to select the script named in the button, and clicking in the script name causes the script to run. **A script may be terminated at any time by pressing the "esc" key**.



RepGrid "Scripts" pane

The sets of scripts are within the *Rep IV* application directory "GridScripts," and the name of the script is what appears on the popup menu. Thus one can set up multiple scripts for different purposes (see Section 6.3).

The text output to support interaction through the scripts may be edited to be in a language other than English and, since *Rep IV* uses a Unicode text representation, supported non-Roman scripts may be used. The display and analysis tools have been designed to use only the text entered into the grid so that they also support graphic output in the language being used.

The initial set of scripts currently supplied with *Rep IV* are "Elicit Grid" and "Enter Grid." Selecting one of these from the popup menu starts it running, and the purpose and behavior of these scripts is described in Section 6.

5.6 "Save," "Save As," "Undo," "New," "Copy," "Exchange," "Elements," "Constructs"

When any grid data, analysis parameters or state of the analysis tools or scripts menus are changed, the "Save" item in the "File" menu becomes active, and selecting it or keying CMD-S saves the changed grid to its existing file. The "Save As" item in the "File" menu is active at all times and may be used to save the grid to a new file. When a grid is saved the analysis parameters last used and the states of the analysis tools and scripts menus are saved with it. They are restored when the grid is re-opened so that if particular analyses or scripts are being used for that grid they do not have to be set up each time it is opened.

When grid data is changed the state of the grid before the change is recoded, the "Undo" item in the "Edit" menu becomes active, and selecting it or keying CMD-Z restores the state of the grid

before change. The last fifty state changes since the grid was opened are recorded supporting multiple undoing. This information is discarded when the grid is closed.

Selecting the “Grid” item in the “New” submenu of the “File” menu or keying CMD-N creates a new grid with standard default values. Clicking in the “New” button in the “Grid” area of the Rep IV manager window has the same effect unless a grid has been saved as “Default.rgrid” in the “Rep IV” directory as discussed in Section 3.3, in which case a copy is opened of that default grid. This enables the facilitator to set up a default grid with whatever data in it is appropriate, e.g. terms for elements or constructs, analysis parameters, or default script appropriate to a particular domain.

The “Copy” button in the “Grid” area of the Rep IV manager window may also be used to open a copy of one of several default grids appropriate to specific purposes. The “Exchange,” “Elements,” and “Constructs” buttons open a copy of a grid in which the ratings have been set open, or only the element or construct names are copied, respectively.

6 Grid entry, elicitation and export scripts

The scripts accessible through the "Scripts" pane are designed to support rapid entry of existing grid data, and conversational elicitation of new grids.

6.1 Enter Grid script

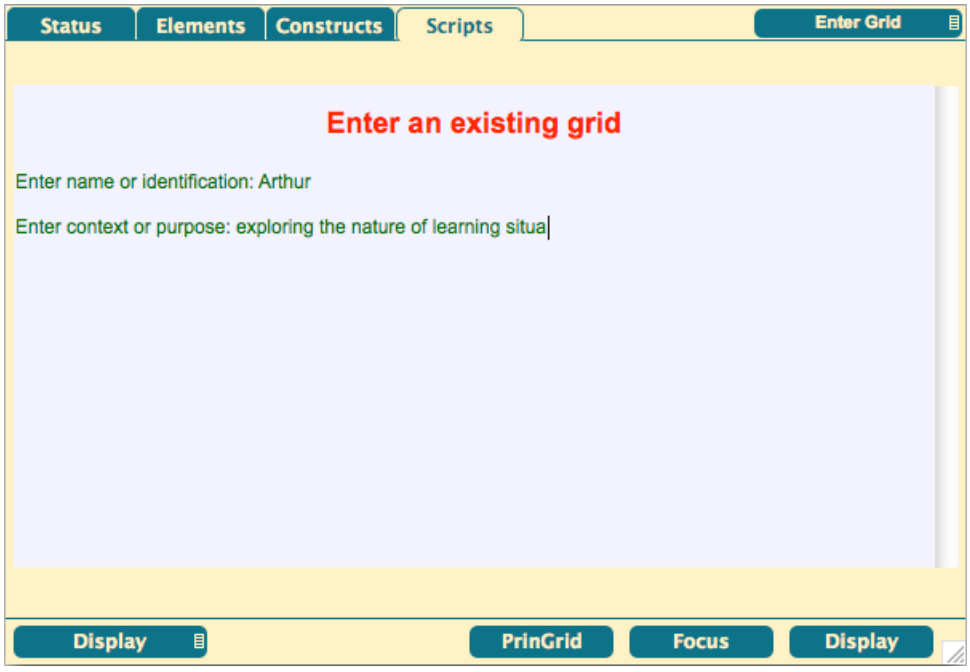
The "Enter Grid" script allows existing grid data to be entered rapidly. The script is programmed to:-

1. Request missing fields in the "Status" window such as the user's name and the purpose of the elicitation
2. To ask the user to enter the elements
3. To ask the user to enter the constructs and their ratings on the elements
4. To offer the user the option to edit and enter more elements or constructs, or to finish the entry process

The "Enter Grid" script may be run immediately with a new grid, or with one where the name and purpose have been entered on the "Status" pane, and/or the elements have been entered on the "Elements" pane. **If the rating scale is other than 1 to 5 or the terms for elements and constructs are different then these should be set up in the "Status" pane before the script is run.** In the example below elements have been termed "situations" and constructs "qualities."

The script offers the facility to edit elements, constructs and ratings, and this may also be done through the "Elements" and "Constructs" panes. The "Display" button provides a convenient way of checking the data entered against its source to ensure that it is correct.

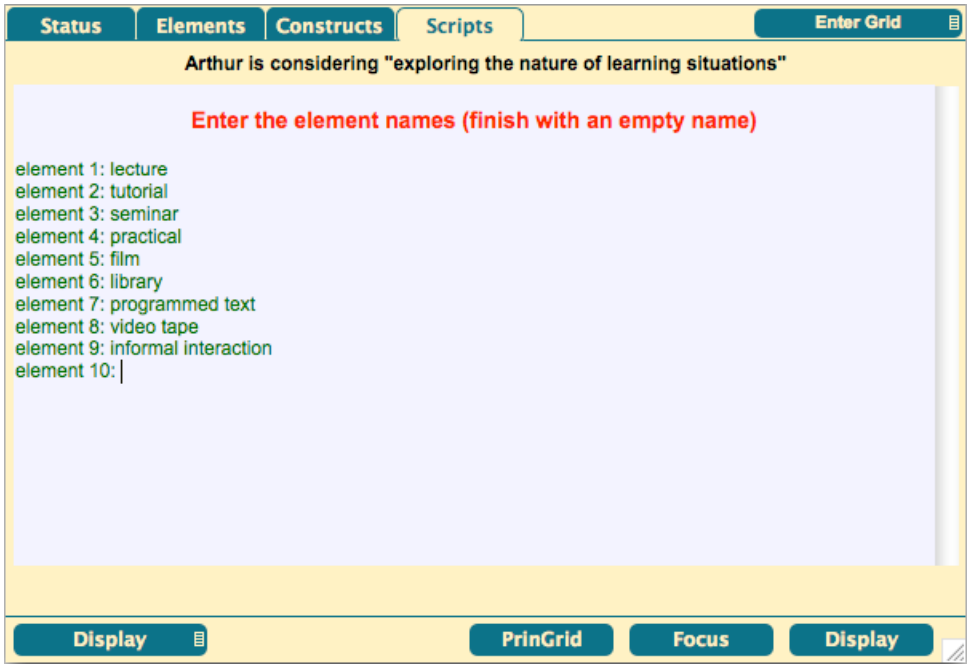
The figures below illustrate the "Enter Grid" script being used to enter the grid used to illustrate this manual. The first screen shows the name and purpose being entered as text terminated by the "return" key.



"Enter Grid" script entering name and purpose

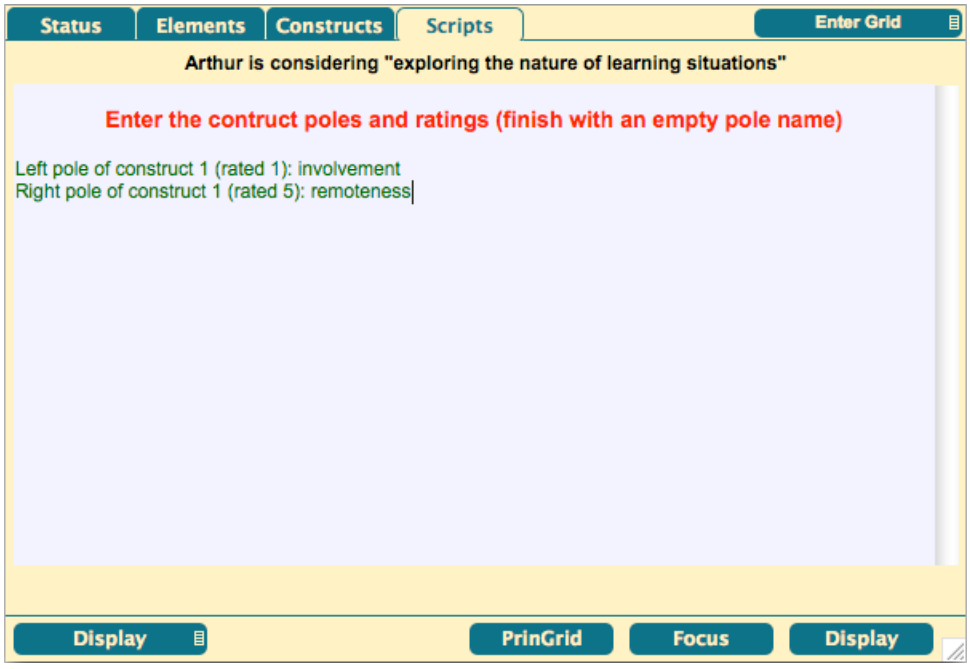
The entry process is similar to that of a text editor. The “delete” key may be used to erase text, and text may be selected, copied and pasted.

After the purpose has been entered, the element names are entered as shown below. An empty name terminates the element entry and proceeds to the constructs and ratings entry.



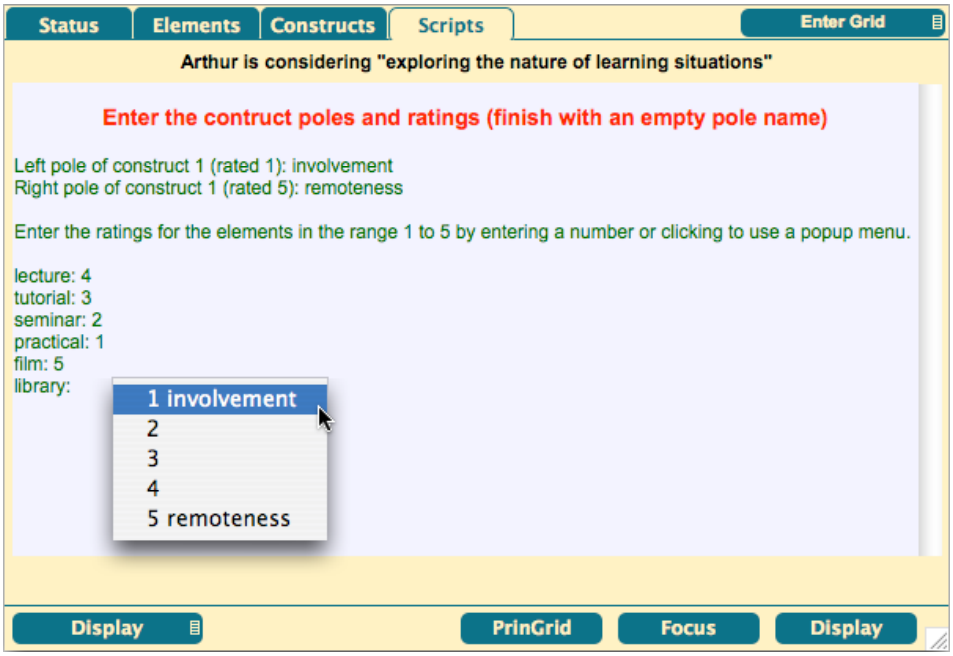
“Enter Grid” script entering element names

The next screen shows the pole names of the first construct being entered.



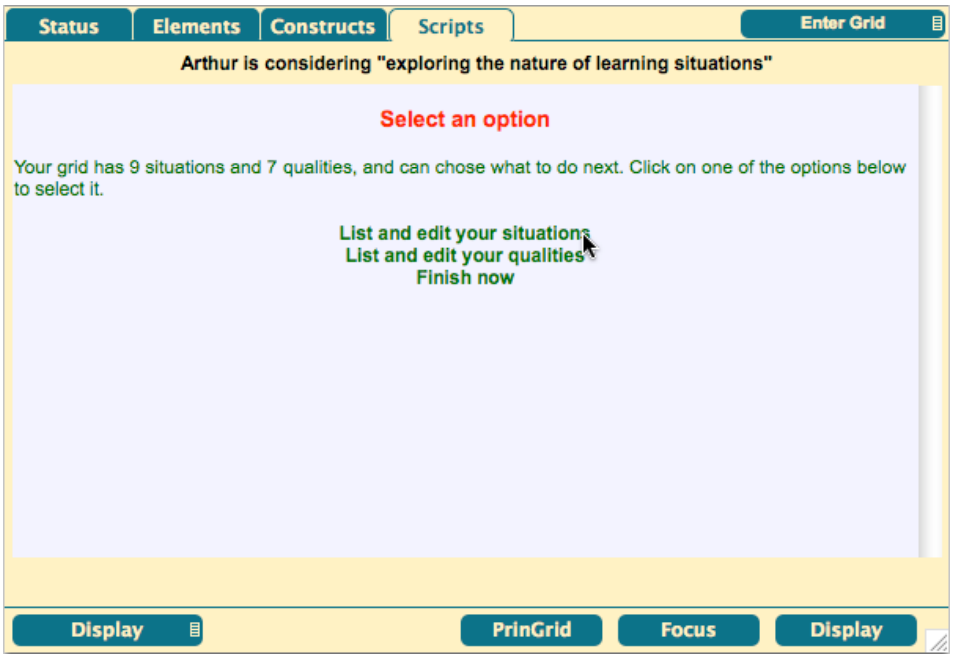
“Enter Grid” script entering pole names of the first construct

Then the ratings on each element are requested as shown below. They can be typed in as numbers followed by “return”, or by clicking the mouse and selecting a rating from a popup menu.



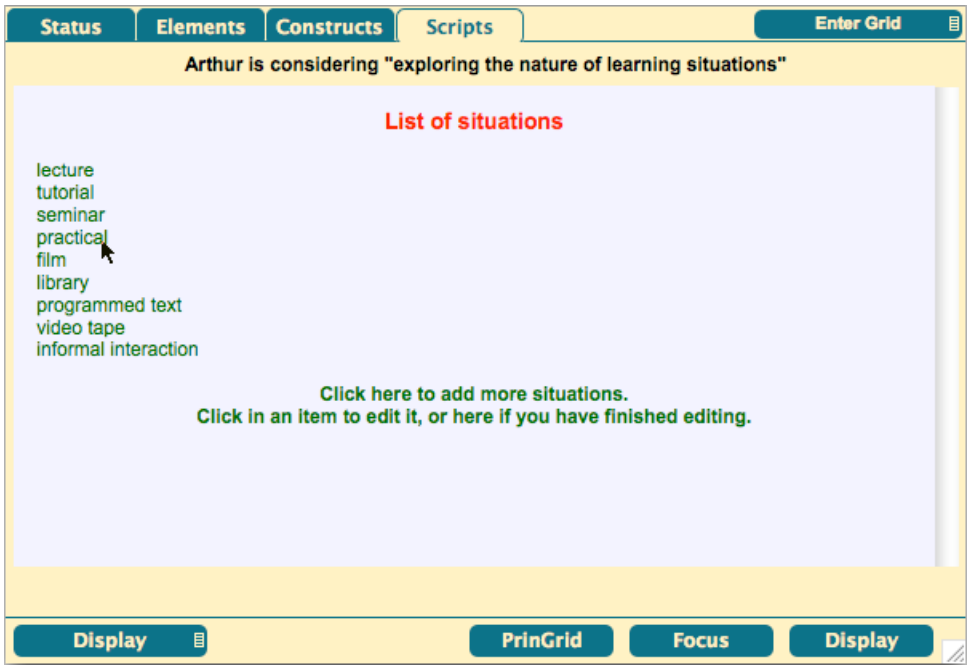
“Enter Grid” script entering element ratings on the first construct

When all the elements have been rated on the first construct, the pole names of the second construct are requested, and so on, until all the constructs and ratings have been entered. Construct entry is terminated when an empty pole name is entered, and grid editing options are listed as shown below.



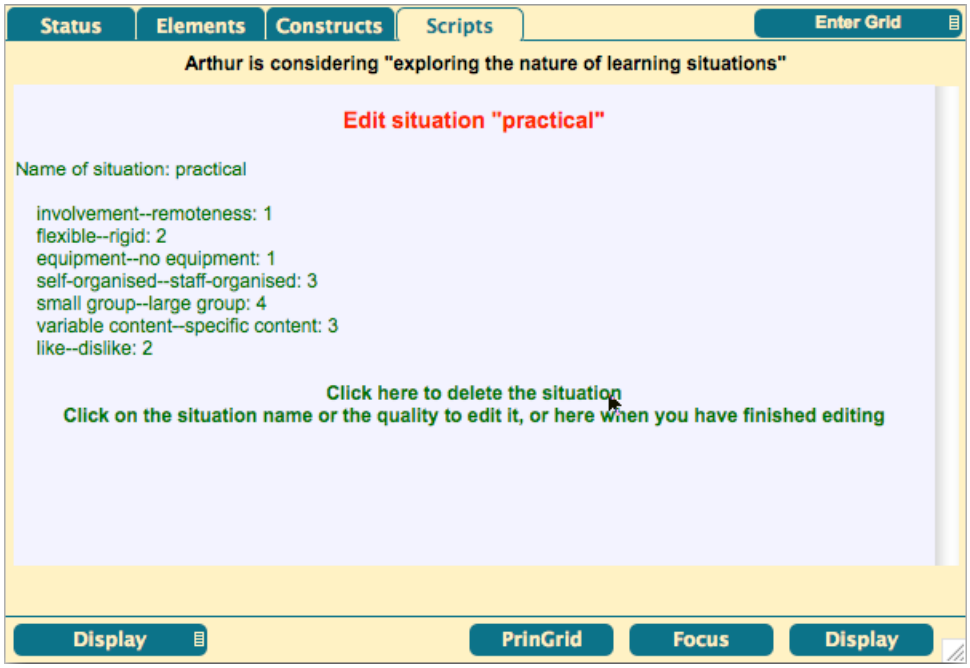
“Enter Grid” script options after grid entry

The “Display” button may be used to display the grid to check that it has been entered correctly. If not, the elements or constructs may be listed and the names or ratings may be edited. The screen below shows the elements and gives options to add more or to edit an element.



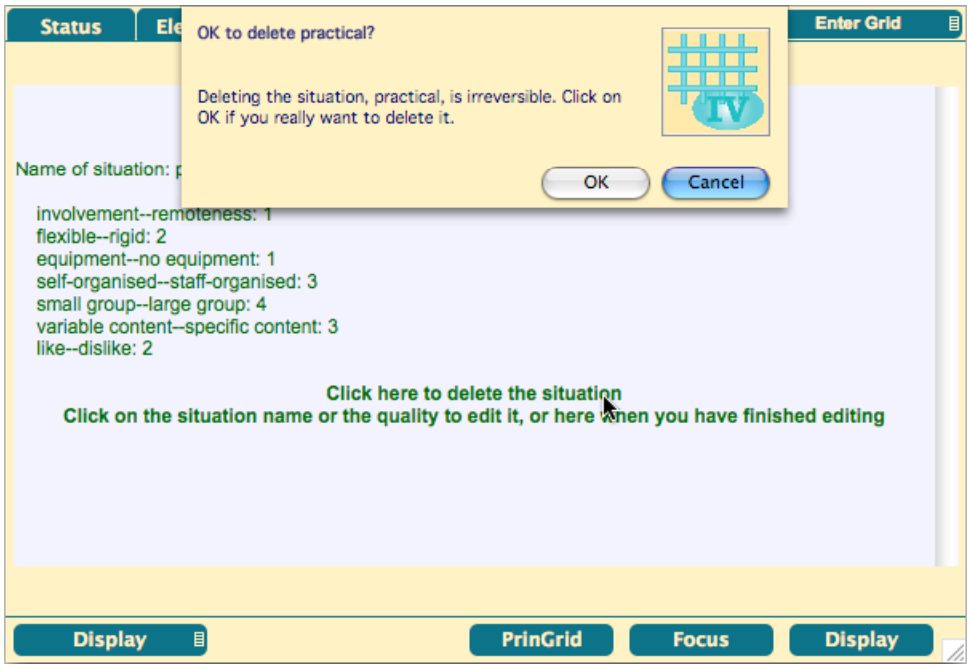
“Enter Grid” script list of elements

Clicking on the element “practical” displays its name and its rating on each construct as shown below.



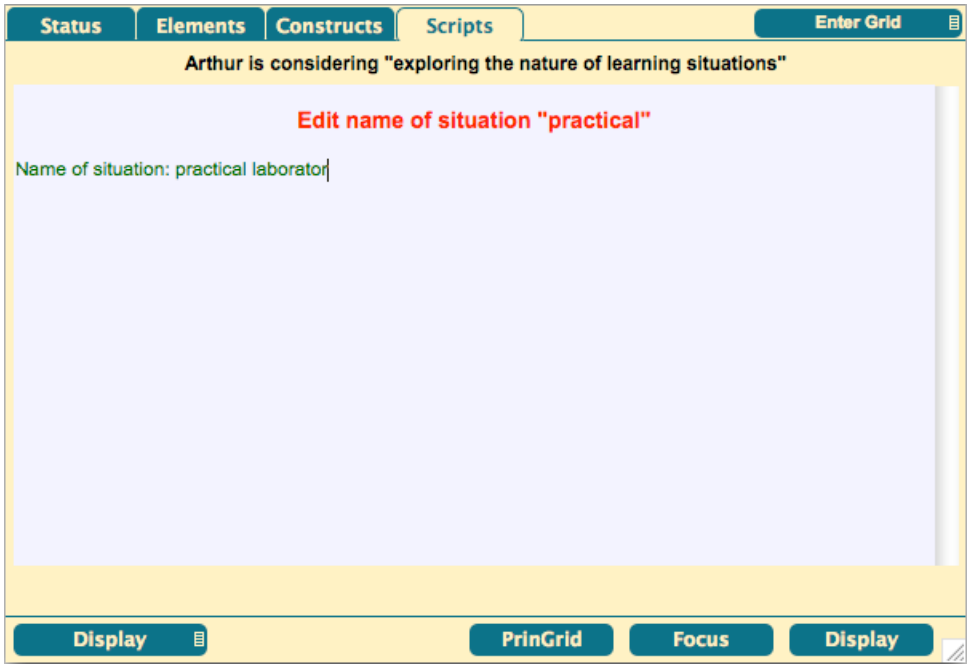
“Enter Grid” script editing a selected element

Clicking on the option to delete the element displays the warning and options below.



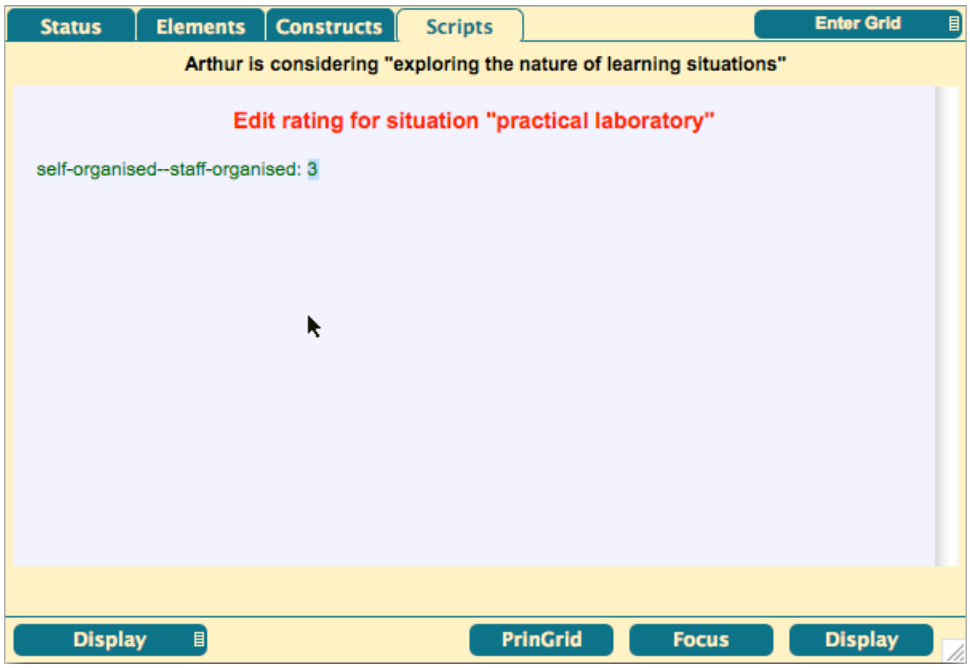
"Enter Grid" script deleting a selected element

Clicking on the name makes it available for editing as shown below.



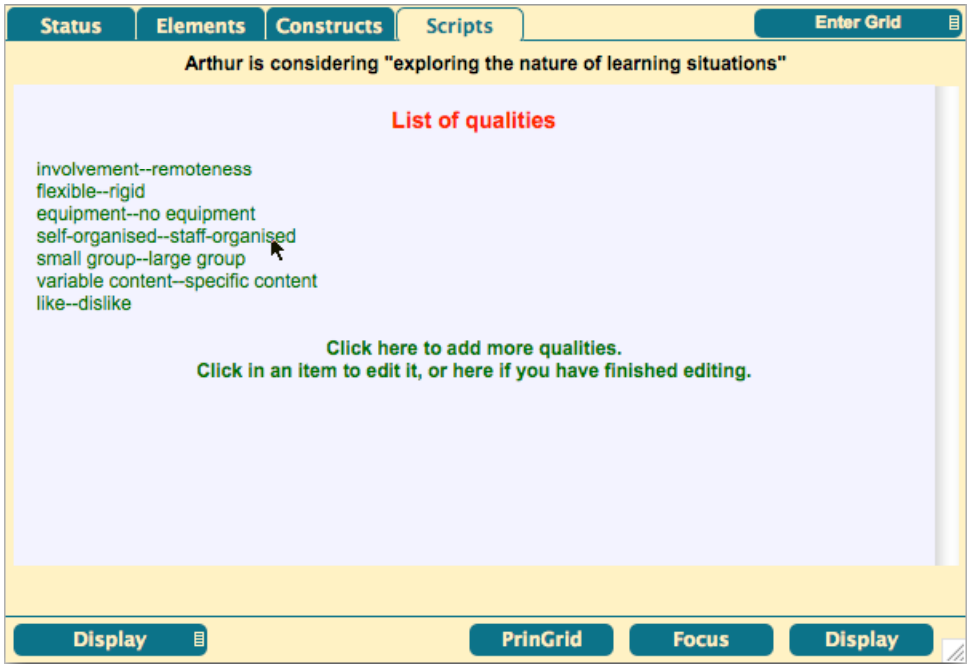
"Enter Grid" script editing an element name

Clicking on a construct makes the rating available for editing as shown below.



"Enter Grid" script editing an element rating on a construct

Similarly, the constructs may be listed for editing as shown below.



"Enter Grid" script list of constructs

Clicking on a construct displays it for editing as shown below. The editing procedures for the pole names and the ratings are essentially the same as those described above for the elements.

"Enter Grid" script editing a selected construct

The grid may also be edited by clicking on the "Status," "Elements" or "Constructs" tab and using editing facilities described in Section 5. If the grid is edited in this way and then the "Scripts" tab is clicked to return to a running script, the script is automatically restarted to show the options so that no incorrect information is displayed on the screen.

Since the script's actions derive from the data in the grid it may be started, restarted or stopped (press "esc" key) at any time. In particular, the grid editing capabilities of the "Enter Grid" script may be used with an existing grid if the user prefers them to those described in Section 5.

6.2 Elicit Grid script

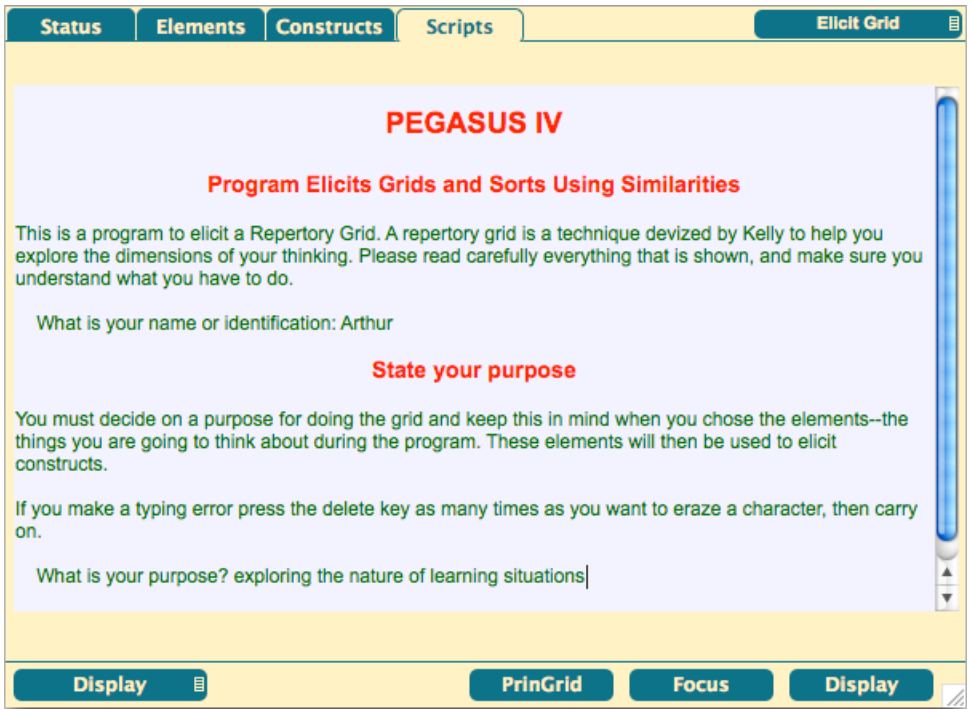
The "Elicit Grid" script emulates the behavior of Shaw's (1980) interactive repertory grid elicitation program, *PEGASUS*. The script is programmed to:-

1. Request missing fields in the "Status" window such as the user's name and the purpose of the elicitation
2. To ask the user to enter six or more elements
3. To elicit constructs from triads of elements until there are four
4. To check element and construct matches and offer the user the opportunity to enter more constructs or elements to break the matches
5. To offer the user the option to elicit more constructs from triads, edit and enter elements or constructs, or to finish the elicitation
6. To ask the user to rate the elements on any given constructs when the elicitation process is finished

7. To modify the elicitation process appropriately to elicit ratings for “exchange” grids in which the elements and constructs are given but the ratings are open, “elements” grids in which the “elements” are given, and “constructs” grids in which the constructs are given.

Once steps 1 through 3 are complete the scripts loop between steps 4 and 5. At any time during the elicitation the user can click on the “Analysis” menu or the “Display,” “Focus,” or “PrinGrid” buttons to display or analyze the grid, and then continue the elicitation.

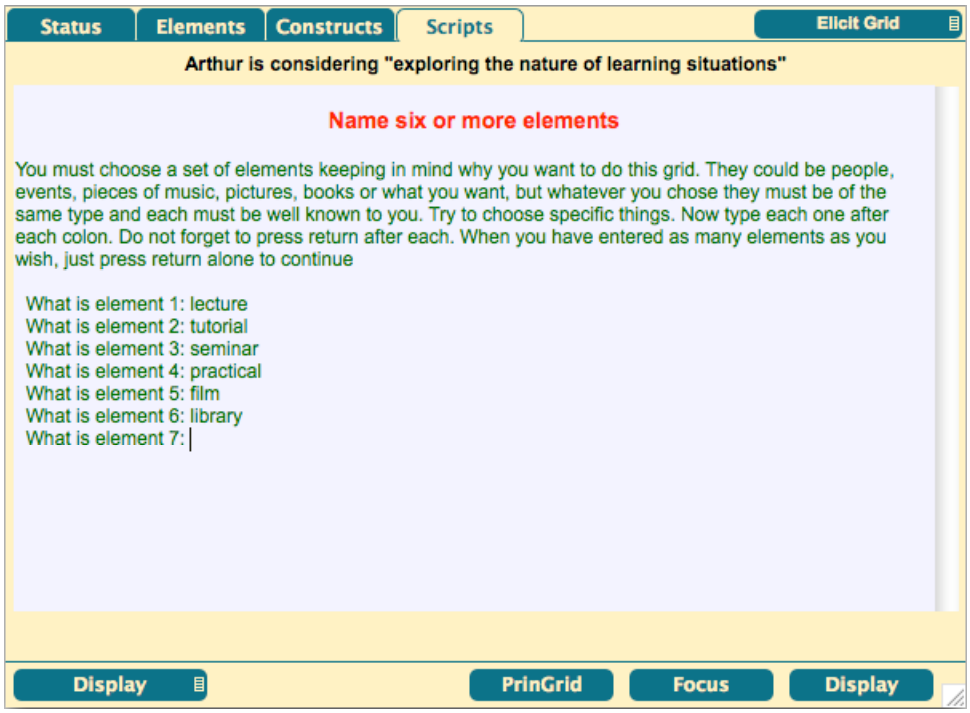
The “Elicit Grid” script operates in a similar way to the “Enter Grid” script except that, as shown below, the interaction is more tutorial with greater explanation.



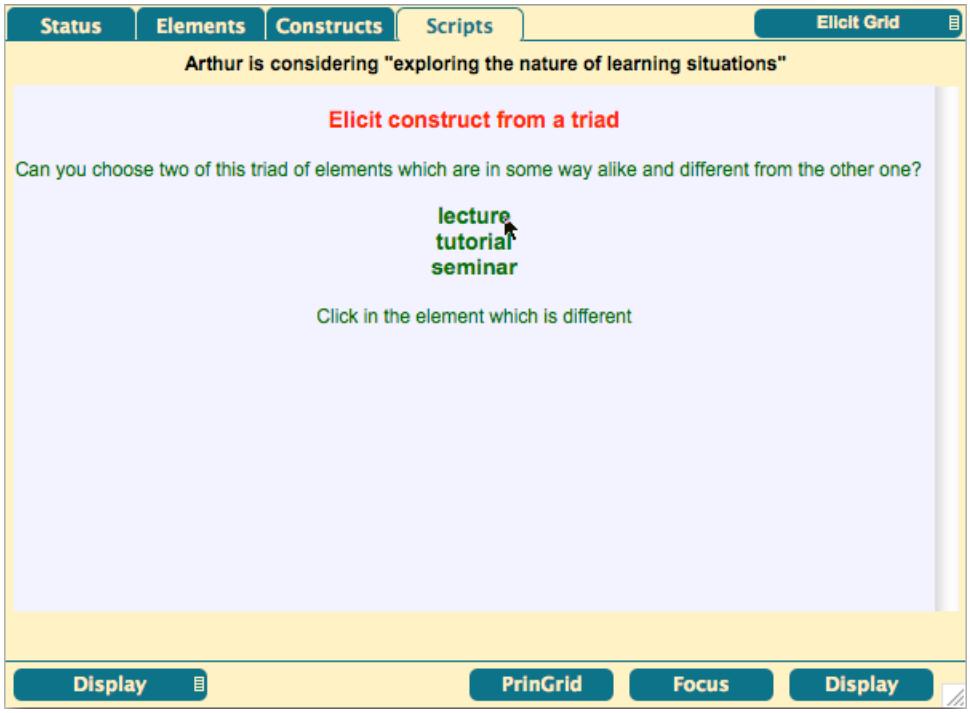
“Elicit Grid” script entering name and purpose

The initial elements are entered in much the same way as for the “Enter Grid” script as shown below. The element elicitation section of the script can be edited to accommodate more specific requests for particular types of element as, for example, might be appropriate to a “role grid” requesting that family members and friends be entered, a core competency grid requesting that employees with different types and levels of skills be entered, or a market research grid requesting that products of certain categories and qualities be entered.

The “Elicit Grid” script differs from the “Enter Grid” script primarily in that it elicits constructs using triadic elicitation in which the user is asked in which way two elements are alike and differ from a third, and in the feedback of element and construct matches to prompt the elicitation of further constructs and elements to reduce the matches (Shaw, 1980).

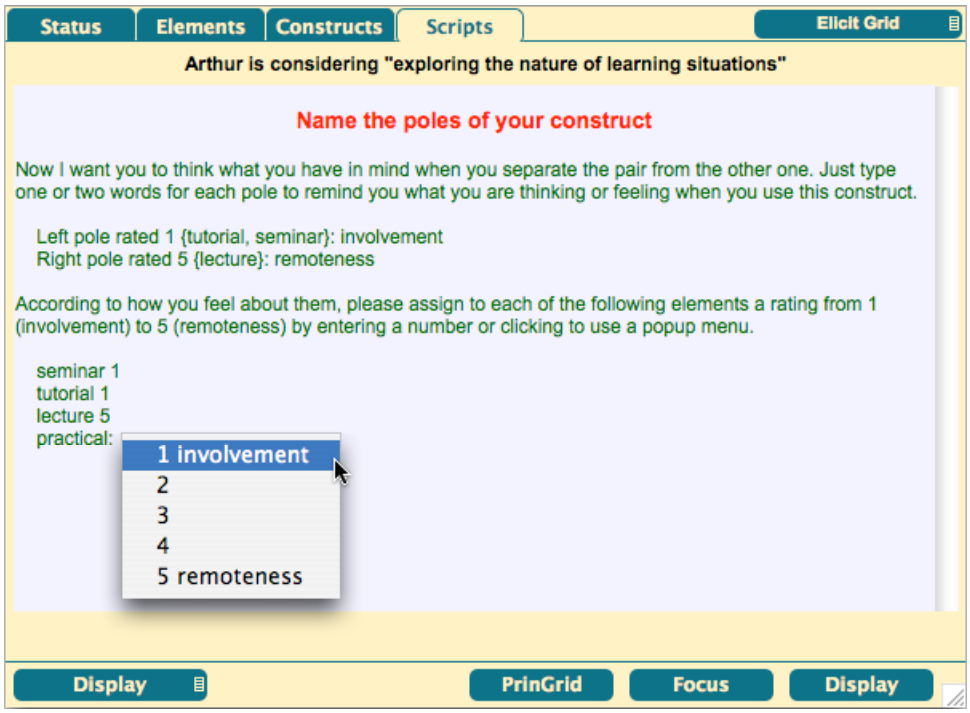


"Elicit Grid" script entering element names



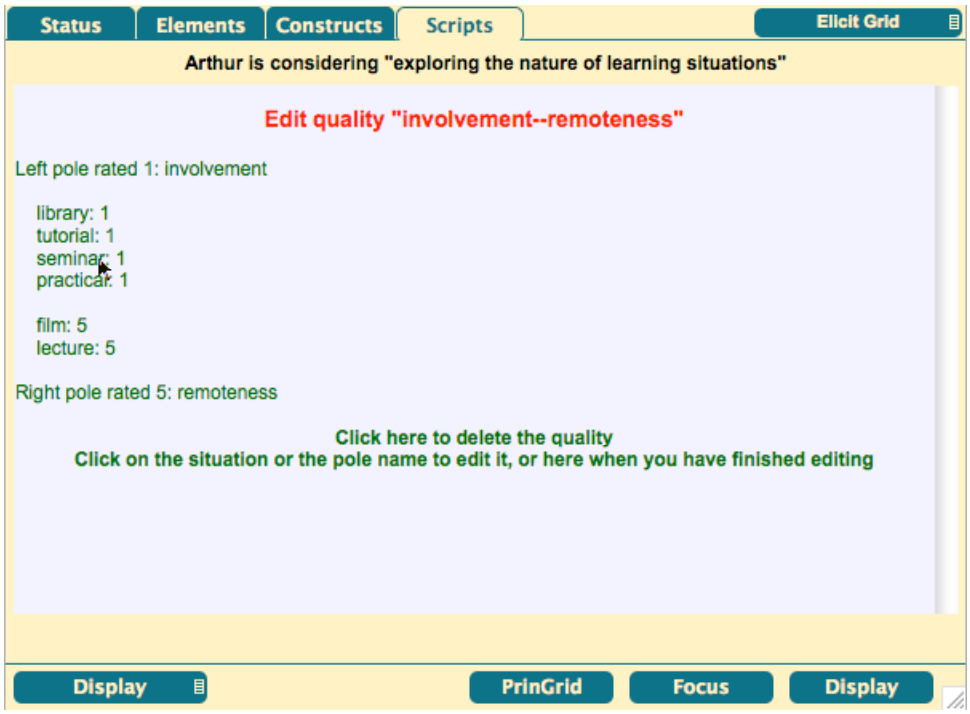
"Elicit Grid" script eliciting a construct from a triad of elements

When the user clicks on an element in the triad the screen below is shown which elicits the construct pole names and ratings.

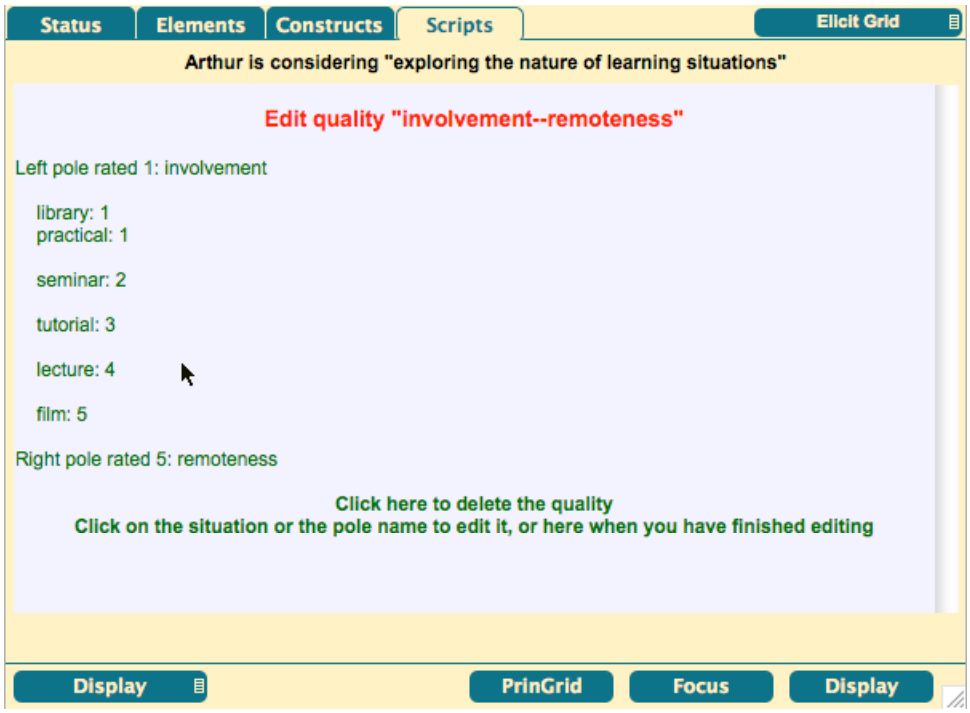


"Elicit Grid" script entering construct pole names and element ratings

When all the elements have been rated the screen below is shown which makes the pole names and ratings available for editing as has been shown for the "Edit Grid" script. Since the process is now one of elicitation rather than data entry it is likely that the user will not be content with the ratings as initially entered and will edit them at this point as shown in the second screen.

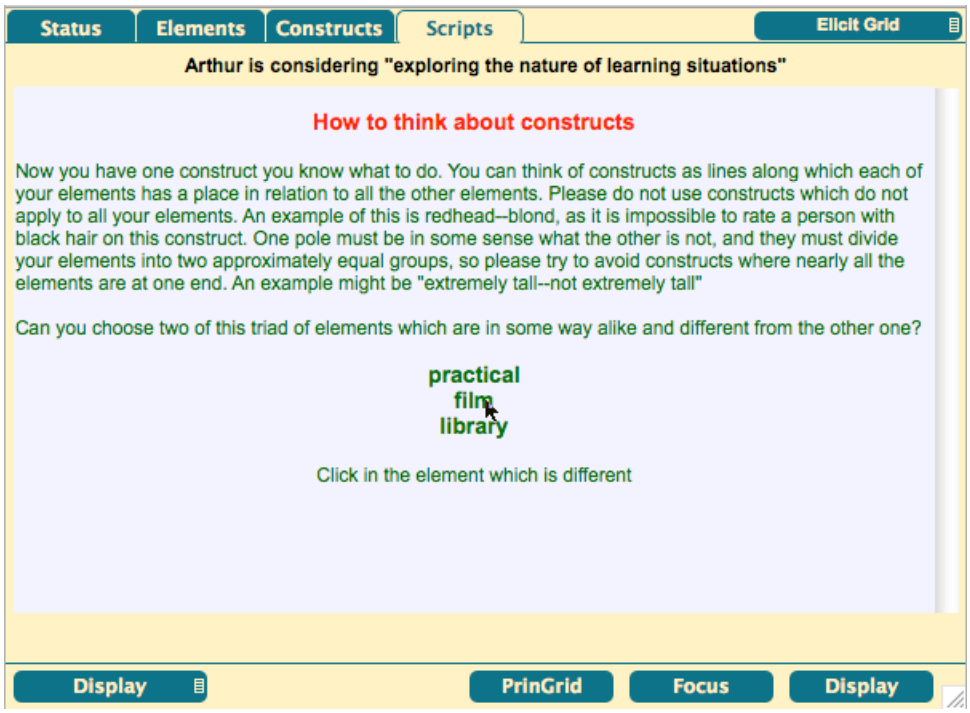


"Elicit Grid" script editing the elicited construct pole names and element ratings



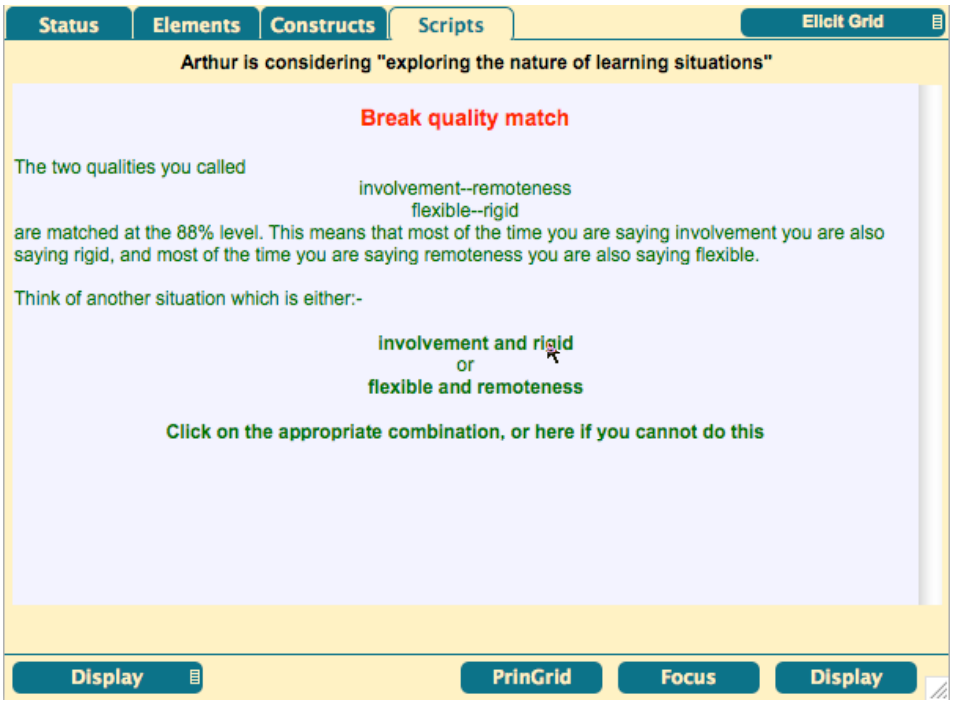
"Elicit Grid" script with the elicited construct pole names and element ratings after editing

Construct elicitation continues with further explanation and another triad of elements as shown below.



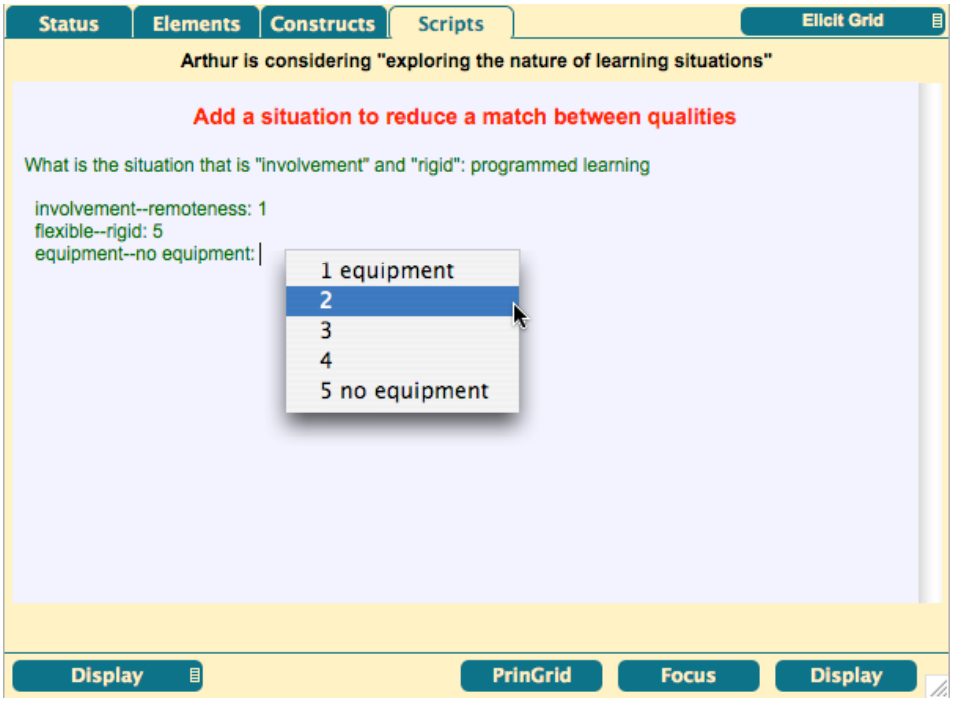
"Elicit Grid" script eliciting a construct from a second triad of elements

When four constructs have been elicited through triads the script tests for matches between constructs and between elements and, if it finds any above eighty per cent, asks the user to enter an element or construct to reduce the match as shown below.



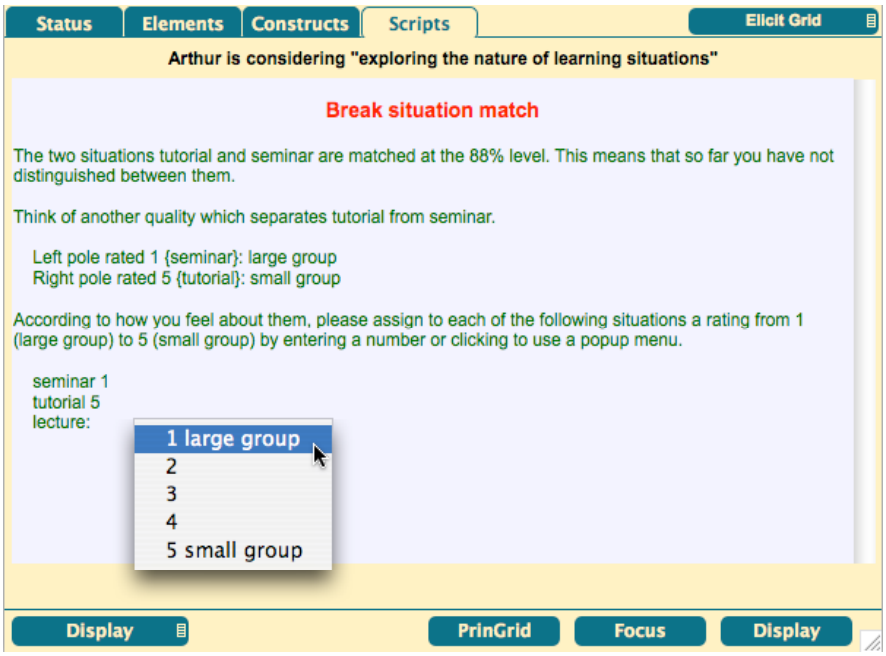
"Elicit Grid" script breaking a construct match

The user clicks on "involvement and rigid," enters a new element "programmed text", and rates it on each of the constructs as shown below.



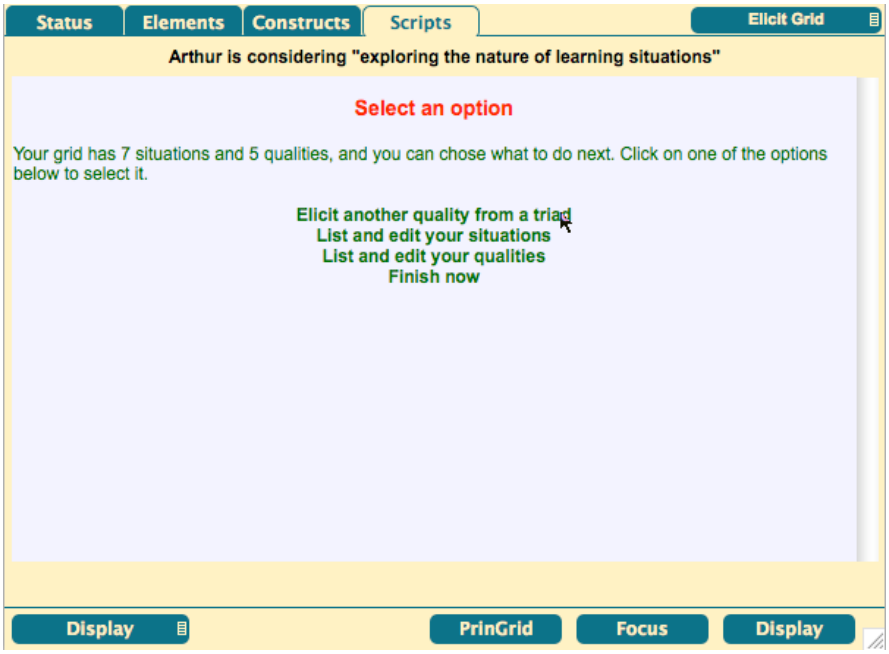
"Elicit Grid" script entering an element to break a construct match

When the new element has been rated the name and ratings can be edited as already shown. The test for matches continues and notes an element match which prompts the elicitation and rating of a new construct as shown below.



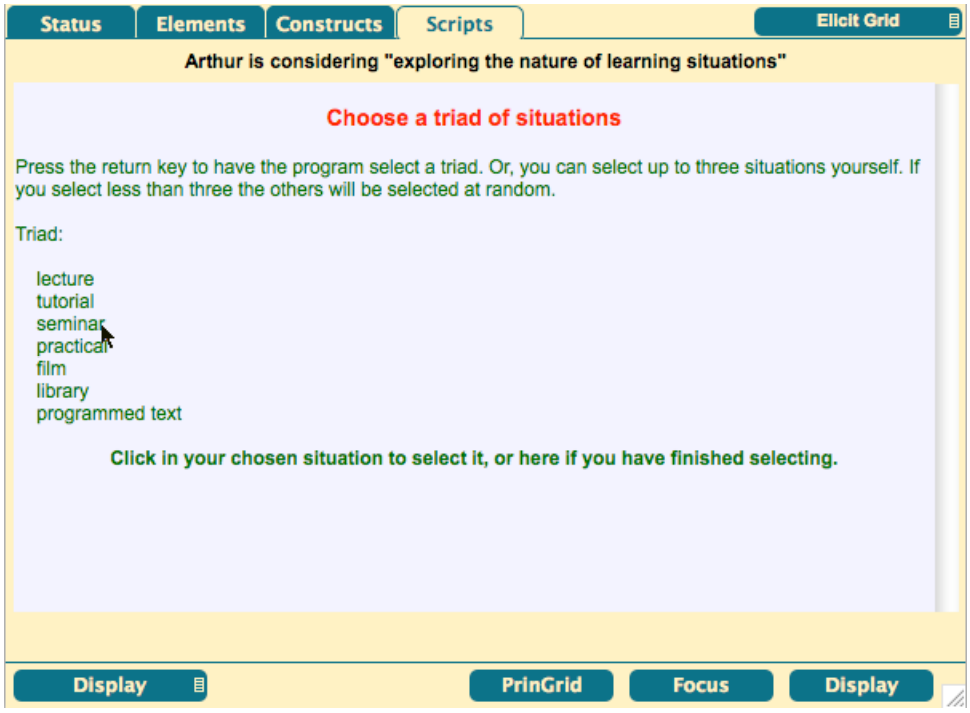
"Elicit Grid" script entering a construct to break an element match

The process continues with a match being found between the constructs "self-organised—staff-organised" and "small-group—large group" which might prompt the elicitation of another element. When there are no further matches various options for further elicitation are listed as shown below.



"Elicit Grid" script options

The options are the same as those for the “Enter Grid” script with the addition of one for triadic elicitation. As shown below selecting this now also provides an option for the user to select some or all the elements of the triad.



“Elicit Grid” script selecting elements for a triad

The user can also use the editing facilities to add and rate elements and constructs directly. The test for matches is applied each time the user enters an item so that further feedback is given if appropriate. This process of elicitation from triads and matches, and entry and editing, proceeds until the user is satisfied that the grid is relatively complete and chooses the option to finish.

Before finishing a check is made for unrated constructs such as “given constructs” provided by the facilitator and the user is asked to rate the elements on these if there are any.

The “Display,” “Focus” and “PrinGrid” buttons may be used during the elicitation to supply an interim analysis of the grid which may itself prompt the entry of further elements and constructs or the editing of the grid.

The “Elicit Grid” script can be run with an existing a grid at any time to elicit further elements or constructs and will automatically skip steps 1, 2 or 3, if the grid already contains the appropriate data. For example, one can prepare a grid for use by others with the purpose specified as “to understand people I know,” with “person” as the term for an element, “people” for elements, “characteristic” for construct, “characteristics” for constructs, and with initial elements “self” and “ideal self.” Running the “Elicit Grid” script set starting with a copy of this grid will result in the user being asked their name, being asked for additional examples of people, having four initial constructs elicited from triads, and then being taken through an elicitation process for further elements and constructs. One can also enter some given constructs such as “powerful—powerless” that capture an important aspect of the purpose of the elicitation, and, as already noted, the script will ask the user to rate the elements on these as they finish.

To facilitate comparison of grids the *Rep IV* manager window (Section 3) allows one to open a copy of an existing grid with the ratings reset to be open ("Exchange") or with the constructs removed ("Elements") or the elements removed ("Constructs"). Another user, or the same user at a later time, can fill in the ratings and add constructs and elements to such grids for comparison with original (Section 7.5). It first requests the user's name. The "Elicit Grid" script supports elicitation commencing with such partial copies of grids. It first requests the user's name and then: with "Exchange" grids it asks the user to rate all the elements on each construct in turn; with "Elements" grids it proceeds immediately to triadic construct elicitation; with "Constructs" grids it requests elements and then asks the user to rate all the elements on each construct in turn. It then offers the normal options.

6.3 Export scripts

Two scripts are supplied which allow the grid data to be exported in formats suitable for use in other applications.

The "Export Text" script writes the grid data into a text window in the basic grid format described in section 11.1.

The "Export Spreadsheet" script writes the grid data into a text window in the tab-delimited grid format described in section 11.2.

The data can then be edited, saved, copied and pasted, or dragged to another application.

6.4 Modifying scripts

The scripts supplied are intended as examples which a facilitator can copy and modify to serve specific requirements and user communities.

Rep IV looks for GridScripts directories both in the application directory and in the "Rep IV" directory where the default files are kept as discussed in Section 3.3. The "Rep IV" directory is intended for scripts developed by the facilitator.

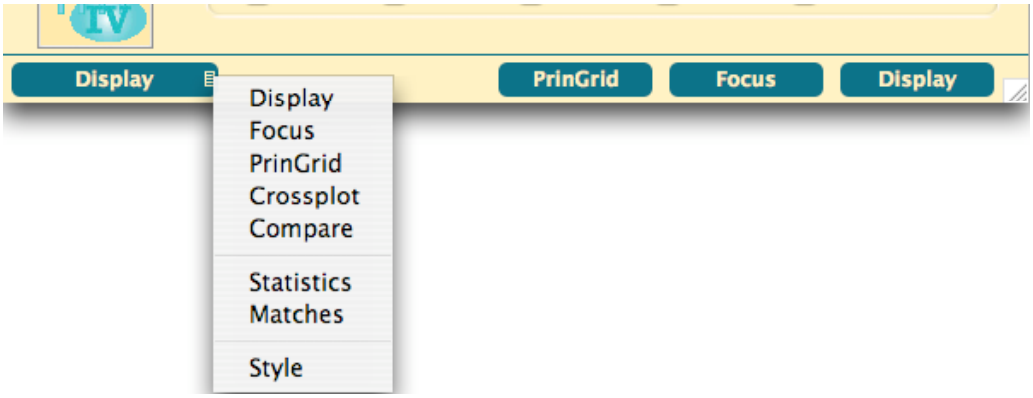
For example, one might copy the "Elicit Grid" scripts from the *Rep IV* application directory, rename them with an appropriate name to appear in the popup menu, and edit the "Main" script to make the initial element elicitation more specific to the purpose, for example, by requesting the names of the user's mother and father, good friend, teachers, and so on.

One might also develop highly specific elicitation procedures for specific purposes such as market research, knowledge management or requirements elicitation.

It is also reasonably straightforward to translate the existing scripts to support conversational elicitation in languages other than English.

7 Grid display and analysis

The analysis button/popup menu and the "PrinGrid," "Focus," and "Display" buttons at the bottom of a RepGrid window provide access to various grid analysis functions which will be described in the following sections.

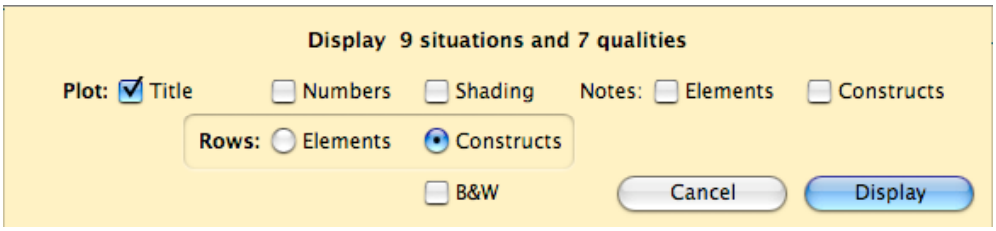


RepGrid "Analysis" menu

Clicking in the arrow on the right of the button at the bottom left (or right-clicking anywhere in the button) brings up a popup menu enabling the analysis tool name shown in the button to be selected. Clicking in the analysis tool name itself brings up a dialog window providing control over the analysis parameters that are stored as part of the grid data. The buttons to the right activate the most common analyses instantly, using their current parameters.

7.1 Display

Clicking on "Display" in the analysis button brings up the dialog shown below.

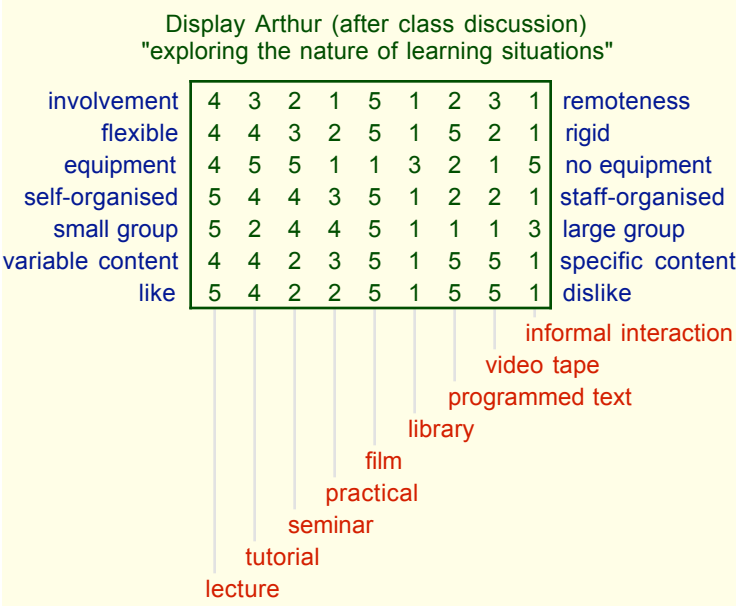


RepGrid "Display" dialog

The row of check boxes at the top determine whether the plot is titled, whether the elements and constructs are numbered, whether the ratings are shaded (to indicate the top third of high values and bottom third of low values), and whether the notes attached to elements and/or constructs are shown.

The "Rows" sub-panel determines whether the matrix of grid data is displayed with elements or constructs as rows. The "B&W" check box puts out the display in black and white which may be useful with certain printers, otherwise the color scheme set up through the "Style" menu is used (Section 7.8).

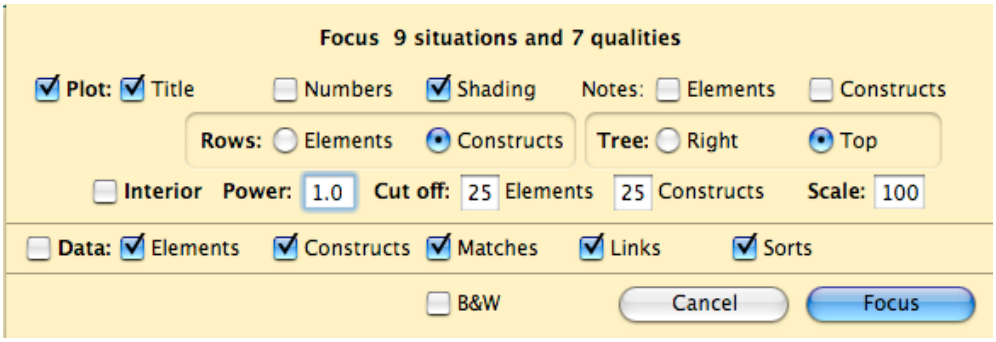
Below is the plot produced when you press the "Display" button with the settings above. The title, constructs, elements and ratings are shown. The plot may be saved as a net and edited in RepNet (Section 8).



RepGrid graphic display of the data in the grid

7.2 Focus sorting and hierarchical clustering

Clicking on "Focus" in the analysis button brings up the dialog shown below.



RepGrid "Focus" dialog

The row of check boxes at the top determine whether a graphic plot is produced, whether it is titled, whether the elements and constructs are numbered, whether the ratings are shaded (to indicate the top third of high values and bottom third of low values), and whether the notes attached to elements and/or constructs are shown.

The "Rows" sub-panel determines whether the matrix of grid data is displayed with elements or constructs as rows. The "Tree" sub-panel determines whether Focus cluster tree for the columns is shown at the top of the grid or at the lower right.

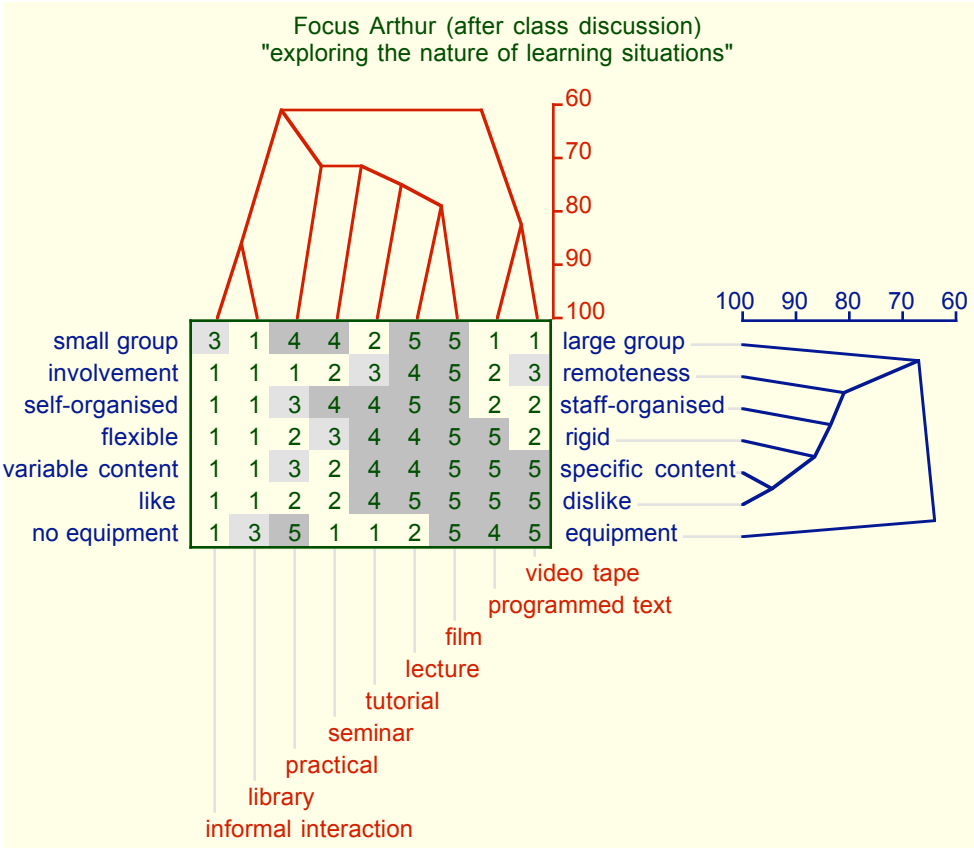
The "Interior" check box controls the Focus matching strategy. Leaving it unchecked specifies the standard Focus algorithm in which items are matched only against the items at the edges of existing clusters. This sometimes leads to items with a high match to interior items being shown as having a lower match to an edge item. Checking the "Interior" check box allows Focus to match against interior items in an existing cluster; it then displays the interior match and places the item at the edge of that cluster that has highest match to the item.

The “Power” value determines the exponent used in the *Minkowski metric* used to compute matching scores (Shaw, 1980 p.160). The default (and generally recommended) power of 1.0 defines the standard *city block metric* normally used in the Focus algorithm. A power of 2.0 defines a *Euclidean metric*. Fractional powers in the range 0.1 to 10.0 may be used; a higher power weights larger differences more than smaller ones, and vice versa.

The “Cut off” values determine the level of match below which an element or construct cluster will not be shown. The “Scale” value determines how much space will be allocated to the trees showing the cluster hierarchies.

The row of check boxes near the bottom determine whether a textual analysis is produced, whether the element and construct data are output, and whether match matrices, cluster links, and sorts are output. The “B&W” check box puts out the display in black and white which may be useful with certain printers, otherwise the color scheme set up through the “Style” menu is used (Section 7.8).

Below is the graphic plot produced when you press the “Focus” button with the settings above. The plot may be saved as a net and edited in RepNet (Section 8).



RepGrid graphic plot of a “Focus” cluster analysis of the grid

The grid has been sorted to bring closely matching elements together, and closely matching constructs together. This manual does not cover the interpretation of grid analyses but there several books that do so (Shaw, 1980; Shaw, 1981; Shaw and McKnight, 1981; Denicolo and Pope, 2001; Jankowicz, 2003). Below is the textual output of the data underlying the plot.

Element Matches

	*	1	2	3	4	5	6	7	8	9	
1	*	100	75	61	46	79	21	54	50	29	lecture
2	*	75	100	71	50	54	39	64	61	46	tutorial
3	*	61	71	100	71	39	54	43	39	68	seminar
4	*	46	50	71	100	46	61	50	61	61	practical
5	*	79	54	39	46	100	7	61	57	7	film
6	*	21	39	54	61	7	100	46	50	86	library
7	*	54	64	43	50	61	46	100	82	32	programmed text
8	*	50	61	39	61	57	50	82	100	36	video tape
9	*	29	46	68	61	7	86	32	36	100	informal interaction

Construct Matches (values on diagonal and below are for reverse match)

	*	1	2	3	4	5	6	7	
1	*	39	81	53	81	67	78	78	involvement--remoteness
2	*	42	33	50	83	64	86	86	flexible--rigid
3	*	58	56	22	56	53	36	36	equipment--no equipment
4	*	42	39	50	33	81	75	75	self-organised--staff-organised
5	*	44	53	47	36	28	56	56	small group--large group
6	*	39	36	69	47	61	28	94	variable content--specific content
7	*	33	31	64	42	61	22	17	like--dislike

Element Links

6	9	85.7
7	8	82.1
1	5	78.6
1	2	75.0
2	3	71.4
3	4	71.4
4	6	60.7
5	7	60.7

Construct Links

6	7	94.4
2	6	86.1
2	4	83.3
1	4	80.6
1	5	66.7
7	3 R	63.9

Element Sort

9	6	4	3	2	1	5	7	8

Construct Sort

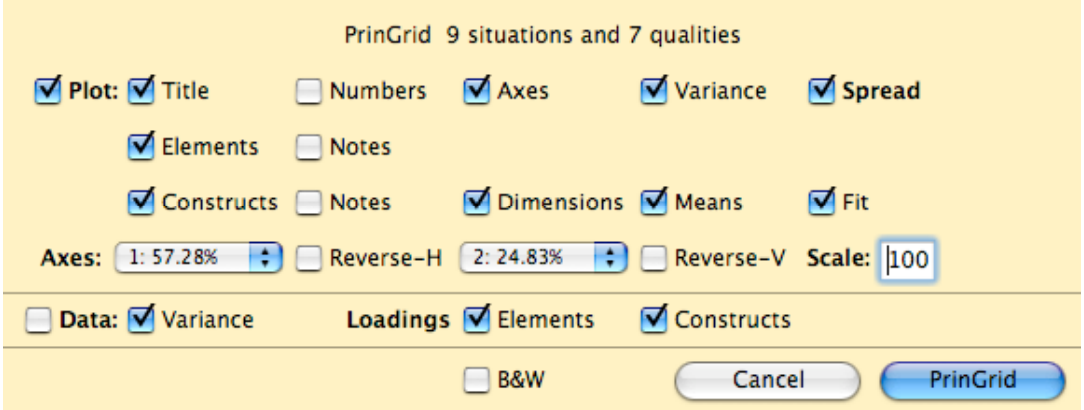
5	1	4	2	6	7	3R

RepGrid data from a "Focus" cluster analysis of the grid

The element and construct "Matches" are shown as a percentage of the maximum possible match, and it should be noted that the values on the diagonal and below it in the construct match matrix correspond to the match when one of the constructs is reversed in its values. The "Links" data corresponds to the clusters in the plot. The "R" indicates that the Focus algorithm has reversed construct 3 in determining the highest matches. The "Sort" data indicates how the algorithm has sorted the grid data to produce the Focus plot.

7.3 PrinGrid spatial rotation

Clicking on "PrinGrid" in the analysis button brings up the dialog shown below.



RepGrid "PrinGrid" dialog

The row of check boxes at the top determine whether a graphic plot is produced, whether it is titled, whether the elements and constructs are numbered, whether the component axes are shown, whether the percentage variance attributable to each component will be shown at the bottom of the plot, and whether the element and construct pole names are spread out automatically to avoid overlap (you can also drag them to different positions in the plot itself).

The row of check boxes below it whether the elements and the element notes are plotted.

The row of check boxes below it whether the constructs and the construct notes are plotted, and whether the construct dimensions are shown as a line between the poles.

The "Means" check box determines whether the construct pole positions are symmetrical about the origin or whether they are placed such that the mean of the element values on the construct is at the origin. This option is useful to allow the plot to allow the plot to convey information about the asymmetrical use of a construct. It maximizes the information conveyed in that the angles between dimensions convey the correlations between them, the length of each conveys the combined loadings on the components plotted, and the position of the center conveys the mean element value.

The "Fit" check box determines whether the construct pole positions will be scaled to have the same maximum position as the element positions. This is a useful option for grids with large numbers of constructs as the geometry of the analysis tends to project the element outside the hypercube formed by the constructs. Since only the relative direction of the construct dimensions is meaningful, not the absolute position of the poles, this scaling has no effect on the interpretation of the analysis.

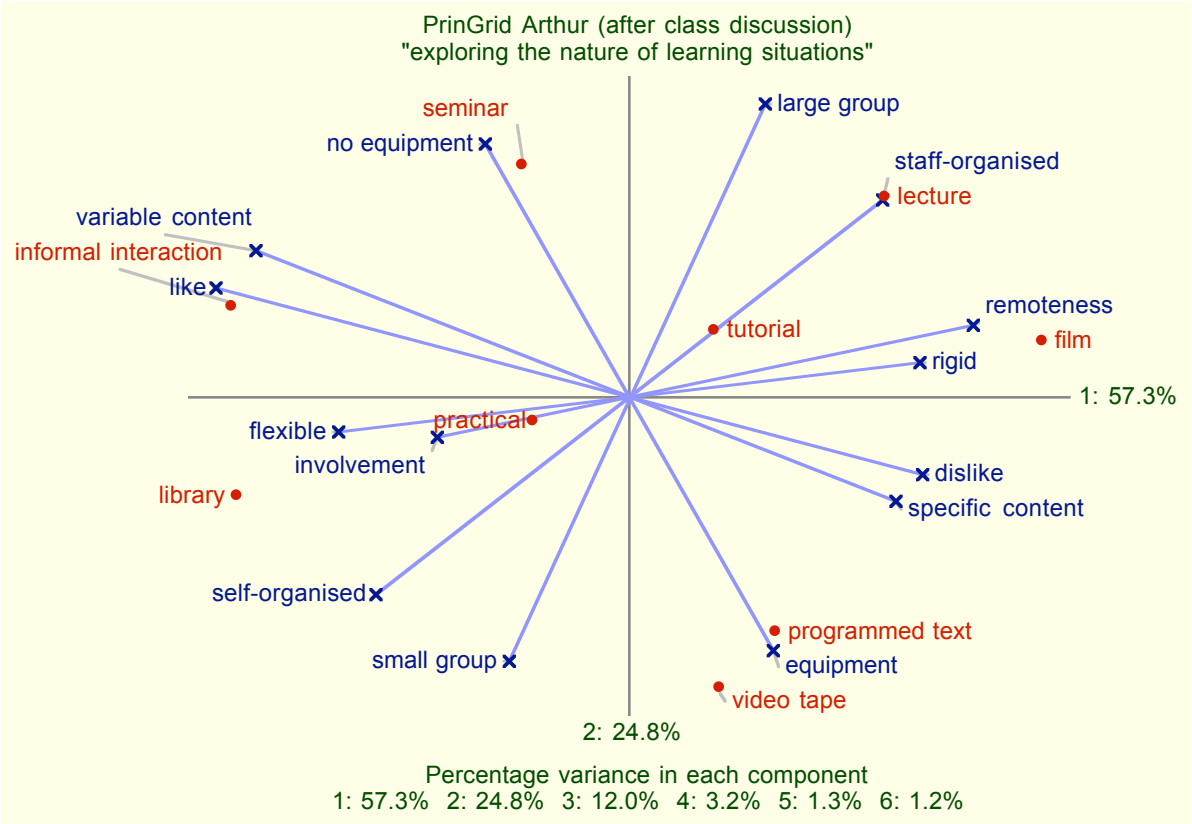
The "Axes" menus show the principal components with the percentage variance for which each accounts, and are used to select which components are plotted on the horizontal and vertical axes. The associated "Reverse" check boxes allow the plot to be reversed horizontally and vertically. These are useful options if multiple PrinGrid analyses are to be compared as they enable one to show the elements in similar quadrants in successive plots to the extent that this is possible (the quadrant placement is otherwise arbitrary).

The "Scale" value determines how much space will be allocated to the plot. This is a useful option for larger grids to make more space for the labels and prevent then being spread too far from their original positions.

The row of check boxes near the bottom determine whether a textual analysis is produced, whether the percentage variances for the components are output, whether the element and construct loadings on the components are output.

The "B&W" check box puts out the display in black and white which may be useful with certain printers, otherwise the color scheme set up through the "Style" menu is used (Section 7.8).

Below is the plot produced when you press the "PrinGrid" button with the settings above. The plot may be saved as a net and edited in RepNet (Section 8).



RepGrid graphic plot of a "PrinGrid" spatial analysis of the grid

The grid has been treated as if the elements were points plotted in an n-dimensional space defined by the constructs as axes centered on the means of the elements. The data has then been rotated through principal components analysis to spread the elements out as much as possible in a 2-dimensional plot. Slater (1976; 1977) is the definitive work on such analysis of grids. Joliffe (1986) is a good general source on principal components analysis. Gower (1966) is the definitive work on the spatial model involved, and Gower and Hand (1995) on the presentation of the analysis as a *biplot*.

The title, element names and construct pole names in the PrinGrid plot are nodes in a net that may be dragged to different positions to make the plot more readable. RepGrid places them so they do not overlap one another and connects the text to the locations on the plots with a line that

will redraw as you change the positions of the text so that the spatial data presented is not distorted.

Below is the textual output of the data underlying the plot. Note if comparing the data with other principal components analyses that the absolute values of the loadings produced are arbitrary and depend on how the grid data has been scaled. Only the relative values are meaningful.

As a technical note, PrinGrid carries out an analysis of the double-centred matrix of distances between elements with all construct ranges scaled to be the same (because RepGrid supports grids with constructs having differing ranges). As Gower (1966) shows, this is equivalent to a principal components analysis of the construct variance matrix which is the basis of most grid analysis packages emulating Slater's (1976; 1977) "Ingrid."

Percentage Variance in Each Component

1	2	3	4	5	6	
57.28	24.83	12.03	3.22	1.28	1.18	%
57.28	82.11	94.14	97.36	98.64	99.82	Cumulative %

Element Loadings on Each Component

	*	1	2	3	4	5	6	
1	*	1.54	1.22	-0.11	0.30	0.23	-0.06	lecture
2	*	0.53	0.41	-1.20	0.00	-0.11	0.30	tutorial
3	*	-0.65	1.40	-0.18	-0.21	-0.06	0.16	seminar
4	*	-0.59	-0.16	1.38	-0.37	0.22	0.28	practical
5	*	2.48	0.35	0.81	0.02	-0.33	-0.24	film
6	*	-2.36	-0.60	0.09	0.08	-0.43	-0.01	library
7	*	0.88	-1.42	-0.72	-0.68	0.12	-0.20	programmed text
8	*	0.56	-1.75	0.05	0.67	0.12	0.14	video tape
9	*	-2.39	0.55	-0.12	0.18	0.23	-0.37	informal interaction

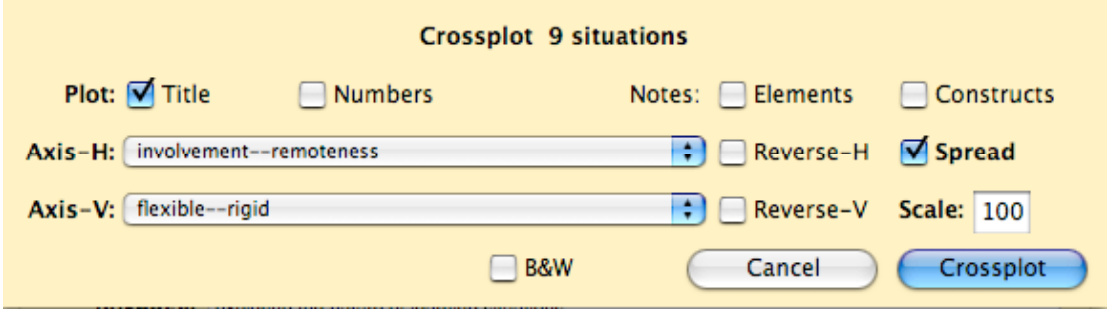
Construct Loadings on Each Component

	*	1	2	3	4	5	6	
1	*	1.81	0.38	-0.07	0.65	-0.39	-0.23	involvement--remoteness
2	*	1.96	0.24	-0.58	-0.84	-0.19	-0.22	flexible--rigid
3	*	-0.99	1.70	-1.61	0.15	0.16	-0.01	equipment--no equipment
4	*	1.70	1.33	0.18	-0.03	-0.17	0.51	self-organised--staff-organised
5	*	0.87	1.87	1.16	-0.03	0.30	-0.23	small group--large group
6	*	2.14	-0.86	-0.18	-0.01	0.28	0.17	variable content--specific content
7	*	2.37	-0.64	-0.53	0.30	0.28	-0.08	like--dislike

RepGrid data from a "PrinGrid" principal components analysis of the grid

7.4 Crossplot

Clicking on "Crossplot" in the analysis button brings up the dialog shown below which allows the elements to be plotted in two-dimensions with two selected constructs as axes.



RepGrid "Crossplot" dialog

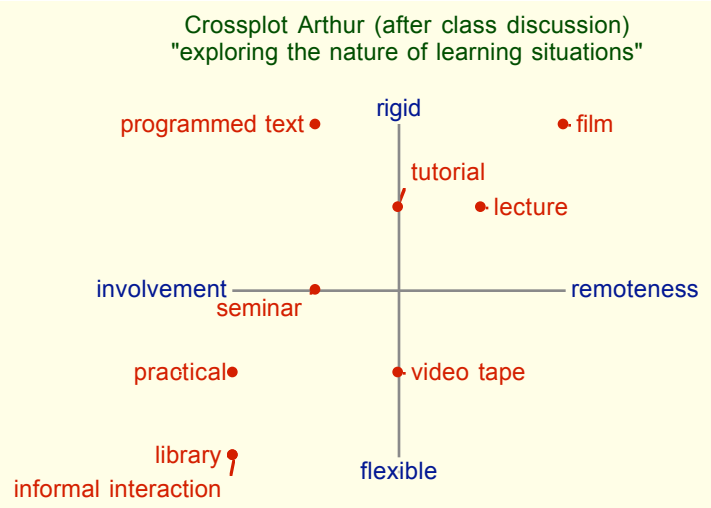
The row of check boxes at the top determine whether the plot is titled, whether the elements and constructs are numbered, and whether the notes attached to elements and/or constructs are shown.

The row below allows the construct for the horizontal axis to be selected, followed by a check box determining whether it is reversed. The "Spread" check box determines whether the element and construct pole names are spread out automatically to avoid overlap (you can also drag them to different positions in the plot itself).

The row below allows the construct for the vertical axis to be selected, followed by a check box determining whether it is reversed. The "Scale" value determines how much space will be allocated to the plot.

The "B&W" check box puts out the display in black and white which may be useful with certain printers, otherwise the color scheme set up through the "Style" menu is used (Section 7.8).

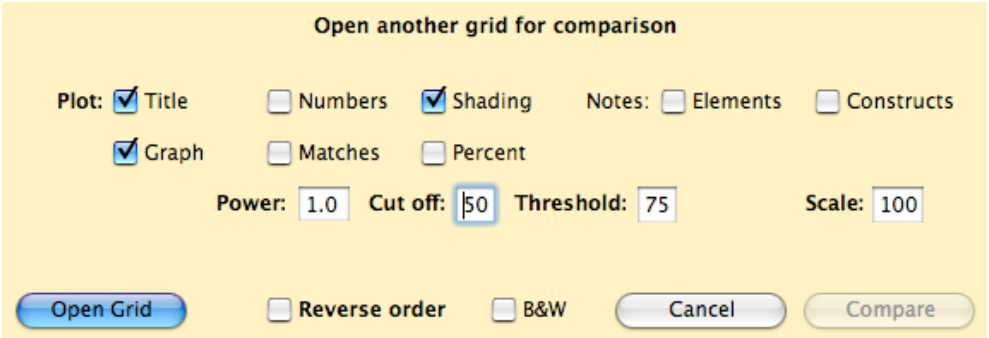
Below is the plot produced when you press the "Crossplot" button with the setting above. The plot may be saved as a net and edited in RepNet (Section 8).



RepGrid graphic crossplot of the elements on two selected constructs

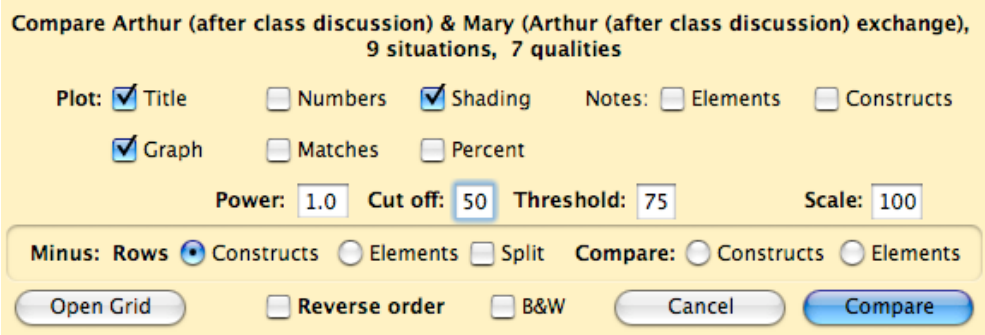
7.5 Compare

Clicking on "Compare" in the analysis button brings up the dialog shown below which allows the current grid to be compared with a selected one having elements in common with it.



RepGrid "Compare" dialog

The “Open Grid” button at the bottom left is highlighted, and the “Compare” button on the left is disabled, because one needs to open a second grid for comparison before proceeding with the analysis. Clicking on the “Open Grid” button brings up a standard file open dialog where one can open a secondary grid for comparison that has elements or constructs in common with the primary grid. Below is shown the dialog when an “exchange” grid having both elements and constructs in common is opened.



“Compare” dialog — grid with same elements and constructs opened for comparison

The text at the top notes the grids being compared and the number of elements and constructs they have in common. Note that determining common elements across grids is based on equality of the element names, and common constructs on the equality of the rating scale range, pole names and construct name (if any). Hence a grid being compared **should not have two or more elements with the same name or two or more constructs that are equal on the above criterion**. Note also that in comparing grids the presupposition that elements and/or constructs are “the same” in some sense is a very strong one and needs careful consideration and justification if the analysis is to be meaningful.

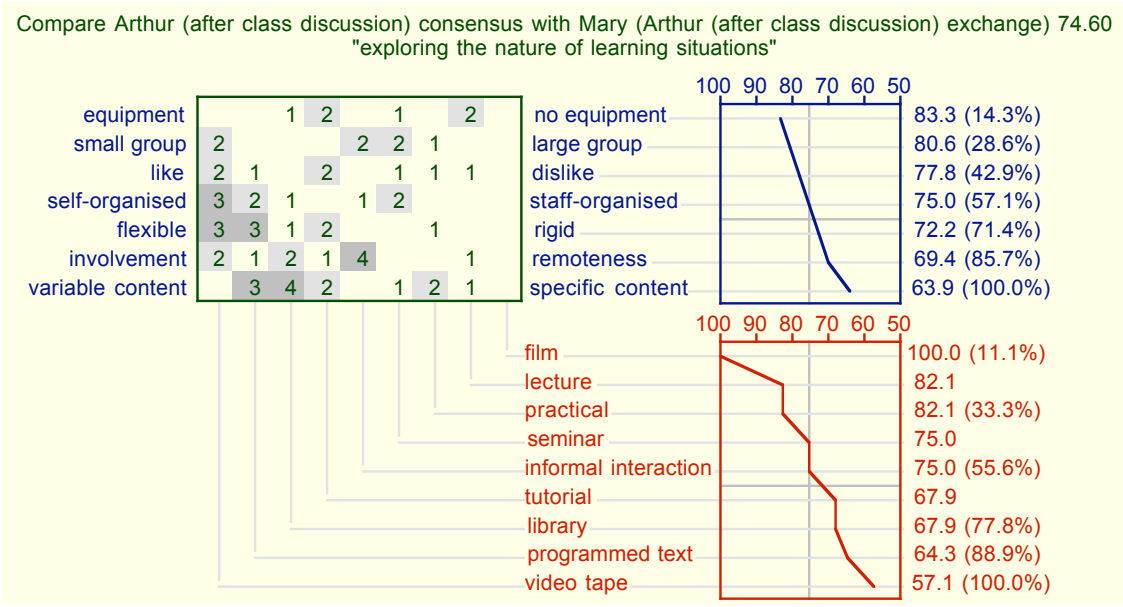
The row of check boxes at the top determine whether the plot is titled, whether the elements and constructs are numbered, and whether high and low differences are shaded. The “Power” value determines the exponent used in the *Minkowski metric* used to compute matching scores as discussed in Section 7.2. The “Threshold” value determines where in the plot matches will be shown as below threshold.

The row below determines whether the matches will be graphed, whether the match values will be shown, and whether the cumulative percentage of matches above or equal to the match value will be shown. The “Cut off” value specifies the lowest match that will be plotted. The “Scale” value determines how much space will be allocated to the plot.

The panel below is only visible if the options in it are applicable. The four radio buttons select whether a “Minus” plot of the difference grid is required and, if so, whether the rows should be constructs or elements, or whether a “Compare” plot is required where the best matching constructs or elements are shown. The “Split” check box determines whether a “Minus” plot shows the difference in ratings or the actual ratings on separate lines (“Compare” plots always use separate lines).

The normal mode of comparison is that the primary grid is compared with the secondary grid, and the “Reverse order” check box reverses this. The “B&W” check box puts out the display in black and white which may be useful with certain printers, otherwise the color scheme set up through the “Style” menu is used (Section 7.8).

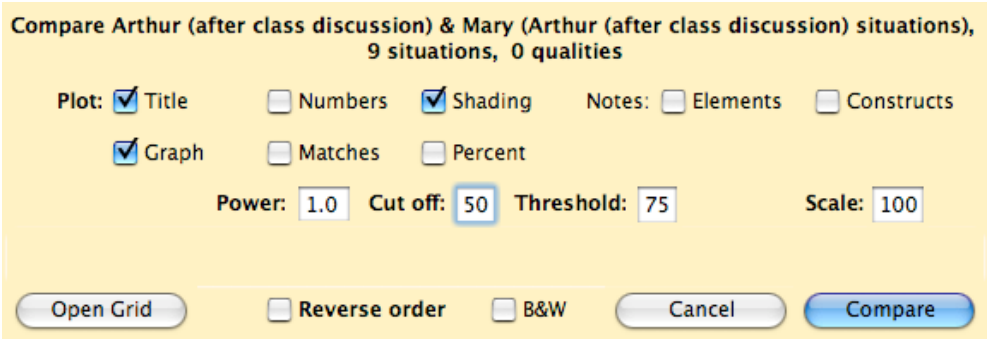
Below is the plot produced when you press the "Compare" button with the settings above. The plot may be saved as a net and edited in RepNet (Section 8). On the left it shows the absolute difference between the ratings in the two grids with the constructs and elements sorted so that those that are most similar in the two grids are the top and on the left, respectively. The number on the right of the first line of the title is the overall match between the two grids. If the power is set to 1.0 it corresponds to both the mean construct match and the mean element match.



RepGrid graphic plot comparing two grids with the same elements and constructs

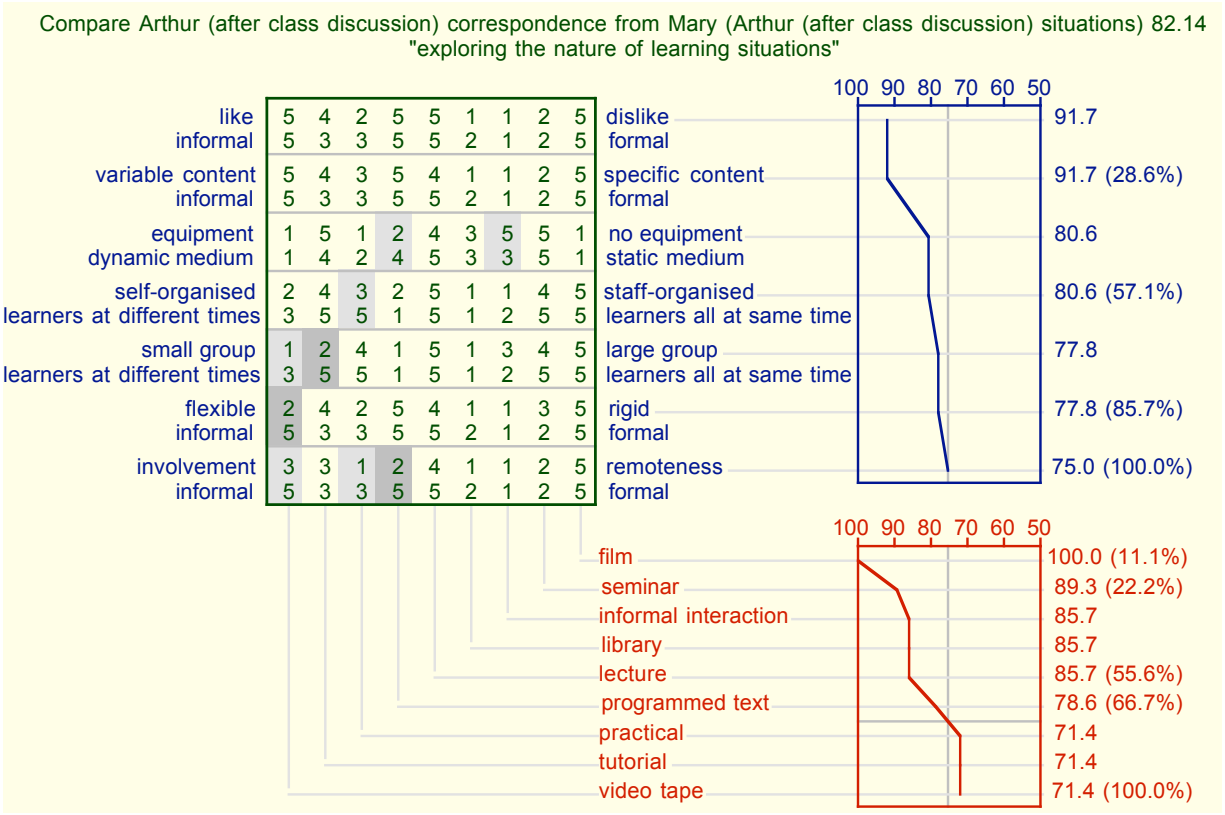
The graphs on the right provide a plot of the individual construct and element matches between the grids being compared. The numbers on the right show the numeric match value and, in parentheses, the cumulative percentage of items matching at that value or greater.

Below is shown the "Compare" dialog when a grid having the same elements but different constructs is opened for comparison.



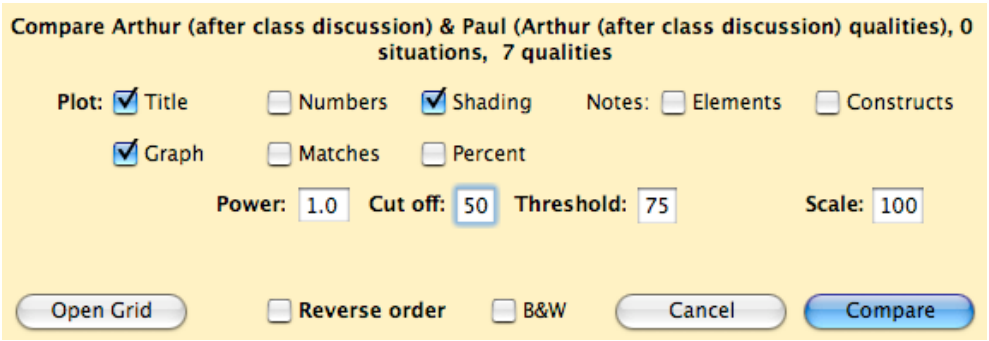
"Compare" dialog — grid with same elements and different constructs opened

Below is the plot produced when you press the "Compare" button with the settings above. Each of the constructs in the primary grid is shown with the best matching construct in the secondary grid on the line below it. Element differences have also been computed based on the two grids of matching constructs, and constructs and elements have been sorted so that those that are most similar in the two grids are the top and on the right, respectively.



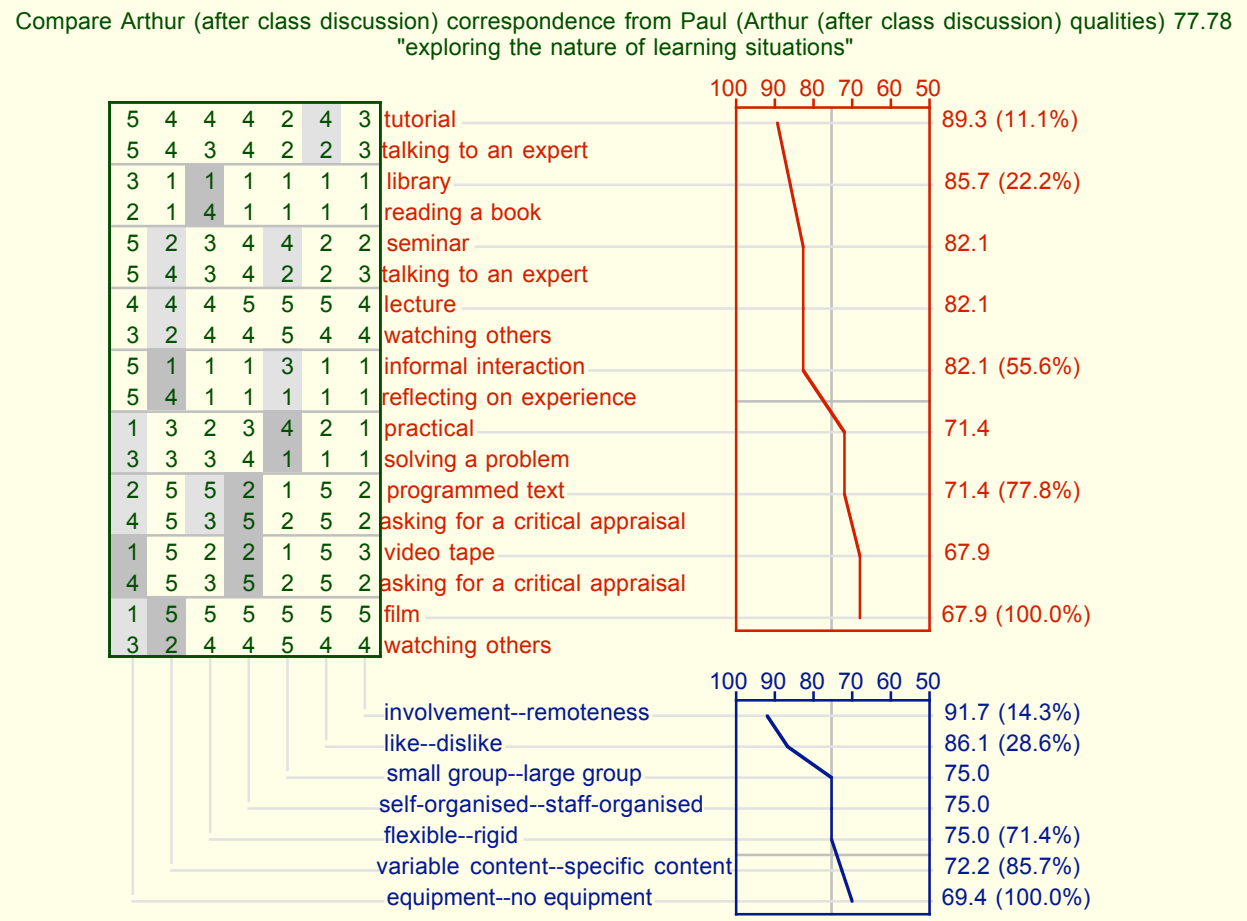
RepGrid graphic plot comparing two grids with the same elements

Below is shown the "Compare" dialog when a grid having the same constructs but different elements is opened for comparison.



"Compare" dialog — grid with same constructs and different elements opened

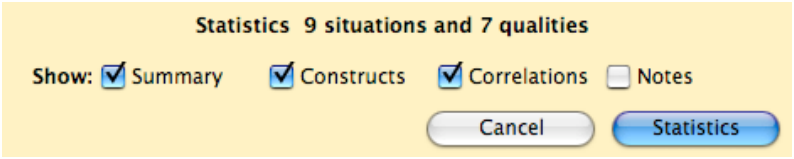
Below is the plot produced when you press the "Compare" button with the settings above. Each of the elements in the primary grid is shown with the best matching element in the secondary grid on the line below it. Construct differences have also been computed based on the two grids of matching elements, and elements and constructs have been sorted so that those that are most similar in the two grids are the top and on the right, respectively.



RepGrid graphic plot comparing two grids with the same constructs

7.6 Statistics

Clicking on “Statistics” in the analysis button brings up the dialog shown below.



RepGrid “Statistics” dialog

The row of check boxes determine whether a summary is output, whether the rating scale range, minimum and maximum values, and standard deviations of constructs are shown, whether the constructs correlation matrix is shown, and whether the construct note field is shown as part of its name. Below is the textual output produced when you press the “Statistics” button with the settings above.

Statistics for Arthur (after class discussion)

9 Elements (situations) 7 Constructs (qualities)

Construct Statistics

	Range,		Min	Max,	Mean,	S.D.	Construct
1:	1	5	1	5	2.4	1.3	involvement--remoteness
2:	1	5	1	5	3.0	1.5	flexible--rigid
3:	1	5	1	5	3.0	1.7	equipment--no equipment
4:	1	5	1	5	3.0	1.5	self-organised--staff-organised
5:	1	5	1	5	2.9	1.6	small group--large group
6:	1	5	1	5	3.3	1.6	variable content--specific content
7:	1	5	1	5	3.3	1.7	like--dislike

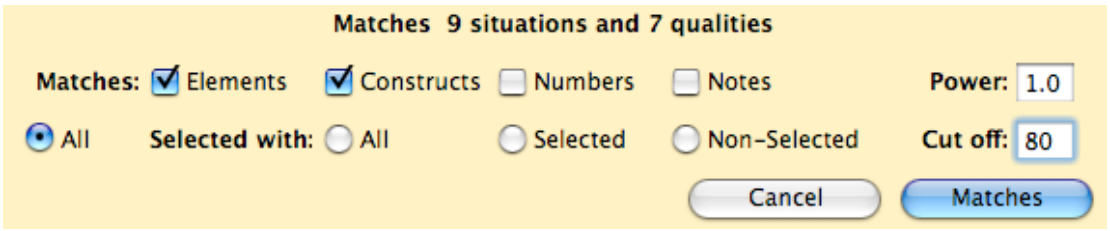
Construct Correlations

*	1	2	3	4	5	6	7	
1 *	1.00	0.72	-0.19	0.78	0.44	0.72	0.81	involvement--remoteness
2 *	0.72	1.00	-0.13	0.70	0.28	0.76	0.79	flexible--rigid
3 *	-0.19	-0.13	1.00	0.04	0.08	-0.54	-0.38	equipment--no equipment
4 *	0.78	0.70	0.04	1.00	0.75	0.48	0.53	self-organised--staff-organised
5 *	0.44	0.28	0.08	0.75	1.00	0.01	0.05	small group--large group
6 *	0.72	0.76	-0.54	0.48	0.01	1.00	0.96	variable content--specific content
7 *	0.81	0.79	-0.38	0.53	0.05	0.96	1.00	like--dislike

RepGrid summary statistics for the grid

7.7 Matches

Clicking on "Matches" in the analysis button brings up the dialog shown below.



RepGrid "Matches" dialog

The "Matches" check boxes determine whether matches are output for elements, constructs, or both. The "Numbers" check box determines if the element and construct numbers are shown. The "Notes" check box determines if the element and construct notes are shown. The "Power" value determines the exponent used in the *Minkowski metric* used to compute matching scores as discussed in Section 7.2.

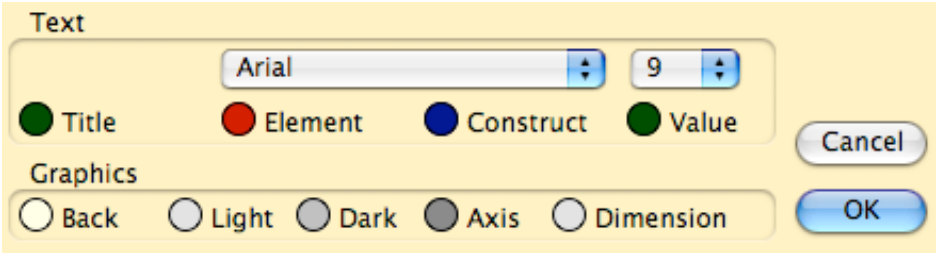
The four radio buttons below select whether all matches above the specified cut off value are output, or just those for the selected items compared with all, the selected items, or the non-selected items. Selection of elements and constructs is set up in the "Elements" and "Constructs" panes, respectively (and is independent of the state of the "Analyze Selected" check boxes).

Below is the output produced when you press the "Matches" button with the settings above.

RepGrid element and construct matches for the grid

7.8 Style

Clicking on "Style" in the analysis button brings up the dialog shown below which controls the color schemes used in all the other analyses. Section 10.2 details how these are translated into a color scheme in RepNet.



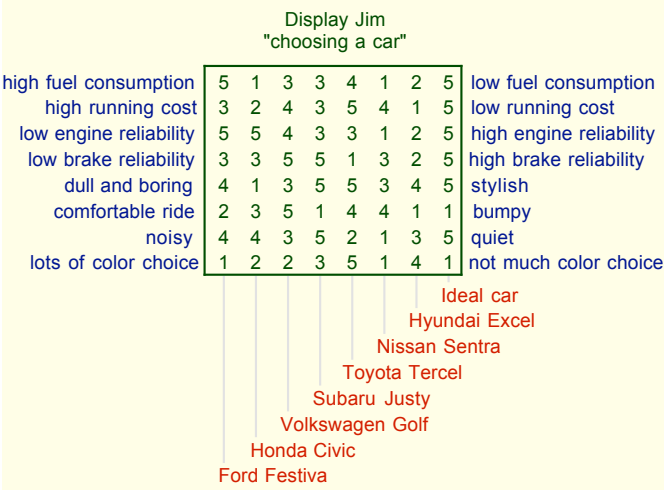
RepGrid "Style" dialog

The "Text" sub-panel allows the font and size for text output to be specified. The color swatches allows the color for the text and associated graphics in the "Title," or an "Element," "Construct," or "Value," to be specified.

The "Graphics" sub-panel allows the "Back" color of the window, "Light" and "Dark" shading of values in Focus and the color of an "Axis" or "Dimension" in PrinGrid to be specified.

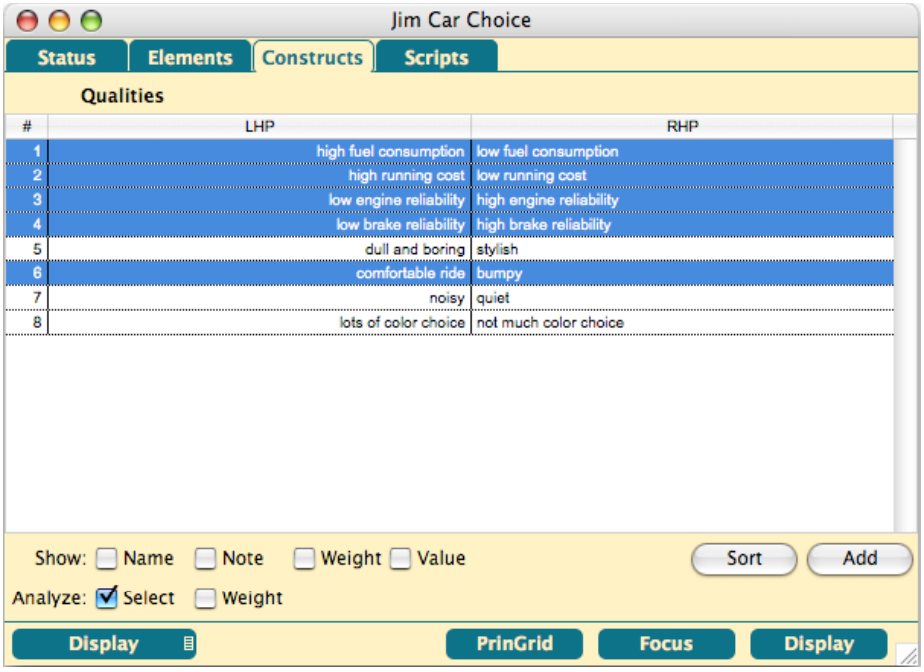
7.9 Analysis of selected elements and constructs

At the bottom left of the "Elements" and "Constructs" panes are check boxes specifying that only selected items should be analyzed. In essence the grid to be analyzed is reduced to contain only the selected items, and hence all the analyses may be used on a partial grid without actually deleting elements or constructs. Shown below is a version of a grid developed to help in the choice of a car (Shaw and McKnight, 1981).



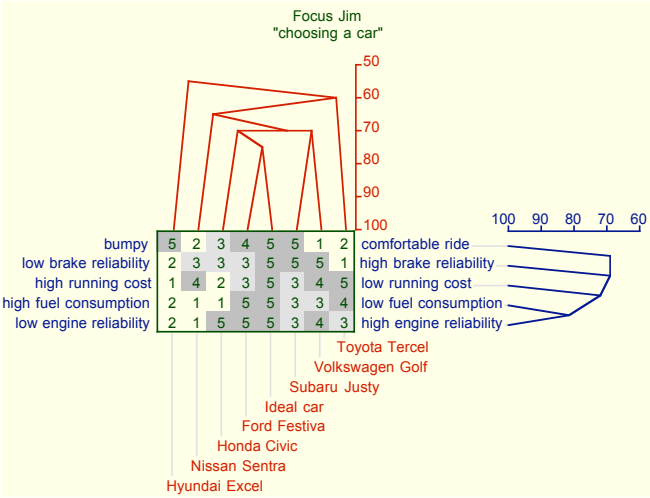
Decision-support grid

The user has entered seven cars as potential choices together with an "ideal car" that will serve to elicit his preferences, and rated the cars on relevant constructs. A "Focus" analysis serves to show how the potential choices cluster with the "ideal car." After seeing this he may be interested in clustering based only on the most significant constructs, and can restrict the analysis by selecting these in the "Constructs" pane and clicking on "Analyze Selected" as shown below.



Decision-support grid with analysis based on selected constructs

Clicking on the “Focus” button results in an analysis based only on the selected constructs as shown below. The elements to be used can be selected on the “Elements” pane in the same way. Using “Analyze Selected” for both elements and constructs provides the facility to display or analyze partial grids without editing the grid data.

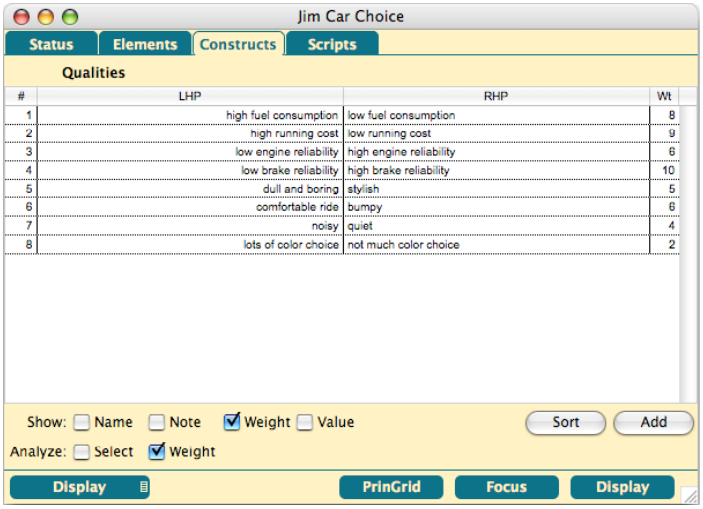


Decision-support grid “Focus” analysis based on selected constructs

7.10 Analysis of weighted elements and constructs

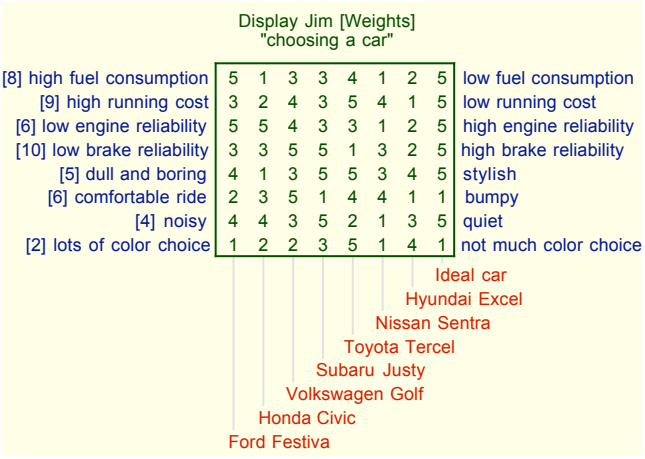
Grid analysis can also be refined by weighting elements and constructs. At the bottom left of the “Elements” and “Constructs” panes are check boxes specifying that the weight values should be used in analysis. These affect “Display,” “Focus,” “PrinGrid,” and “Matches” in the form of plot and the type of analysis, if appropriate. In all cases, if weights are used this is indicated in the title of the output and the weight is shown in square parentheses by the items in the plot.

Shown below is the “Constructs” pane with of the car choice grid where the user has weighted the constructs to indicate their relative importance to him in deciding which car best satisfies his needs. The “Weight” and “Analyze Weighted” check boxes have been selected to show the weights and use them in analysis.



Decision-support grid with weighted constructs

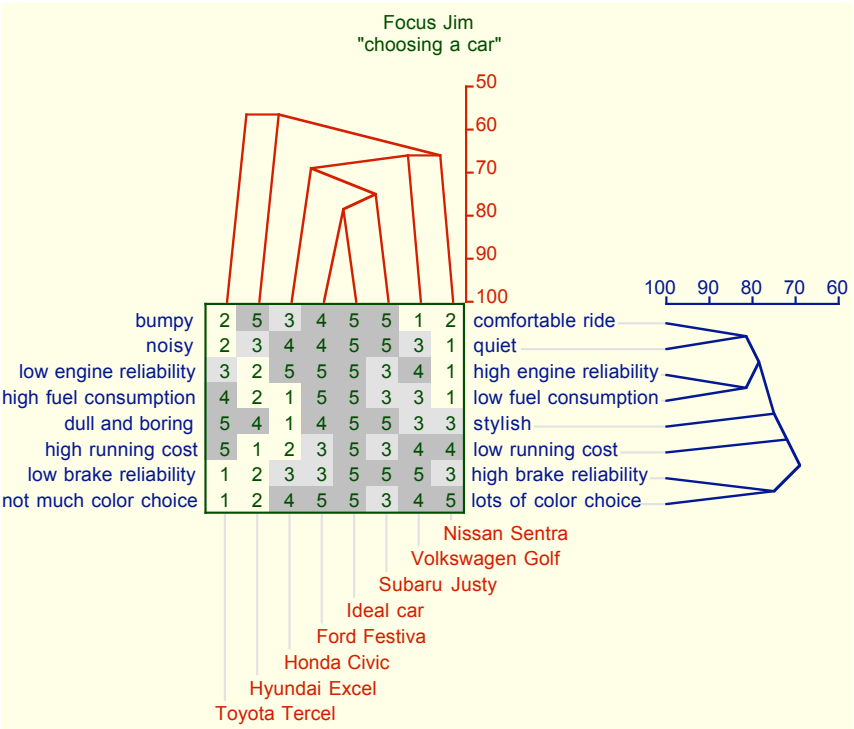
Clicking on the “Display” button displays the grid as shown below. That weights are in use is noted in the title, and their values are displayed on the left of each construct.



Display of decision-support grid showing construct weights

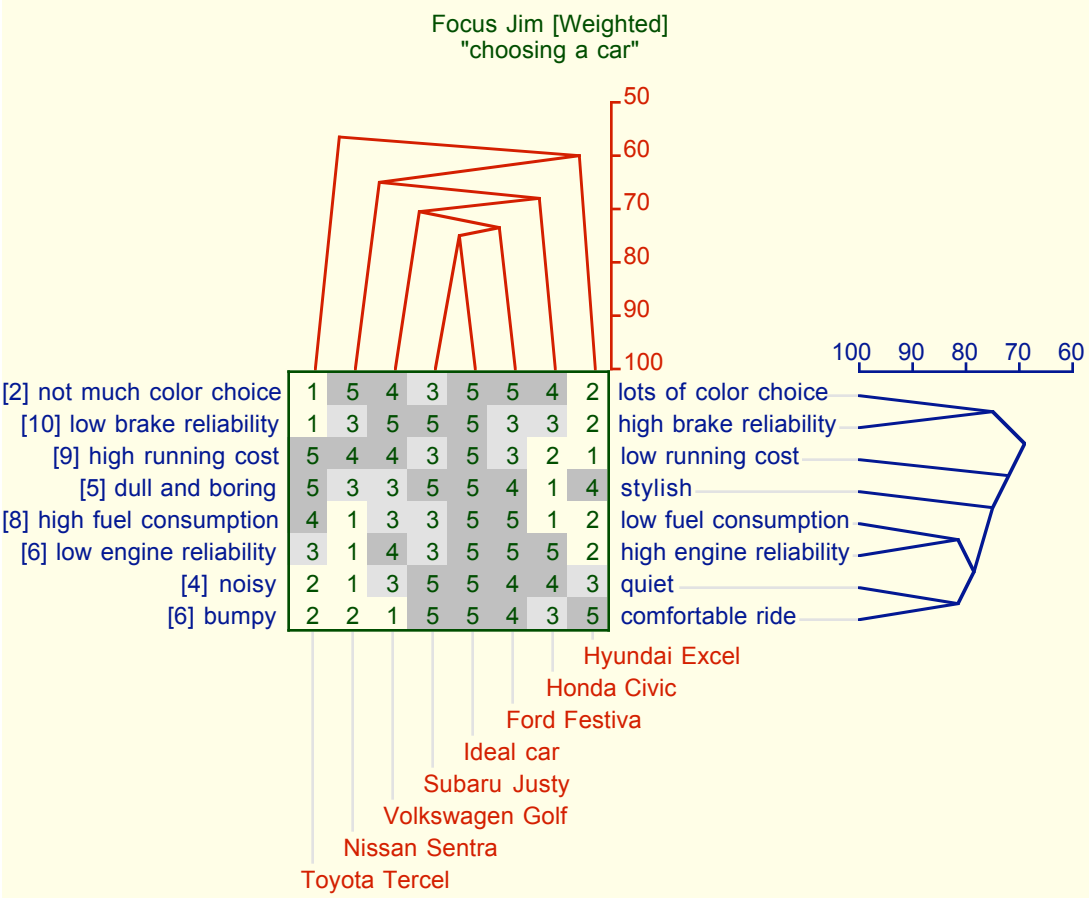
Only the relative values of weights are significant, and they may take any integer value from zero upwards. It is common to use 0 through 10 or 0 through 100. In the calculation of match scores for the “Focus” and “Matches” analyses, construct weights are used to weight differences in values on constructs in computing element matches, and element weights are used in computing construct matches. The effect on the analysis is the same as if the item with weight n had been entered in the grid n times.

Below is shown the unweighted “Focus” analysis for the car choice grid, where “Ideal car” clusters most closely with “Ford Festiva.”



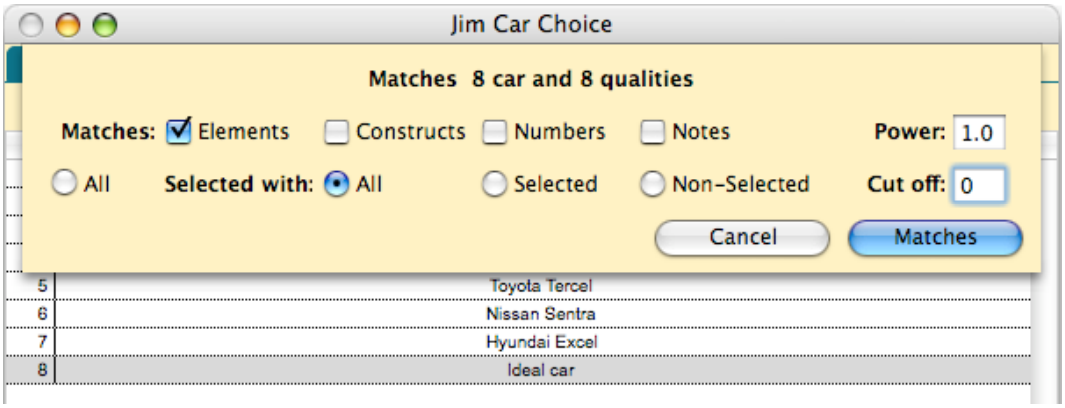
Unweighted “Focus” analysis of decision-support grid

However, as shown below, when the weights are taken into account in the analysis “Ideal car” clusters most closely with “Subaru Justy.”



Weighted “Focus” analysis of decision-support grid

If the user wishes to see the rank ordering of the matches of the “Ideal car” against all the others then “Ideal car” may be selected in the “Elements” pane, and “Matches” selected in the “Analysis” menu with the parameters selected as shown below to show the element matches of the selected element with all the others.



“Matches” analysis to show “Ideal car” against the others

This results in the list of matches shown below.

Element Matches based on Weighted Constructs

75.0%
Ideal car
Subaru Justy

73.5%
Ideal car
Ford Festiva

62.5%
Ideal car
Volkswagen Golf

51.0%
Ideal car
Toyota Tercel

41.5%
Ideal car
Honda Civic

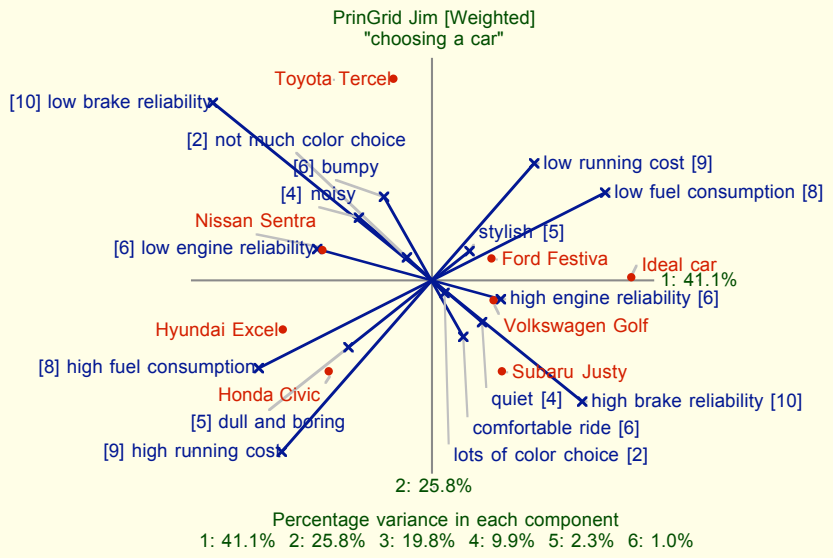
36.5%
Ideal car
Hyundai Excel

35.5%
Ideal car
Nissan Sentra

Weighted "Matches" analysis of decision-support grid

The element and construct weights, if selected, are used multiplicatively in the calculation of the covariance matrix for a principal components analysis. Below is shown the "PrinGrid" output with the construct weights specified. "Ideal car" appears to be discriminated by the first component plotted on the horizontal axis, with "Subaru Justy" being the nearest to it along that axis (i.e. when only the horizontal coordinate is taken into account).

The next two cars are reversed in order in their positions along the horizontal axis from the "Focus" and "Matches" analyses, and this is because those analyses are based on a "boxcar" metric which sums absolute distances whereas the principal components analysis uses a "Euclidean" metric which sum the square of the distances and hence gives a greater weight to larger differences.



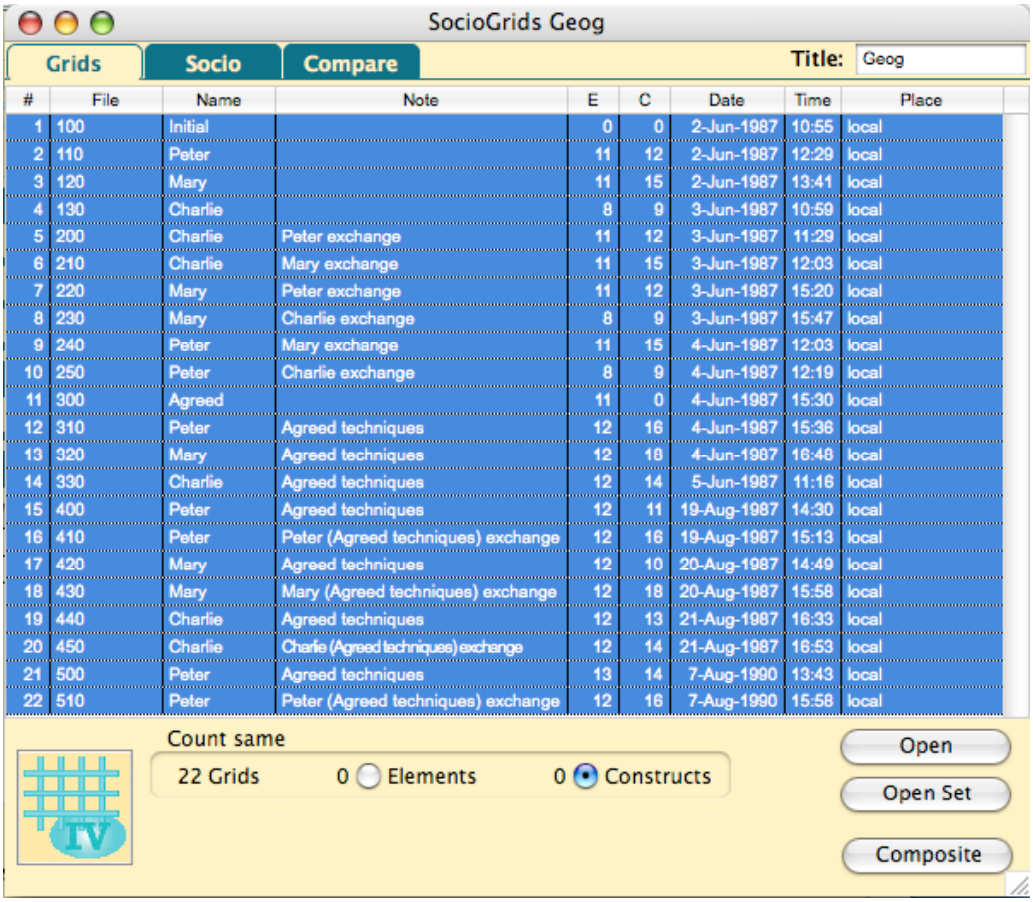
Weighted "PrinGrid" analysis of decision-support grid

8 Multiple grids analysis: SocioGrids

The SocioGrids tool in *Rep IV* provides the capability to analyze data from multiple repertory grids, and to reflect back the underlying psychological processes in graphic form (Shaw, 1980). It includes tools to merge grids for display and analysis as a single grid, to compare grids, to extract a ModeGrid of the most commonly used constructs, and to display SocioNets of individual grids based on their commonality of construction. The analyses present multiple grids in a way that reflects the relationships between their meanings to promote discussion, understanding, decision-making, conflict mediation, and further elicitation.

8.1 SocioGrids window

Clicking on the "Open" button in the "SocioGrids" section of the *Rep IV* manager window brings up a file directory dialog that allows a set of grids to be opened simultaneously in a SocioGrids window as shown below.



SocioGrids window with "Grids" pane showing

If the "New" button had been used to open an empty SocioGrids window then the "Open" or "Open Set" button at the bottom right could have been used to open the same set of grids. The "Open" button opens one grid at a time, and the "Open Set" button opens the set of grids in a directory. If that directory also contains non-grid files these will not be opened and no error will be reported so that notes and analyses may also be stored in the same directory as the grids.

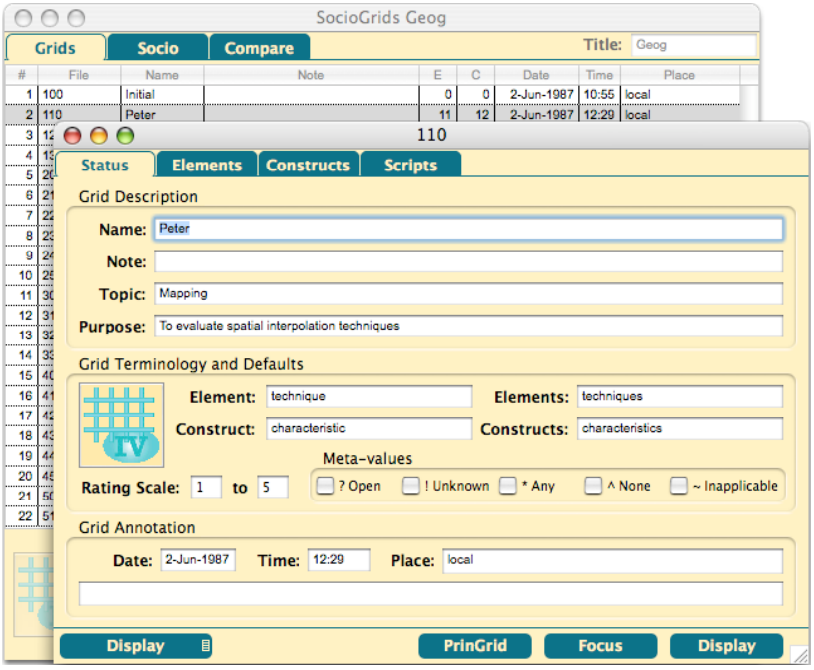
The tab ribbon along the top of the SocioGrids window lets you select any one of the the panes: “Grids,” “Socio,” and “Compare.” The SocioGrids window opens with the “Grids” pane showing, and clicking on one of the other tabs brings its pane into view. The following sections describe the functions of each pane.

8.2 Grids pane

The rows in the table of grids in the “Grids” pane shows data on each grid: the file name; the name and note stored in the grid; the numbers of elements and constructs; the date and time when the grid was stored; and the IP address of the client if the grid was elicited through WebGrid. The “Title” edit panel at the top right is used to entitle the various analyses. It is initially blank for a new SocioGrids window, or contains the name of the directory opened. It may be edited at any time to contain an appropriate title.

The data shown is that of the “Geog” example data supplied with *Rep IV*, that was elicited from three geography researchers studying spatial mapping techniques (Shaw and Gaines, 1989). The first grid is an empty one naming the purpose and the types of elements and constructs. The next three contain elements and constructs elicited from each of the researchers separately. The next six consist of ‘exchange’ grids where each of the researchers rated each of their colleagues’ elements on their colleagues’ constructs. Grid 11 contains a set of eleven elements agreed between the researchers after discussion based on their initial grids, and the next three grids contain constructs related to these elements elicited from each of researchers. The next six grids are a replication study some 2.5 months later in which the researchers repeated this elicitation and then re-rated their previous grids. The final two grids are a similar replication study with the senior researcher some 3 years later. This is a useful dataset with which to explore the facilities provided in the SocioGrids tool.

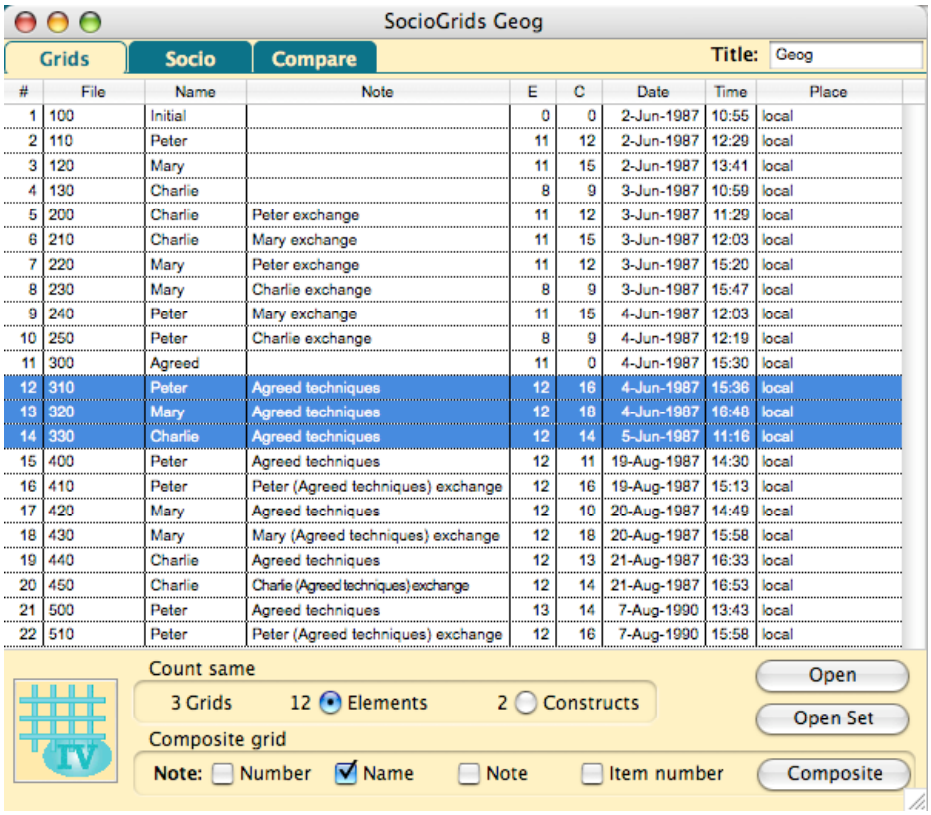
Double-clicking on a row in the grid table opens its grid in RepGrid for individual analysis as shown below.



Grid opened for individual analysis by double-clicking row in “Grids” pane

Many of the SocioGrids analyses work on the subset of grids that have been selected by clicking in the row for that grid. Multiple rows may be selected by holding down the "shift" key for contiguous selections and the CMD key for non-contiguous selections, consistent with the normal conventions of the Mac and Windows operating systems. When grids are opened they are all selected automatically.

The "Count same" pane at the bottom left provides a dynamic analysis of the number of grids selected and the number of elements and constructs they have in common, if any (determined by the equality of name criteria defined in Section 7.5). The radio buttons control whether the Socio analyses are based on the common elements or the common constructs, and are set initially to the higher of the two counts. For the "Geog" data set with all grids selected there are no common elements or constructs. When some related grids are selected then the "Count same" pane shows their overlap as shown below.

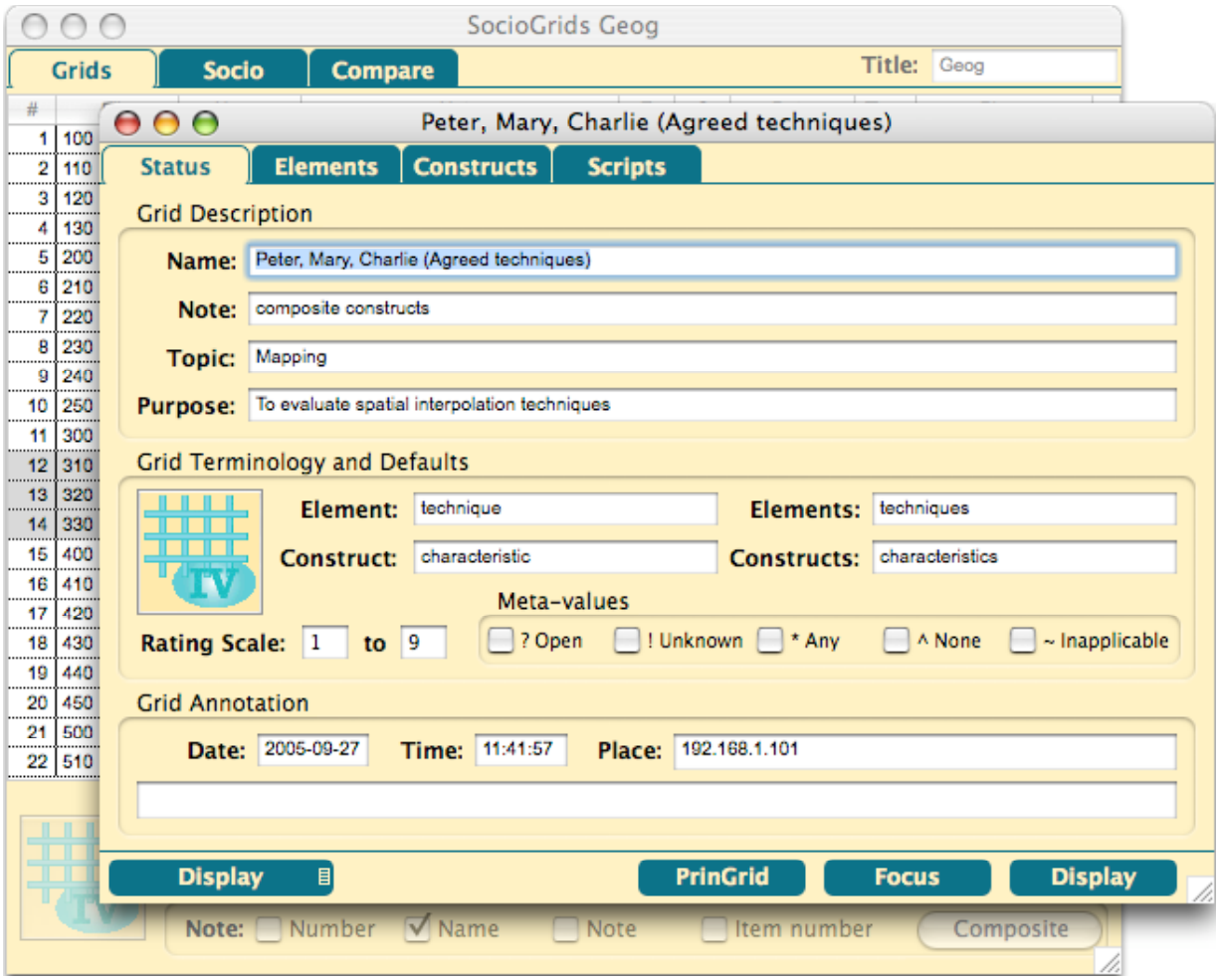


#	File	Name	Note	E	C	Date	Time	Place
1	100	Initial		0	0	2-Jun-1987	10:55	local
2	110	Peter		11	12	2-Jun-1987	12:29	local
3	120	Mary		11	15	2-Jun-1987	13:41	local
4	130	Charlie		8	9	3-Jun-1987	10:59	local
5	200	Charlie	Peter exchange	11	12	3-Jun-1987	11:29	local
6	210	Charlie	Mary exchange	11	15	3-Jun-1987	12:03	local
7	220	Mary	Peter exchange	11	12	3-Jun-1987	15:20	local
8	230	Mary	Charlie exchange	8	9	3-Jun-1987	15:47	local
9	240	Peter	Mary exchange	11	15	4-Jun-1987	12:03	local
10	250	Peter	Charlie exchange	8	9	4-Jun-1987	12:19	local
11	300	Agreed		11	0	4-Jun-1987	15:30	local
12	310	Peter	Agreed techniques	12	16	4-Jun-1987	15:36	local
13	320	Mary	Agreed techniques	12	18	4-Jun-1987	16:48	local
14	330	Charlie	Agreed techniques	12	14	5-Jun-1987	11:16	local
15	400	Peter	Agreed techniques	12	11	19-Aug-1987	14:30	local
16	410	Peter	Peter (Agreed techniques) exchange	12	16	19-Aug-1987	15:13	local
17	420	Mary	Agreed techniques	12	10	20-Aug-1987	14:49	local
18	430	Mary	Mary (Agreed techniques) exchange	12	18	20-Aug-1987	15:58	local
19	440	Charlie	Agreed techniques	12	13	21-Aug-1987	16:33	local
20	450	Charlie	Charlie (Agreed techniques) exchange	12	14	21-Aug-1987	16:53	local
21	500	Peter	Agreed techniques	13	14	7-Aug-1990	13:43	local
22	510	Peter	Peter (Agreed techniques) exchange	12	16	7-Aug-1990	15:58	local

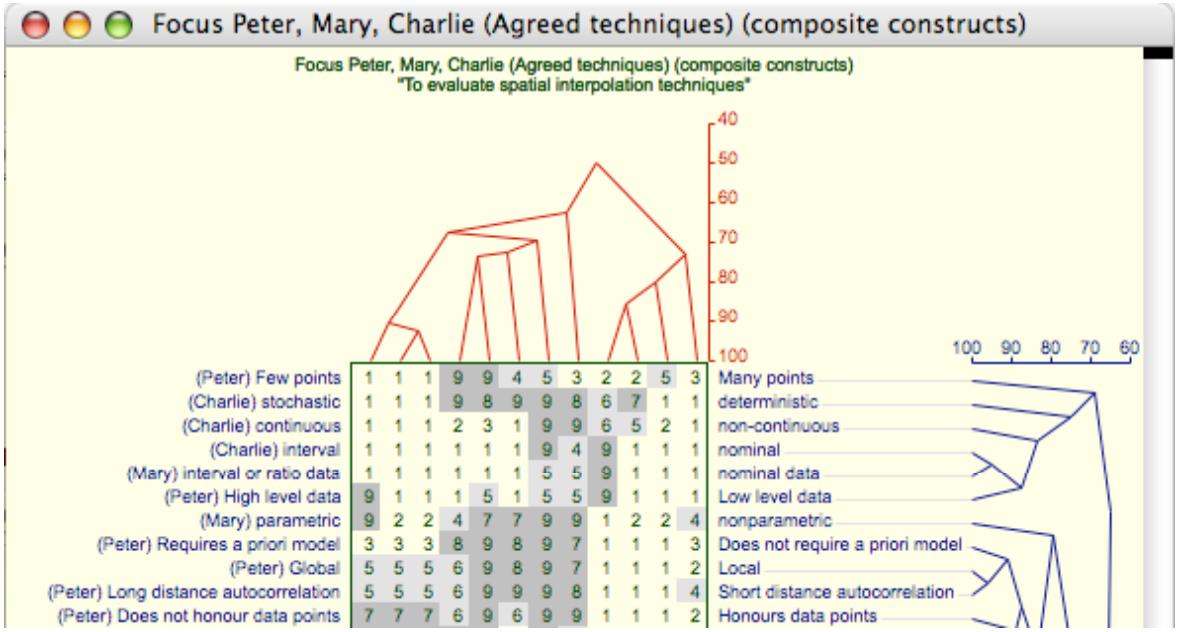
"Count same" panel showing the number of common items in the selected grids

8.3 Composite grid sub-pane

The "Composite grid" pane at the bottom allows the selected grids to be merged into a single composite grid based on either their common elements or their common constructs, as selected through the radio buttons in the "Count same" pane. The check boxes in the "Composite grid" panel control what information is put into the note field of each item so that they can be distinguished in the composite grid. In this case the name field from the original grid is adequate to distinguish the source of each construct in the composite grid. The analysis tools in RepGrid allow the note field to be shown in parentheses in the various analyses. The top part of a Focus analysis of the composite grid is shown to illustrate this.



Composite grid created from the selected grids



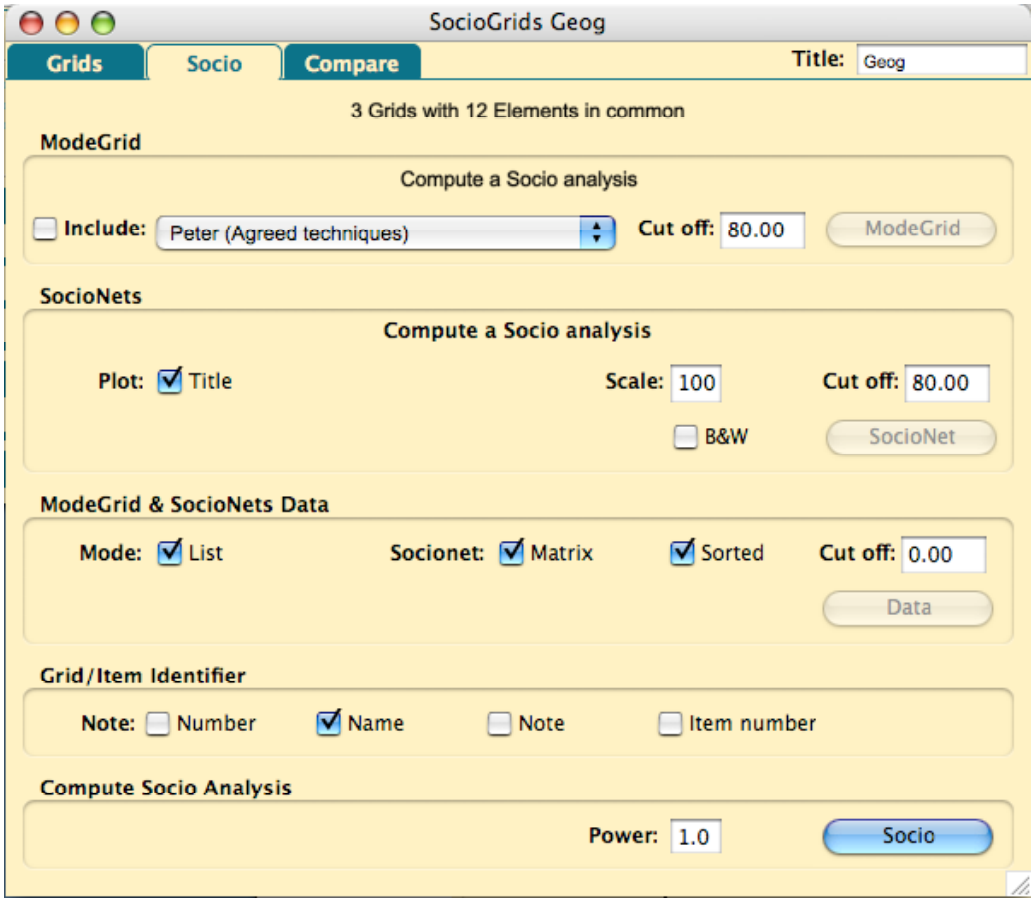
Part of Focus analysis of composite grid showing original grid names annotating constructs

Note how SocioGrids has generated a meaningful name for the composite grid based on the names and notes of the grids from which it is composed.

The weights of items in the original grids are copied into the composite grid and hence may be used in later analysis. The weights for the common items are taken from the first of the selected grids. If these weights are used in an analysis of the composite grid, it is important to ensure in the grid elicitation process that participants understand and use weight values in a mutually consistent manner.

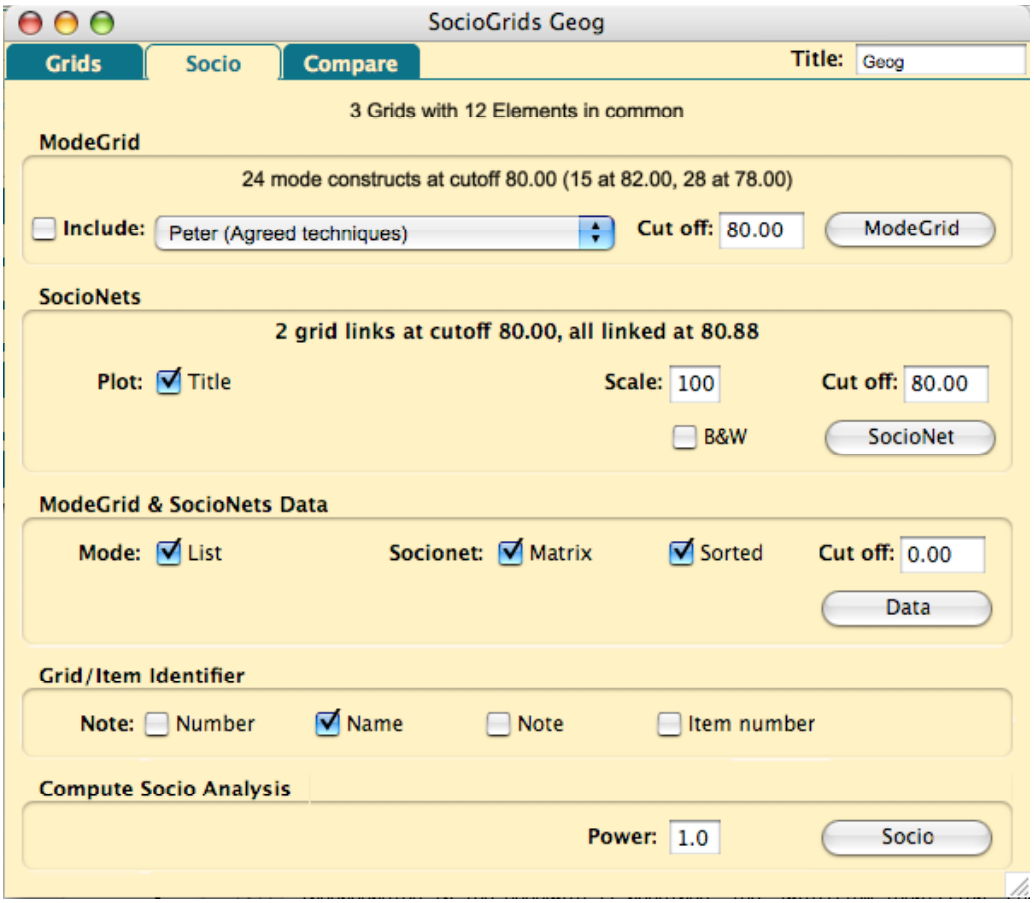
8.4 Socio pane

Clicking on the "Socio" tab in the SocioGrids window brings up the pane shown below.



SocioGrids window with "Socio" pane showing

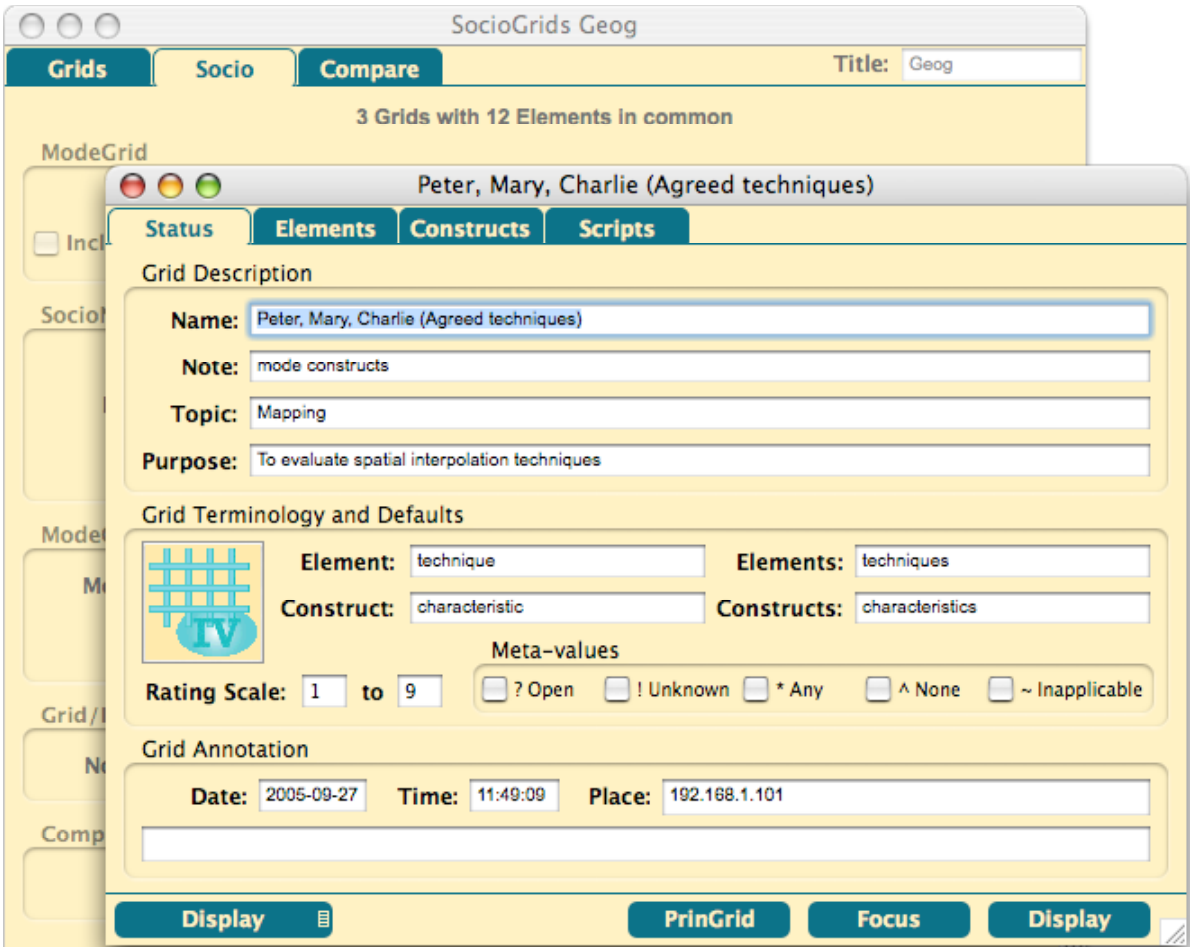
When the "Socio" button is clicked, SocioGrids displays a progress bar and computes a Socio analysis and displays the results as shown below. The "Power" value determines the exponent used in the *Minkowski metric* used to compute matching scores as discussed in Section 7.2. Depending on the setting of the radio buttons at the bottom of the "Grids" pane, similarities between the constructs or the elements in the selected grids are computed using the algorithms described in (Shaw, 1980), and these are used to determine the mode constructs or elements and the socionets associated with the selected grids.



SocioGrids window with "Socio" pane after a Socio analysis

8.5 ModeGrid sub-pane

The "ModeGrid" sub-pane allows a composite ModeGrid to be created from the grids based on the constructs or elements most commonly used in all of them. The number of mode items which will be included depends on the value set in the "Cut off" text box, and the message at the top of the sub-pane indicates the number of items that will be included at the value entered together with the number for values either side of it. This helps the analyst determine an appropriate value for the cut off. The "Include" check box on the left allows the grid selected on the popup menu to the right of it to be fully incorporated in the ModeGrid if required. The "Grid/Item Identifier" sub-panel provides the same capability to annotate the items in the ModeGrid as already described for composite grids. Clicking on the "ModeGrid" button outputs the composite grid in RepGrid for analysis as shown below.



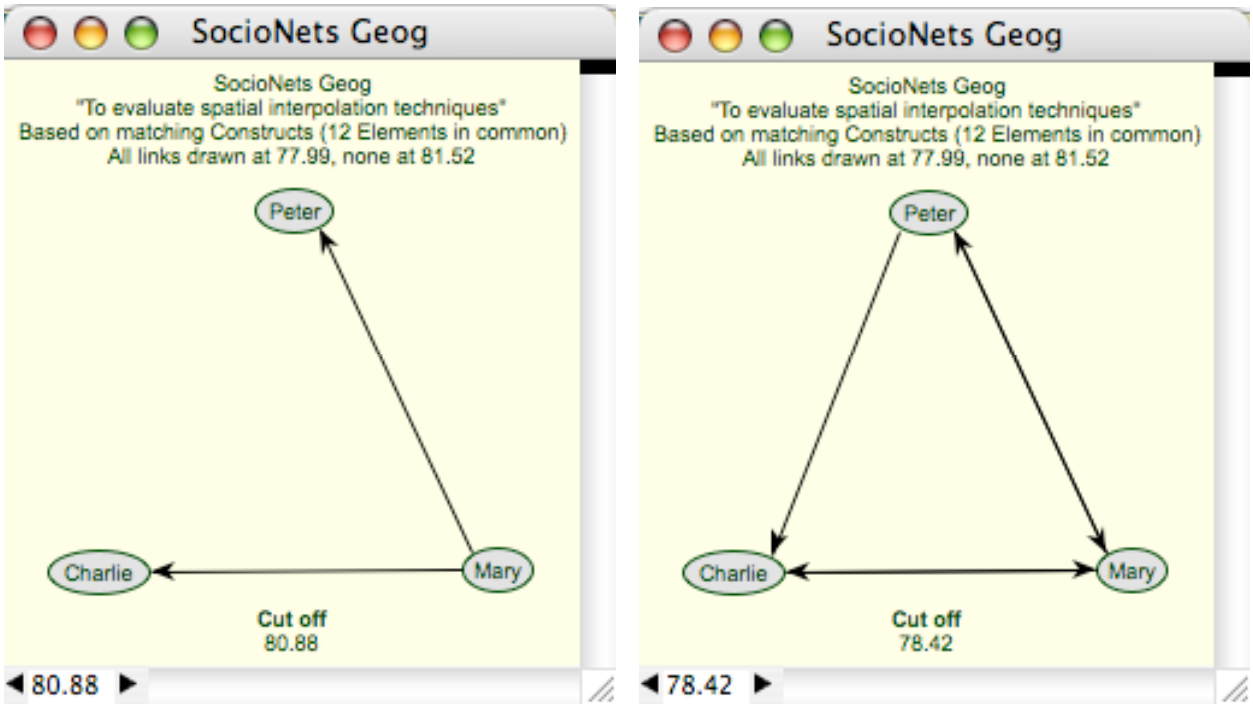
Generation of a ModeGrid

The weights of items in the original grids are copied into the mode grid as discussed for composite grids in Section 8.3.

8.6 SocioNets sub-pane

The "SocioNets" sub-pane allows a plot to be generated in RepNet that shows the extent to which the items in one grid may be used to match the items in another grid. The value of the cut off determines how great a similarity is needed before a link is shown initially, but the plot is dynamic and one can adjust the cut off in RepNet. The text at the top of the sub-pane shows the number of grids with links at the current cut off, and the maximum cut off for every grid to have at least one link. The "Title" check box determines whether the plot is titled. The "Scale" value determines the size of the initial plot. The "B&W" check box allows the plot to be restricted to black and white which may be helpful with certain printers.

Clicking on the "SocioNet" button generates the plot shown on the left below.



Generation of and interaction with a SocioNet

The arrows from Mary to Peter indicates that the average over all the constructs in Peter's grid of the matches of the best-matched constructs in Mary's grid is greater than or equal to the cut off, indicating that Mary should be capable of understanding Peter's constructions. The cut off is shown in the text box at the bottom left and may be adjusted by typing in a different value, or by clicking on the triangular markers on either side of it to change to the next value of cut off that changes the number of links. This allows the SocioNets structure to be explored dynamically. The plot on the right is one where the cut off has been reduced to show all but one of the possible links.

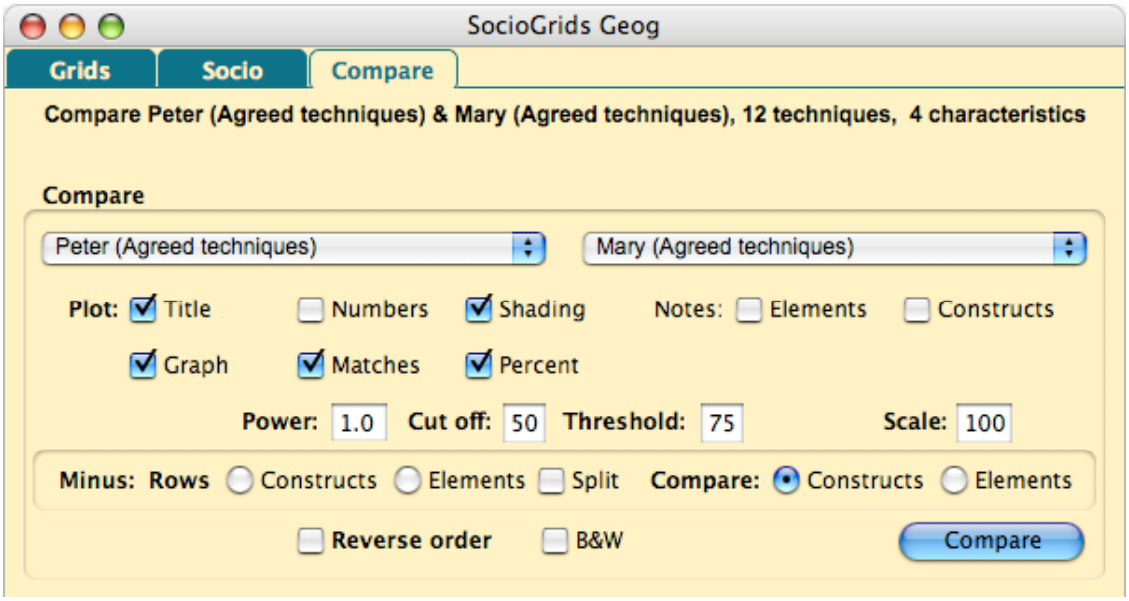
The plot is a net in the RepNet tool (Section 9) and hence it can be edited, saved in a file and opened again. In plots with large numbers of grids it is often useful to be able to drag the nodes around to make the plot more understandable.

8.7 ModeGrid & SocioNets Data sub-pane

The "ModeGrid & SocioNets Data" sub-pane allows the data from the Socio analyses to be output in text form. The "List" check box on the left controls listing the mode items. The "Matrix" and "Sorted" check boxes control listing the matrix of matches used in the SocioNets analysis as matrix or sorted list, respectively. The "Cut off" text box sets the value below which matches will not be listed.

8.8 Compare pane

Clicking on the "Compare" tab in the SocioGrids window brings up the pane shown below.



SocioGrids window with "Compare" pane showing

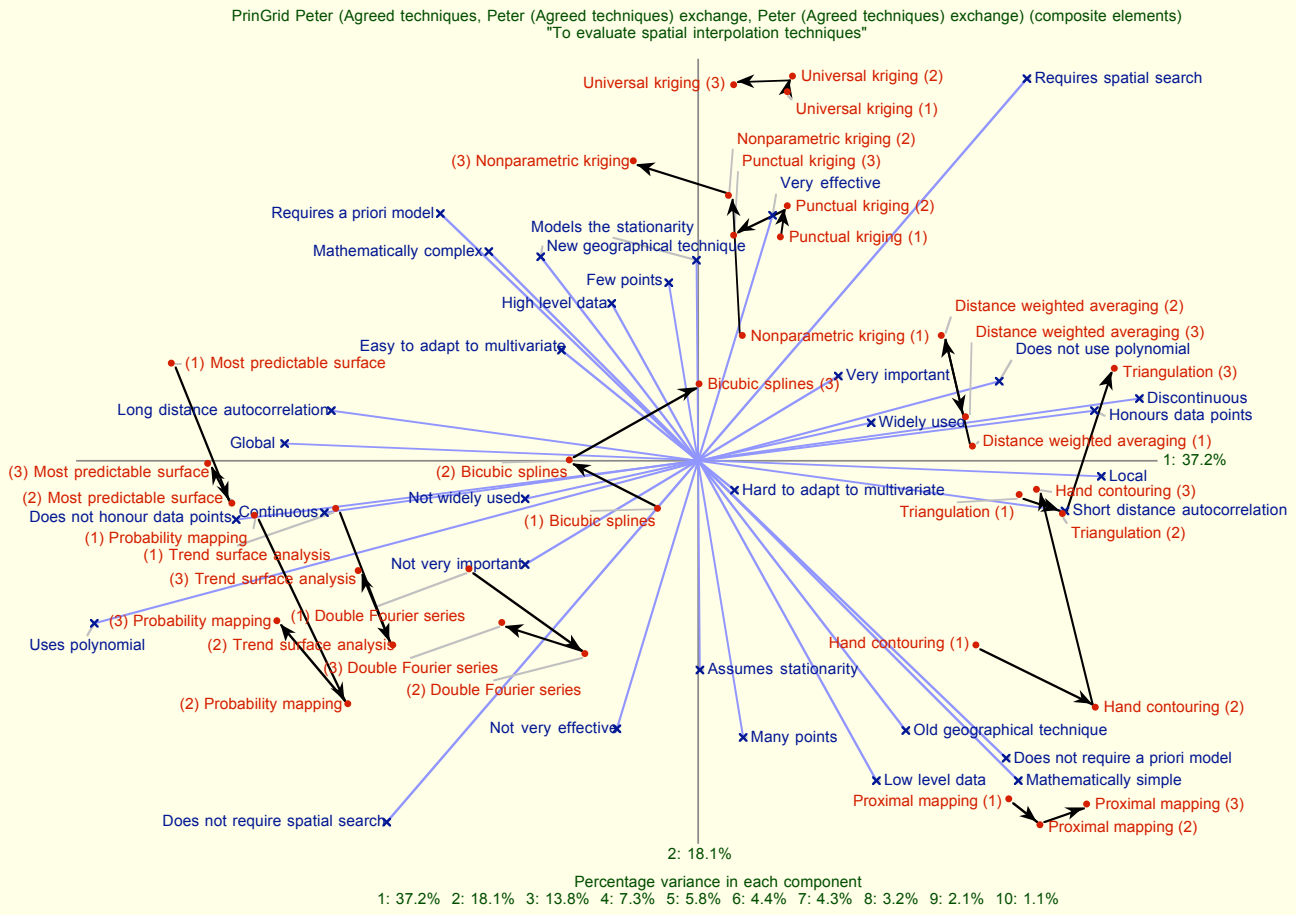
This provides similar pairwise comparison capabilities to those already described for RepGrid, (Section 7.5), but now the two grids to be compared are selected through two popup menus listing all the grids that have been opened in SocioGrids.

8.9 Grid comparison based on the analysis of composite grids

The use of the "Compare" algorithms to compare grids may be complemented in SocioGrids by using the capability to form a composite grid and then analyzing those grids with the RepGrid and RepNet tools. For example, in the "geog" sample data there are two exchange grids elicited from Peter some 10 weeks (grid 16) and some 3 years (grid 22) after the original elicitation (grid 12). One can, for example, form a composite grid based on the common constructs in these grids and perform a PrinGrid analysis.

Then in RepNet one can run the script "PrinGrid Trajectories" which joins up the plots of the elements having the same names in each grid to produce the plot shown below. This may be used to discuss with the person from whom the grid was elicited the ways in which his construction of the mapping techniques appears to have changed over time, and whether this is meaningful to him.

It is obviously also appropriate to discuss meta-questions such as whether the underlying assumptions of the analysis are reasonable, that the construct dimensions are the same in each grid and the elements have changed along them.



"PrinGrid Trajectories" script plotting element trajectories in a composite grid

9 Representing construct networks: RepNet

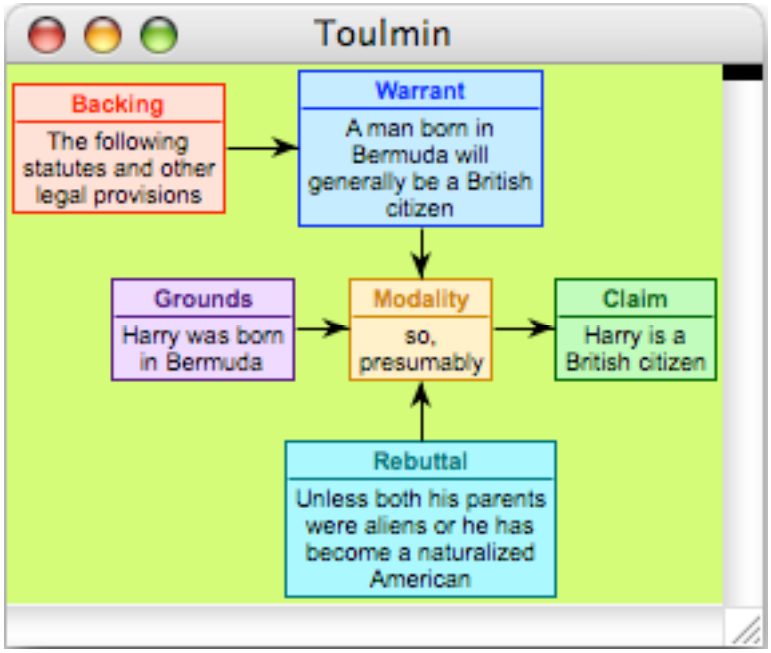
The RepNet tool in *Rep IV* may be used on its own for entering, editing and sharing graphic representations of construct networks, and also in conjunction with RepGrid, for example in element elicitation. The content of nodes in nets may be dragged to RepGrid panes to become elements or construct poles (as can text from documents), and *vice versa*. In addition, all the RepGrid graphic analyses are output as RepNet nets which makes them easy to enhance through appropriate editing and to store as editable graphics.

The theory and application of construct representation techniques is described in the literature on *argument forms*, *entailment meshes*, *bond graphs*, *concept maps*, *petrinets, influence diagrams, causal maps, belief nets, semantic networks* and so on (Toulmin, 1958; Pask, 1976; Blundell, 1982; Novak and Gowin, 1984; Reisig, 1985; Oliver and Smith, 1990; Sowa, 1991; Lehmann, 1992; Mintzes, Wandersee and Novak, 1998; Novak, 1998; Mintzes, Wandersee and Novak, 2000; Bryson, Ackermann, Eden and Finn, 2004). Nets and grids are complementary constructivist techniques, and may be used together to help people to explore their ideas about a topic, make them more explicit and discuss them with others.

9.1 Net syntax of node and line types

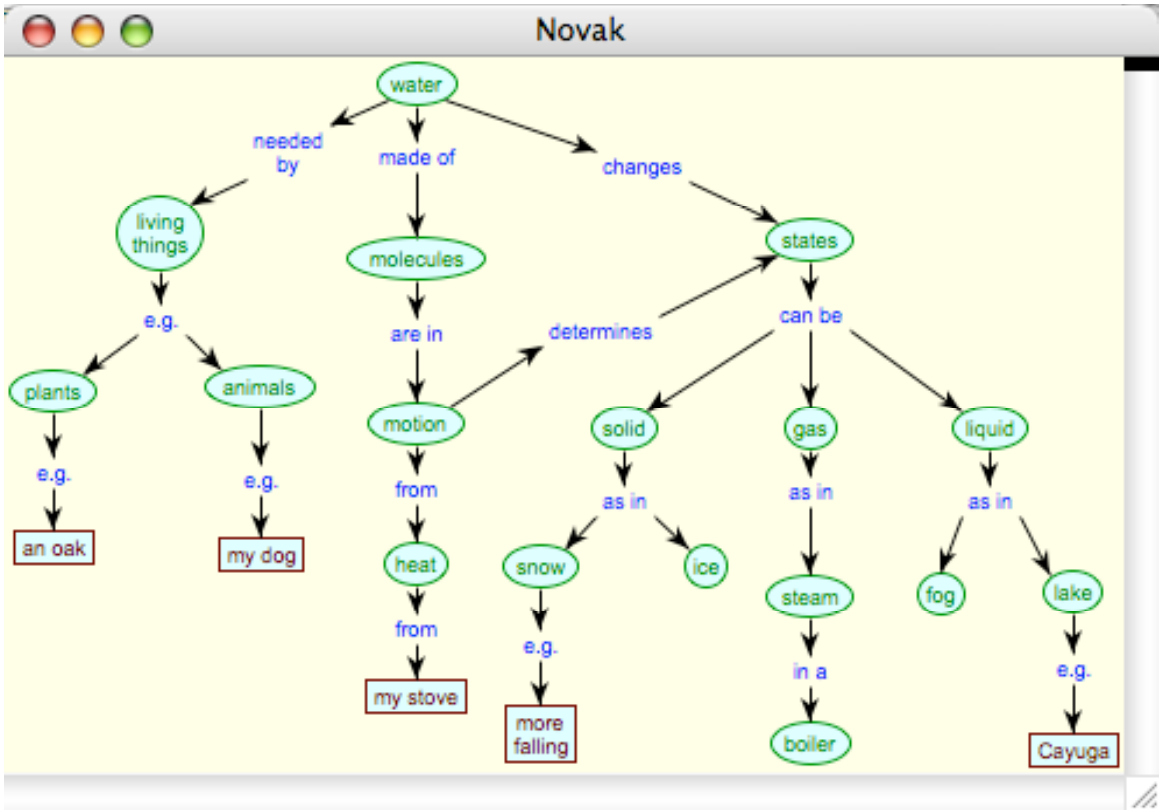
Nets consist of *nodes* which may be joined by *lines*. Nodes have a named *type*, a textual *label* which names them and is generally displayed, and a textual *note* which annotates them and is not generally displayed. The label or note, or both, may be an empty string. Lines between nodes may be decorated in various ways, usually as directed arrows. The collection of node and line types available provide a *syntax* in which can be represented the semantics of the kind of net that can be drawn. The node type determines the style of appearance of nodes of that type.

Below is a Toulmin-style "argument diagram" in a net syntax having six types of nodes: 'Grounds,' 'Modality,' 'Claim,' 'Backing,' 'Warrant' and 'Rebuttal.



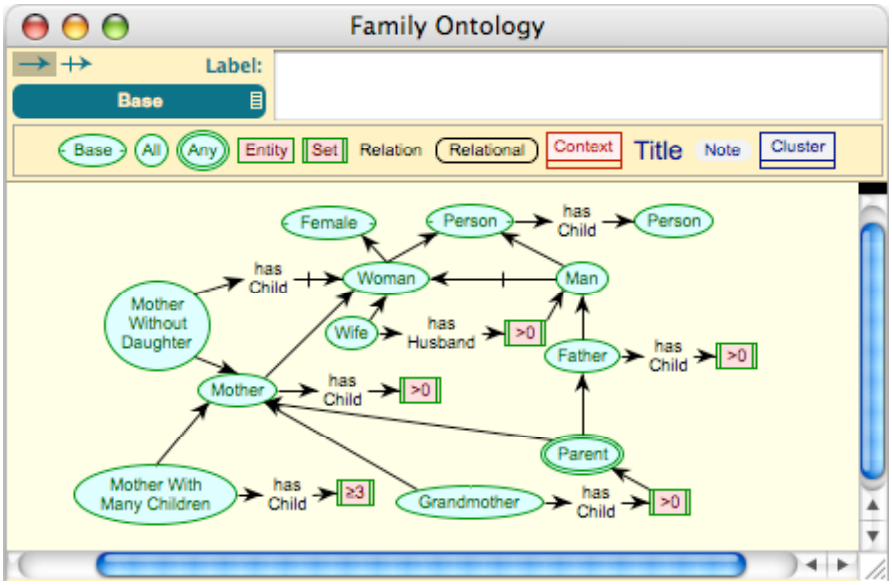
RepNet "argument diagram" example from Toulmin (1958)

Below is a Novak-style "concept map" in a net syntax having three types of nodes: 'Ideas' as text with an oval surround, 'Examples' of them as text with a rectangular surround and 'Link' labels as text without a surround that labels the link between nodes formed by two lines.



RepNet "concept map" example from Novak and Gowin (1984)

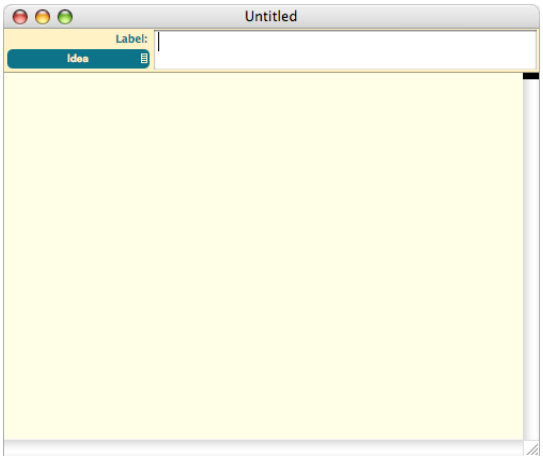
Below is a "semantic network" for a simple ontology of family relationships in a net syntax having eleven types of nodes, and two types of line.



RepNet "semantic network" for a family ontology

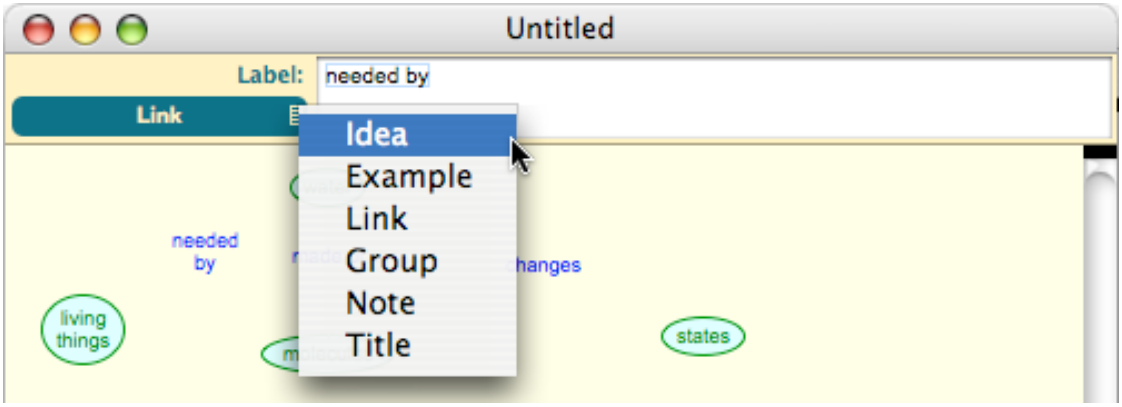
9.2 Entering nodes

When the "New Net" button in the *Rep IV Manager* is clicked a blank RepNet window opens as shown below (or as specified by the file "Default.rnet—see Section 3.3). At the top is an editing area with a popup menu showing the types of node available and a text input field for the node label. If one types a label in this field and keys "return" or "enter," then a new node is created of the type selected on the popup menu. To support rapid entry, the text entered becomes selected so that further typing replaces it.



RepNet initial window for a new net

The node types available for this net and some nodes entered initially are shown below.



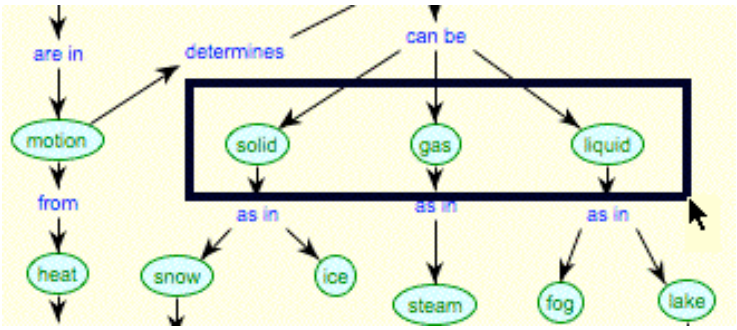
RepNet nodes being entered

The "Idea" type is used for concepts, "Example" for examples of them, and "Link" is used between a pair of arrows to link concepts. The "Group" type provides a labeled enclosure that may be used to group other items and, because an enclosure is a node, the group may itself have links or be enclosed. The "Note" type is provided for annotation, and "Title" for titling. This set of types provides a suitable syntax for a wide range of net applications.

The label text is wrapped automatically to be enclosed in a rectangle with its width about forty per cent more than its height, and the surrounding shape specified by the node type is fitted around this. You can take control of the wrapping by inserting the backslash character, "\", at places where you want to break the line. You can specify an unbroken line by putting a backslash character at the end of it.

9.3 Selecting, positioning, deleting and editing nodes

Nodes may be selected by clicking in them, and are then highlighted to show they have been selected. Multiple selections may be made by holding down the “shift” key while clicking. All nodes may be selected through “Select All” on the “Edit” menu or keying CMD-A. A set of contiguous nodes may be selected by clicking outside them to draw a temporary “selection rectangle” around them as shown below.



Selection rectangle being used to select enclosed nodes

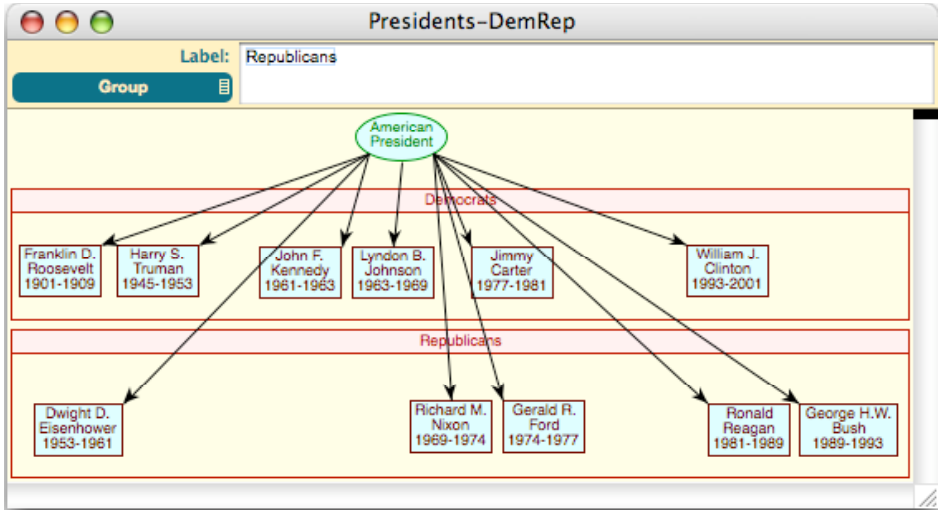
A node may be repositioned by clicking in it and dragging it to a new position. All the selected nodes may be repositioned together by clicking and dragging one while holding down the “shift” key to prevent the other nodes from being deselected.

Nodes may be deleted by pressing the “delete” or “backspace” key after selecting them.

A node may be opened for editing in the edit area by double-clicking in it. This opens the editing area if it is closed and brings up the node type on the popup menu and its label in the text input field. Either may be changed as required and then pressing the “return” or “enter” key will update the node appropriately.

9.4 Enclosure nodes

One of the possible node types supported by RepNet is an ‘enclosure node’ where a node can act as a container for other nodes. The “Group” node type in the default syntax for nets is an enclosure, and its application is illustrated below.



Enclosure nodes used to group other nodes

An enclosure node is created in the normal way, but it takes account of any selected nodes and positions itself to contain them. When it is dragged to a different position it repositions the enclosed nodes. Lines may be drawn between an enclosure node and other nodes in the normal way.

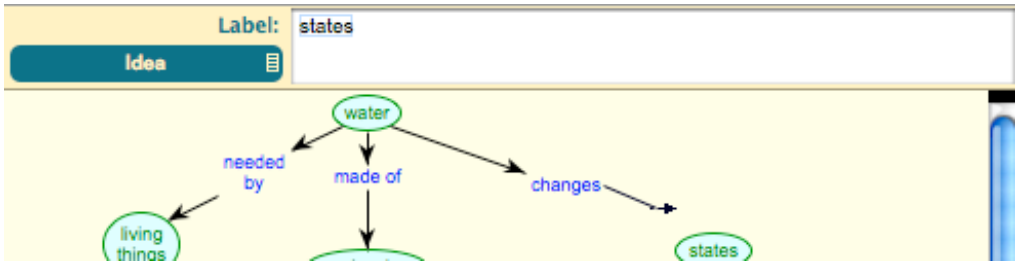
Enclosure nodes may be resized. The cursor changes to a double arrow symbol at each corner of and enclosure node, and clicking and dragging may be used to resize the node.

9.5 Entering and deleting lines

As shown below, as the mouse is used to move the cursor across a node, the cursor changes shape to indicate what action may be performed by clicking and dragging. In the center it becomes a hand to indicate that the node can be grabbed and repositioned. At the right edge of a node it becomes a line (with an arrow head or other decoration if appropriate) to indicate that a line may be drawn from that node to another. At the left edge of a node it becomes an eraser to indicate that the same action will erase any line drawn.

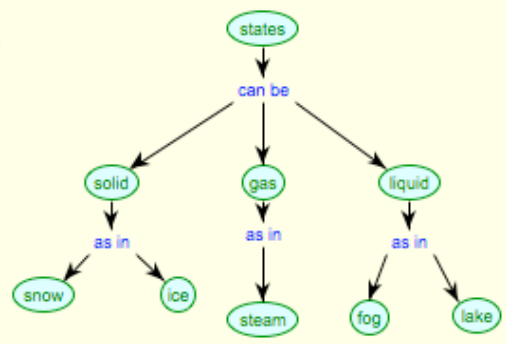
Hand, line and eraser cursors with the mouse at different positions over a node

Clicking in the node when the cursor indicates a line and dragging to another node until the cursor changes to a star indicating the second node has been detected enters a line connecting the two nodes. Below is shown a line in process of being drawn between the nodes labeled “changes” and “states” at the lower right.



Lines with arrowheads being entered

Note that “changes” is essentially a link label for the link between the idea of “water” and that of “states.” RepNet supports the labeling of links between concepts by treating the link label as a node in its own right. This is the most general and flexible way of supporting link labels (and bipartite graphs), enabling links to have types if appropriate, and several links to share the same label if appropriate. As shown below where “can be” and “as in” are used as shared labels this facility avoids the duplication of link labels and simplifies and clarifies the meaning of the net.



A node "link" type being used to support shared link labels

RepNet supports several styles of line and, if more than one is available, buttons appear at the top right of the edit area allowing the style of line to be selected as shown below.

Selection of style of a line

Clicking in a line style button selects it, and the cursor will take the line style at the left and right edges of a node. Dragging from one node to another as described above enters a line based on the selected line style.

Lines are drawn from one of eight positions around a node that are selected automatically to minimize the length of the line and to ensure that it is always in the direction of the relative positions of the node. When nodes are dragged its lines are recomputed automatically, and when a node is deleted its lines are also deleted.

A line between nodes may be over-written by entering a line with a different style. A line between nodes may be erased by dragging the eraser symbol between the nodes.

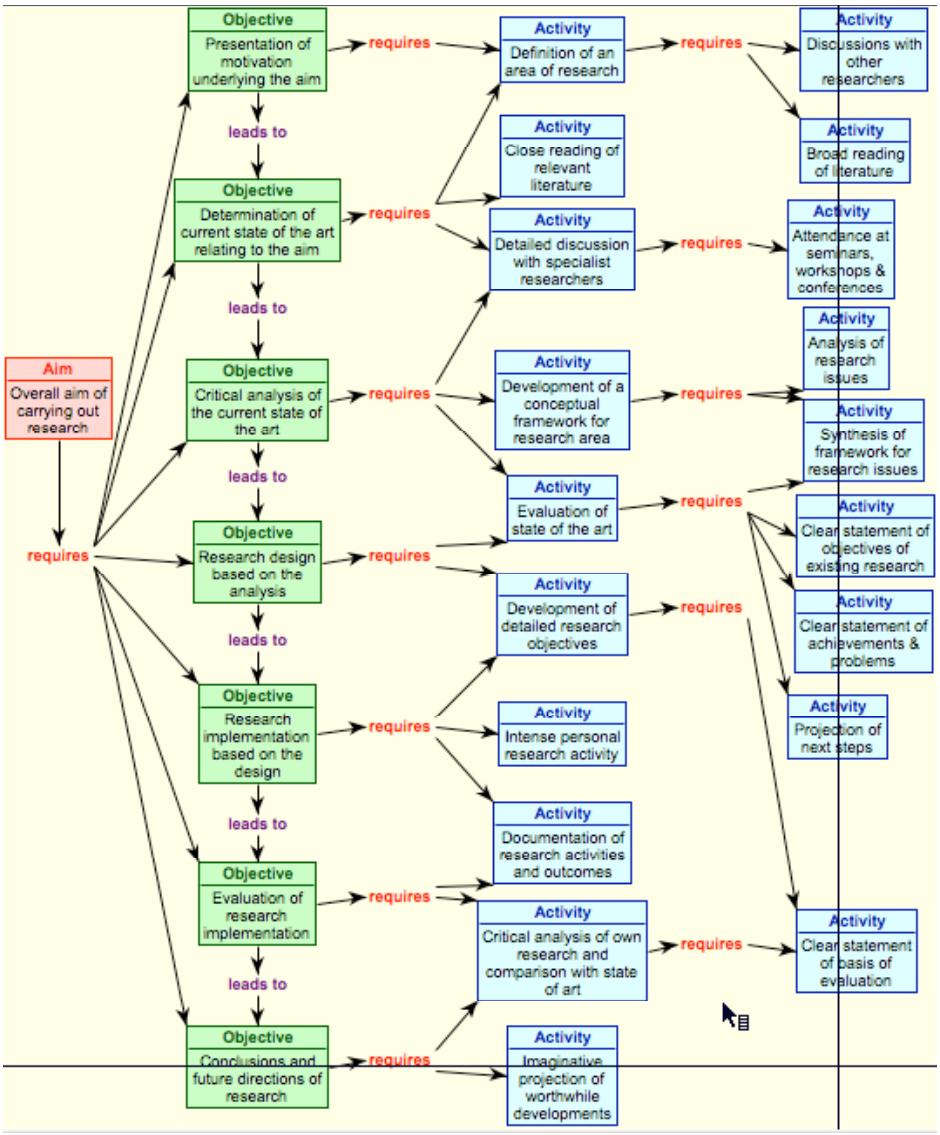
9.6 "Save," "Save As…," "Undo," and "Print"

When the data in a RepNet window is changed the "Save" item in the "File" menu becomes active as does the "Undo" item in the "Edit" menu. You can save the changed data under its original name through the "Save" command. The "Save As…" command in the "File" menu is always active and lets you save the net in a different file.

RepNet supports multi-level undo by the "Undo" item at the top of the "Edit" menu (CMD-Z).

The "Print" item in the "File" menu may be used to print the net image to the currently selected printer. The "Page Setup" item may be used to adjust the scale and orientation of printing, and Rep IV stores whatever format is selected so that it will be retained when the application is terminated and restarted. Under Windows XP the page margins may be set, and "Page Setup" should be used when the application is first installed to ensure these are set up appropriately.

If the net is too large to fit on one page it will be printed on multiple pages that may be glued together to form a larger page. As shown below, the page boundaries may be viewed by holding the "alt" or "option" key down while clicking in the net outside of any nodes.



Viewing the printing page boundaries on a large net

A large net may also be scaled down to fit a single page by using the "Print Fit" item in the "File" menu.

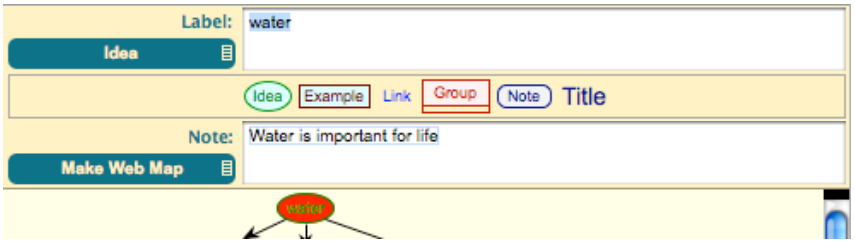
9.7 Covering and exposing the editing area

When a net is completed the editing area may be covered by clicking in the dark rectangle at the top of the vertical scroll bar on the right of the net window and dragging it upwards. This drags the net up to cover the edit area, and it may be dragged down again at any time to expose the edit area. When a normal net file is opened from a file the edit area is covered, and when a new net is created by opening a "master" file (Section 9.11) or clicking on the "New Net" button the edit area is partially exposed.

The editing area has an additional pane which may be exposed dragging the dark rectangle down further. As shown below, the node types available are shown with their shapes and color schemes to support rapid node entry. Clicking on one of these creates a node of that type as if it had been selected in the popup menu above and the "return/enter" key pressed.

Node type buttons in the editing area

Dragging down further exposes the hidden note data associated with a node as shown below.



Note field in the editing area

The note may be entered or edited in the same way as the label, and when the "return" or "enter" key is pressed the node will be created or updated.

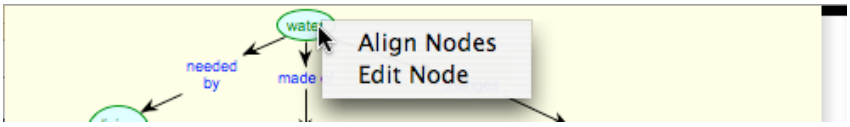
One use for the note field is to store the URL of a document that will be accessed when the node is clicked with the net locked (Section 10.3).

9.8 Script button/popup menu

At the bottom left of the editing area is a button/popup menu giving access to a set of scripts that operate on the net data. What is available on the popup menu depends on what scripts have been installed. Scripts have full access to the data structures underlying the net and can be used, for example, to analyze it or export it in a form appropriate for other applications, for example the script "Make Web Map" generates an HTML client-side image map (Section 10.3).

9.9 Contextual menus

When the cursor is moved around a net it become a hand when over the central area of a node and an arrow when outside a node. The hand cursor symbol has a menu icon on its right indicating that a menu is available if one holds the "control" key down and clicks, right-clicks with a two-button mouse, or clicks and holds the mouse down without moving it. Shown below is the contextual menu that appears when this is done while the cursor is over the top node of the net being used as an example.

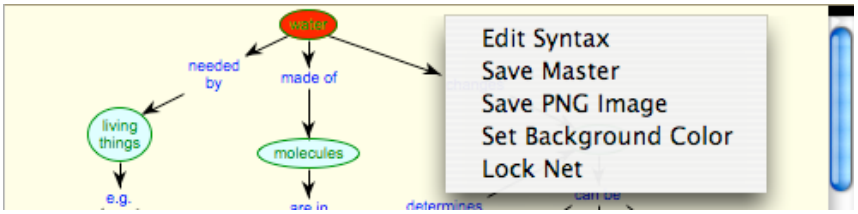


Contextual menu when cursor is over a node

"Align Nodes" causes RepNet to align any selected nodes with the node under the cursor. It aligns the node centers either horizontally or vertically according to which requires the least movement. This usually corresponds to the user's intentions. The most important visual effect is that any lines between the nodes become horizontal or vertical lines which gives the net a neater appearance.

"Edit Node" opens the node for editing as if it had been double-clicked.

Shown below is the contextual menu that appears when the cursor is not over a node.



Contextual menu when cursor is not over a node

"Edit Syntax" brings up a floating dialog that may be used to edit the syntax of the net as detailed in the following section.

"Save Master" brings up a file save dialog that may be used to save the net as a master file (section 9.11).

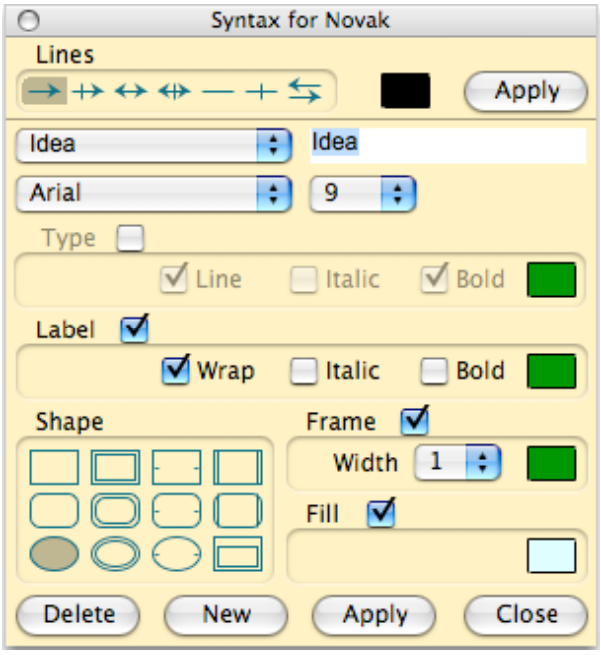
"Save PNG Image" brings up a file save dialog that may be used to save the image of the net in portable network graphics (PNG) format, e.g. for embedding in a web document.

"Set Background Color" brings up a color selection window that may be used to set the background color of the net.

"Lock Net" changes the mode of interaction with the net and is indicated by the cursor becoming a button icon over a node and a star outside nodes. The net can be unlocked by double-clicking outside its nodes. One use of the lock feature is to fetch URL's stored in the hidden note field as discussed in Section 10.3.

9.10 Net syntax editing

The net syntax editing dialog that is activated by the "Edit Syntax" item in the contextual menu is shown below.



Syntax editor floating dialog

The “Lines” panel at the top left may be used to select what lines styles are available when editing a net (Section 9.5). Clicking on an unselected line style selects it, and *vice versa.* Clicking on the color swatch brings up a color picker from which to choose the line color. Clicking on the “Apply” button makes the selected styles available in the editing area of the net.

Immediately below the “Lines” panel is a popup menu of node types, and to the right of it is a text box in which the node type names can be entered and edited. Below these are popup menus for the font and size of text in the node.

The “Type” panel has a check box that controls whether the type name is shown at the top of a node. The “Line” check box controls whether a separator line will be drawn under it if it is shown. The “Italic” and “Bold” check boxes and the color swatch control the style and color of the type name if it is shown.

The “Label” panel has a check box that controls whether the node label is shown. The “Wrap” check box controls whether the label text will be wrapped (if one or more “\” characters are embedded in the label these will be used to wrap it regardless of the “Wrap” check box). The “Italic” and “Bold” check boxes and the color swatch control the style and color of the label if it is shown.

The “Shape” panel allows one of twelve possible frames to be selected in which to display a node. The final shape at the bottom right is different from the others in that it indicates an “Enclosure” node (Section 9.4).

The “Frame” panel has a check box that controls whether the frame is shown. The “Width” popup menu controls the width of the frame and the color swatch controls the color of the frame if it is shown.

The “Fill” panel has a check box that controls whether the frame is filled. The color swatch controls the color of the fill if it is shown.

The “Delete” button deletes the node type shown on the popup menu near the top. If there is only one node type it cannot be deleted.

The “New” button creates a new node type with the name shown in the text box to the right of the popup menu near the top. The name must be different from that of any existing node type.

The “Apply” button transfers the specification of the node type shown on the popup menu near the top to the net, updating the appearance of nodes as appropriate. Note that when one node type is edited, the “Apply” button must be used before proceeding to edit another node type.

The “Close” button closes the floating syntax editor dialog.

9.11 Net master files

The “New Net” button creates a new net with some predefined node types that provides a syntax adequate for many applications. However, a wide variety of sets of node types may be used to support many forms of nets for different purposes such as semantic networks, bond graphs, argument analysis, concept maps and so on. The “Save Master” item in the contextual menu (Section 9.9) enables new types of nodes to be created and stored as a syntactical structure in “master” files which behave like any other net file except that when they open a copy is made with the name “Untitled.”

Thus master files are a way of distributing various syntactical structures for nets suited to different applications of the RepNet tool. *Rep IV* is distributed with various sample nets from different disciplines together with master files for the syntax of those nets.

Master files are useful for issuing syntax nets containing only the node and line types to be used for different representation systems. However, they can also contain a net and hence may also be used for other purposes, such as issuing student tests where some nodes are left blank to be filled by the student.

9.12 Copy and paste

Selected nodes and the lines between them can be copied into the clipboard through the "Copy" command in the "Edit" menu or by keying CMD-C. RepNet puts both the net data and an image in the clip in such a way that it is able to paste the data back into a net whereas other programs, such as word processors, paste the image in their documents. The image is normally in a vector graphics format, but **if the shift key is held down while selecting the "Copy" command in the "Edit" menu then a bitmap image will be placed in the clipboard**. The vector graphics format generally supports higher quality printing and scaling and allows the image to be pasted into a graphics package and edited as vector data. The bitmap option is useful for nets containing non-Roman Unicode characters that may not print correctly or paste correctly in some applications.

Net data in the clipboard may be pasted into another net through the "Paste" command in the "Edit" menu or by keying CMD-V. Nodes pasted may change appearance if the node type in the receiving net has a different graphic representation. If a node type with the same name does not exist in the receiving net then the node type data is also copied to the receiving net (making it possible to copy node types between nets).

Text data in the clipboard may be pasted into a net. Each line of text creates a new node of the type selected in the popup menu, and places the text in both the label and the note fields. This enables the user to edit the label, for example to shorten a journal citation, while retaining the full text in the note field. Tab characters in the data (typically from spreadsheet columns) are replaced by backslash, "\", characters in the label field, and hence generate new lines when the node label layout is calculated.

When you paste data into a net, RepNet places it at the point where you last clicked in the net. Hence, to set the location for pasting, click in the net before you paste.

A line of text data that commences with "http://" or "file://" is treated as a URL and treated differently from normal text. The URL is placed in the note field as usual. The last field in the URL is treated as a filename and placed in the label field after any extension is stripped. It may be edited in the normal way if the filename is not the appropriate label. This makes it easy to set up URL's for use in clickable nets that access them as described in Section 10.3.

9.13 Drag and drop

Drag and drop of net data behaves much the same as cut and paste except that RepNet puts the net data in the drag item for its own use, and the text of the node labels in for use by other applications. To distinguish between repositioning selected nodes and dragging copies of them, one must hold the "alt" or "option" key down when dragging in a node to indicate that it should become a drag item. When this is done the drag item is indicated by a gray rectangle initially surrounding the selected nodes.

Dragging a selected node, or nodes, and dropping them into the same net is a rapid way of duplicating those nodes.

When you drag data into a net, RepNet places it at the point where you drop it.

Files may also be dragged to a net. RepNet automatically converts them into a text item containing a URL commencing with "file://" that provides a link to the file, and will be processed as a URL as noted in the previous section.

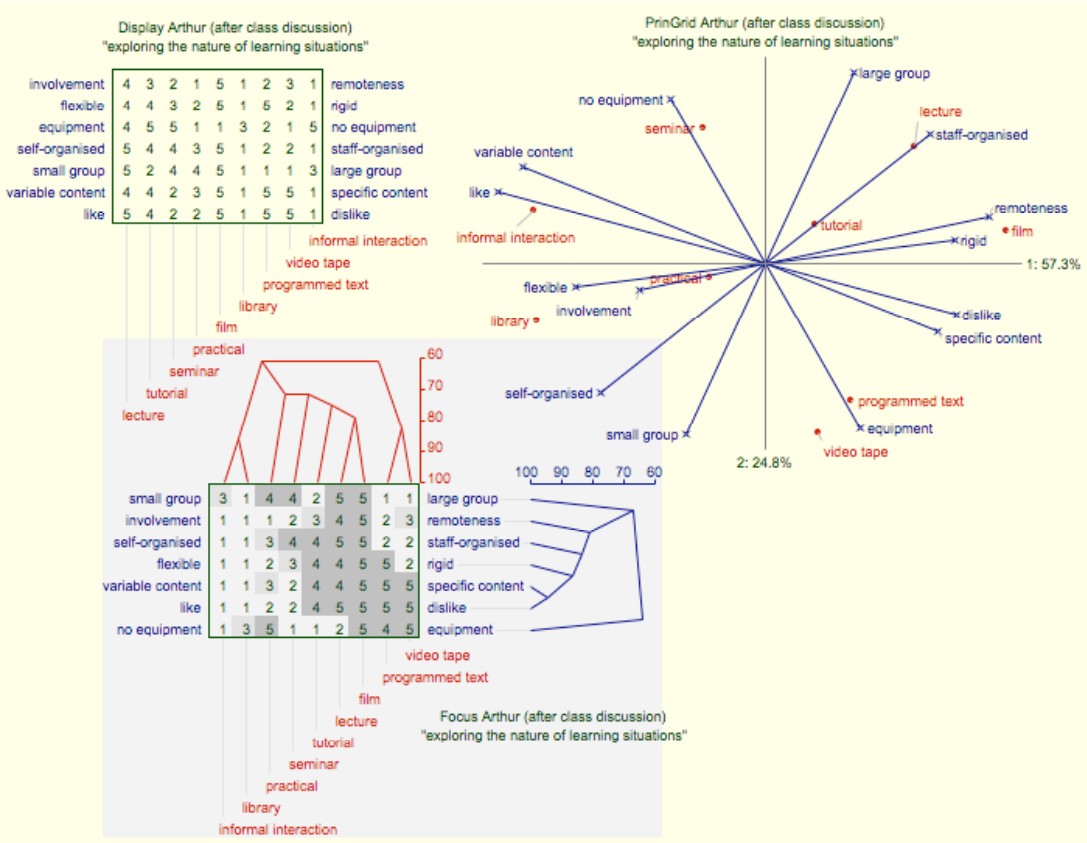
When browsing with a web browser the URL field can be copied and pasted or dragged and dropped to the net, making it easy to create a net of web links.

9.14 Grid analyses in RepNet

The graphic analyses produced by RepGrid and SocioGrids are RepNet nets with some extended features and can be edited, copied and pasted, stored, and so on using RepNet capabilities.

The graphic output from the PrinGrid and Crossplot analyses consists of a net of nodes and lines which includes special nodes having no label but displaying as a cross or a ball. These special nodes may be selected, dragged, copied and pasted in the normal way. Hence, the entire graphic output, or any part of it, may be selected, copied and pasted into another net.

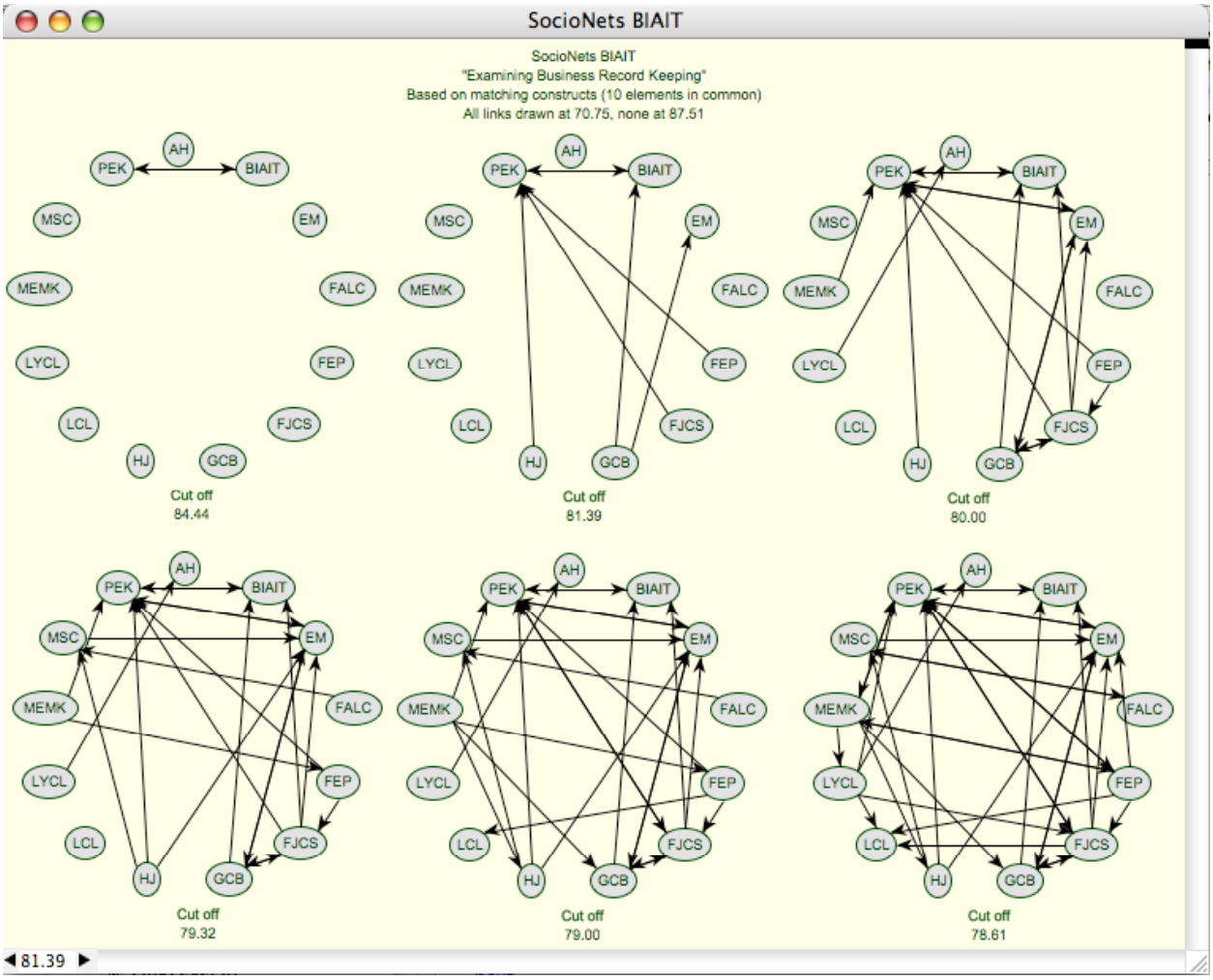
The graphic output from the Display, Focus and Compare analyses consists of a graphic object together with a title node. The graphic object behaves in much the same way as a node in that it can be selected, dragged, copied and pasted. The net below shows Display, PrinGrid and Focus outputs pasted into a single net with the Focus graphic output selected for dragging.



Grid analyses in a net

The graphic output from the SocioNets analysis consists of a net of nodes and lines which includes special lines having a weight so that different nets may be displayed by interactively changing the threshold for a line with a given weight to display. The weight associated with each link is saved with the net, and when the net file is opened it continues to be interactive. The special lines that are visible may be selected, dragged, copied and pasted in the normal way through operations on the nodes which they link.

The net below was created by copying and pasting socionets with different values of the cut off back into the original SocioNets output. The socionet at the top center is the active one, and those around it are snapshots of it at different values of cut off.



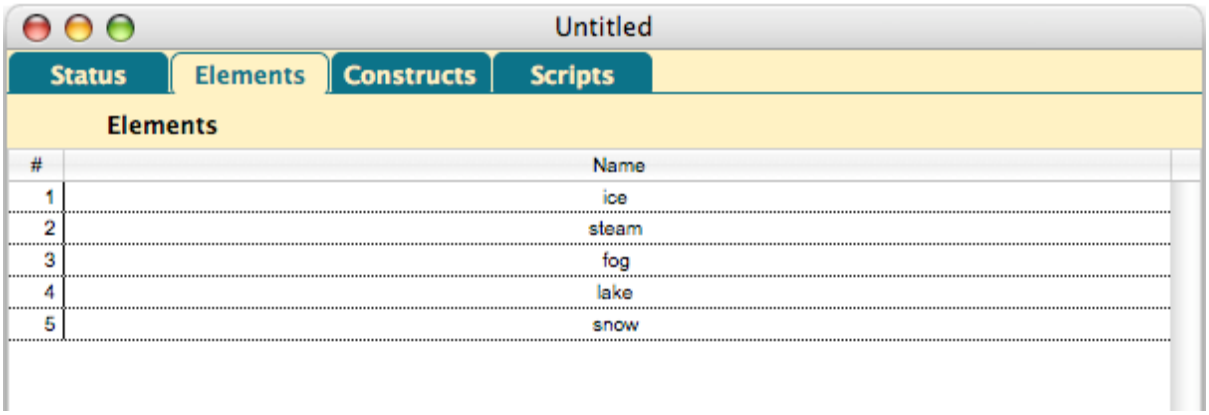
Socionets analyses at different cut offs in a net (top center one is active)

10 Integration with other applications

The tools in *Rep IV* have been designed to operate separately as stand-alone facilities, and also in an integrated way among themselves and in conjunction with other applications such as word processors, spreadsheets and web browsers.

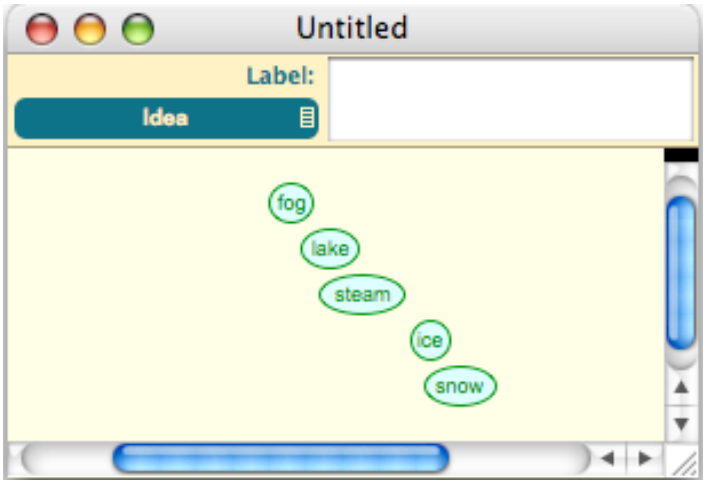
10.1 Integration between RepGrid and RepNet

Nodes in nets may be selected and then copied and pasted, or dragged and dropped, onto a RepGrid window, and the node labels are treated as text entries. The RepGrid elements pane shown below was populated by selecting, dragging and dropping some of the nodes at the lower right of the concept map about water shown in Section 9.1.



Net nodes selected, dragged and dropped into a grid elements pane

Similarly, items in grids may be selected and then copied and pasted, or dragged (while holding down the “alt” or “option” key) and dropped, into a RepNet window, and become the labels of new nodes having the type selected on the popup menu. The net below was populated by selecting, dragging and dropping the elements in the grid window shown above. Thus grids may be created from nets and nets from grids.



Grid elements selected, dragged and dropped into a net

10.2 Changing the color scheme of RepGrid analyses within RepNet

The "Style" in the analysis button in RepGrid (Section 7.8) is the most convenient way to define a color scheme for the graphic analysis of grid. However, sometimes one may wish to adjust the scheme in the output itself using the net syntax editing capabilities of RepNet (Section 9.10). If so, it is useful to know how the color scheme has been mapped into the four net styles defined in the analysis nets, "Title," "Element," "Construct" and "Rating.," as given in the tables below.

	Type	**Label**	**Frame**	**Fill**
Title	Unused	Title text	Unused	Window back color
Element	Unused	Element text	Element tree	Connecting lines
Contruct	Unused	Construct text	Construct tree	Connecting lines
Rating	Unused	Rating text	Rating dark shade	Rating light shade

Color scheme for Display, Focus and Compare analyses

	Type	**Label**	**Frame**	**Fill**
Title	Unused	Title text	Component axes	Window back color
Element	Unused	Element text	Unused	Unused
Contruct	Construct dimensions	Construct text	Unused	Unused
Rating	Unused	Unused	Unused	Unused

Color scheme for PrinGrid and Crossplot analyses

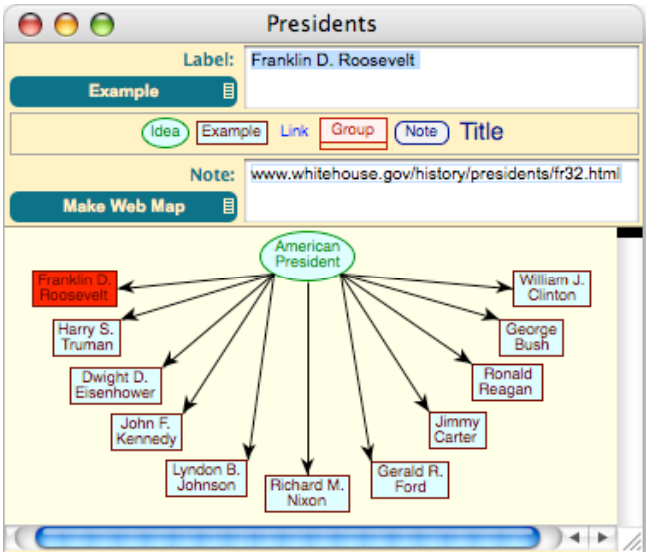
10.3 Integration of RepGrid and RepNet with other applications

The copy and paste, and drag and drop, data interchange works equally well with material in other applications such as text files and spread sheets. For example, a document in a text editor that allows multiple discontiguous selections, such as Microsoft Word, may have various words selected which are then dragged to the elements pane of a grid to become its elements, or to a net to become its nodes.

10.4 Integration with web browsers—accessing URL's by clicking nodes

The hidden note field in each node supports node annotation for a wide variety of purposes. One application that is supported by RepNet is to store a URL in the note field and to access it through a web browser either when the node is clicked locally or when an image of the map is made part of a web page and clicked remotely.

Below is shown a net representing American presidents with the hidden notes having a link to the White House web site page for the appropriate president.



Net with a URL stored in the note field of some nodes

If the net is locked through the contextual menu and a node is clicked then a "ShowURL" command is generated to the operating system that causes the URL to be fetched through the user's preferred web browser. Note that URL's can also take other forms, such as "file://" to open local files, or "mailto:" to generate an email message.

As described in Sections 9.12 and 9.13, lines of text beginning with "http://" or "file://" that are copied and pasted, or dragged and dropped, into a net are automatically processed as URL's, the URL itself is put into the note field, and the file name into the label field. In addition, local files that are dragged to a net are treated as text items containing a "file://" URL linking to the file. Hence it is simple to create a net of nodes containing links to documents on the web, or stored locally, such that the documents will be opened in the appropriate application when the node in the web is clicked.

Note that such documents include grid and net data which will open in RepGrid or RepNet when the node is clicked, so that one readily manage Rep IV projects using Rep IV nets.

10.5 Integration with web servers—saving images and web maps

A graphic image of the net may be saved in PNG format for use on the web by selecting "Save Image" from the contextual menu. A web map in HTML may be generated by selecting and clicking on "Make Web Map" in the Script button/popup menu. The output for the net above is shown below.

```
<!-- This is the client side image map -->
<MAP NAME="Presidents">
<AREA SHAPE="RECT" COORDS="2,25,53,48" HREF="http://www.whitehouse.gov/history/presidents/fr32.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="14,54,55,77" HREF="http://www.whitehouse.gov/history/presidents/ht33.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="24,82,79,105" HREF="http://www.whitehouse.gov/history/presidents/de34.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="48,109,91,132" HREF="http://www.whitehouse.gov/history/presidents/jk35.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="80,136,128,159" HREF="http://www.whitehouse.gov/history/presidents/lj36.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="199,137,245,160" HREF="http://www.whitehouse.gov/history/presidents/gf38.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="138,145,189,168" HREF="http://www.whitehouse.gov/history/presidents/rn37.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="234,108,269,131" HREF="http://www.whitehouse.gov/history/presidents/jc39.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="259,80,301,103" HREF="http://www.whitehouse.gov/history/presidents/rr40.html" TARGET="Presidents">
```

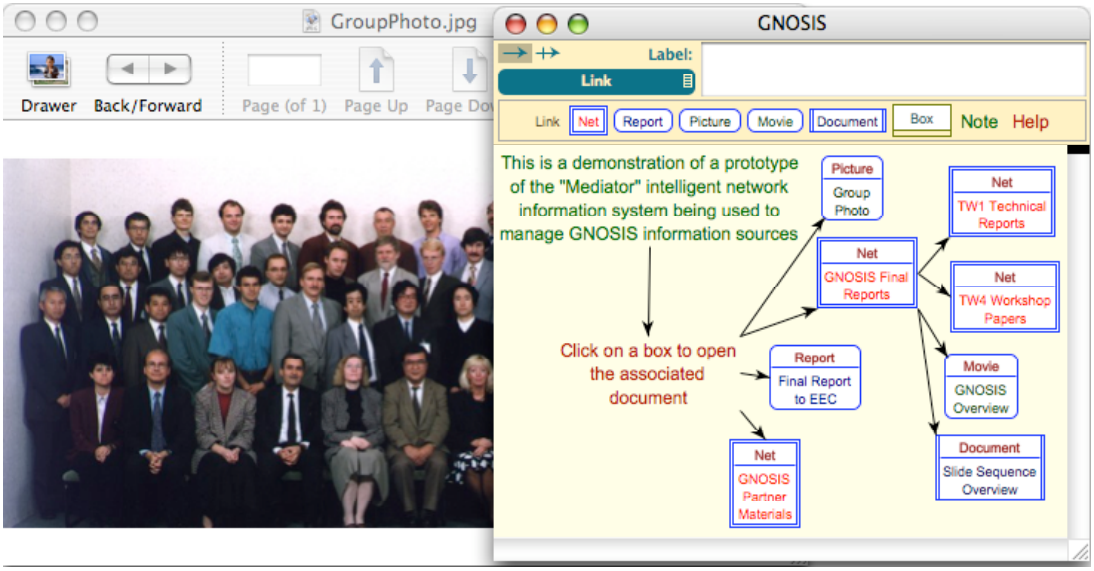
```
<AREA SHAPE="RECT" COORDS="275,54,313,77" HREF="http://www.whitehouse.gov/history/presidents/gb41.html" TARGET="Presidents">
<AREA SHAPE="RECT" COORDS="284,27,330,50" HREF="http://www.whitehouse.gov/history/presidents/bc42.html" TARGET="Presidents">
</MAP>

<!-- This is the image -->
<IMG SRC="Presidents.png" USEMAP="#Presidents" WIDTH="332" HEIGHT="170">
```

Including this as part of a web HTML document will show the net as a clickable image, and clicking on a node that had a URL in its hidden note will fetch the document corresponding to that URL in a new window.

10.6 Monitoring and managing research projects and programs in RepNet

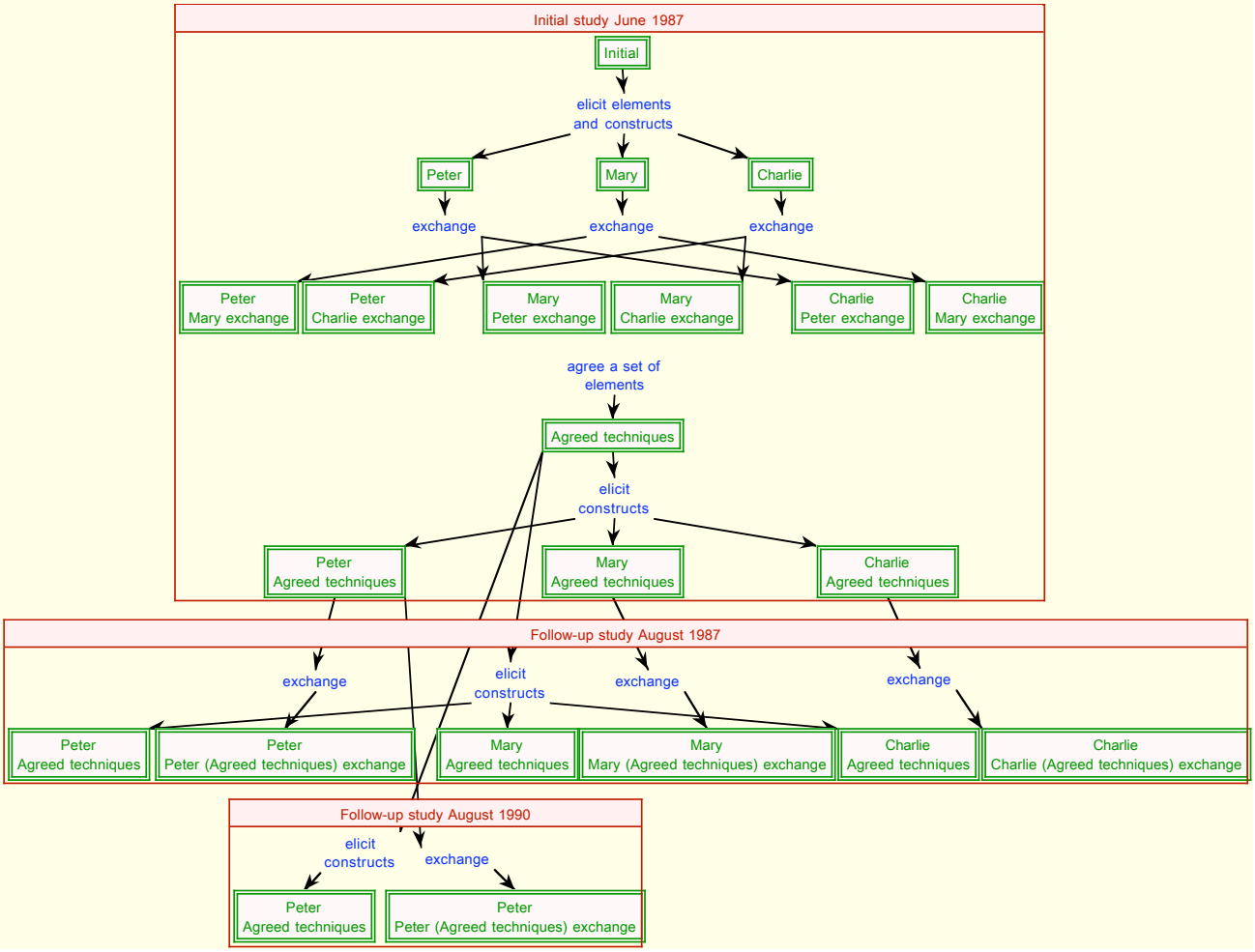
Since RepNet nodes may contain active links to local or remote files and can open these files in the appropriate application, RepNet can be used to monitor and manage research projects and programs. As the files can themselves be nets that will open in RepNet, it is possible to do this using a hierarchical or network structure of interlinked nets. As the files can also be grids that will open in RepGrid it is possible to use RepNet to manage collections of grids and associated documentation. Since the nets with the associated links can be incorporated in HTML documents as clickable images with the links in associated wep maps, the whole, or part, of the network can be made available through the Internet or an intranet.

The net below is the top level entry point for a structure of nets indexing a CD-ROM developed using a previous version of RepNet that documented an international program on intelligent manufacturing systems (Gaines, Norrie, Lapsley and Shaw, 1996). The node containing a group photograph of the project members has been clicked to open the photograph in another application as shown behind the net. Clicking the node headed “Movie” shows a movie about the program, “Report” open the final report in a document viewer, and so on. The nodes headed “Net” when clicked open other nets which give access to more detailed information about specific projects. These can in turn open further nets or open files in other applications such as AutoCAD.



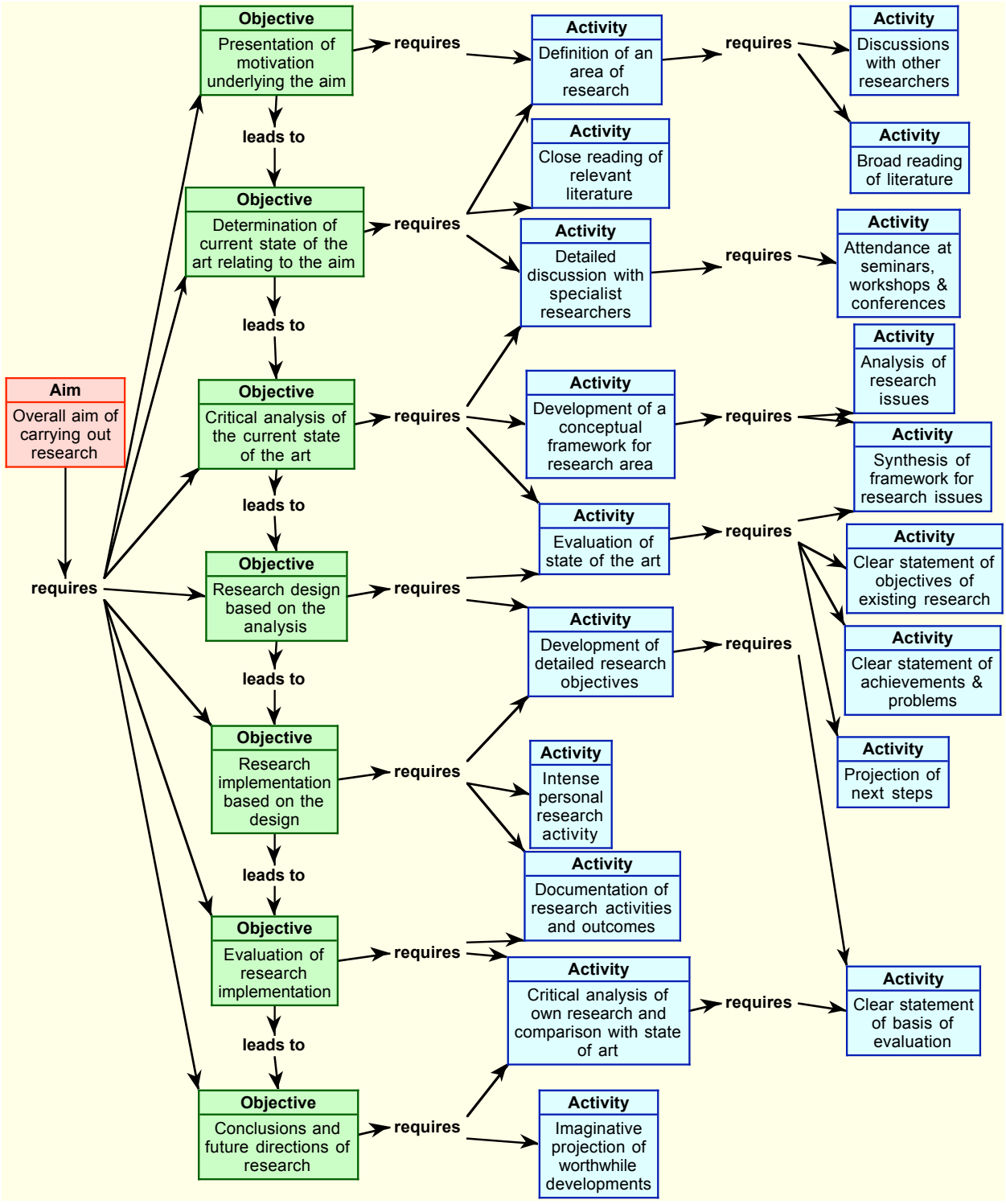
Nets indexing a CD-ROM documenting an international research program

The net below represents the grids used to illustrate SocioGrids in Section 8, showing their roles in the research project (Shaw and Gaines, 1989). Clicking on a grid opens it in RepGrid.



Net indexing a set of grids from a research project

The net below provides a generic framework for graduate research projects (Shaw and Gaines, 1998), based on stating an aim, developing it into a series of objectives, and developing these into a series of activities necessary to achieve them. The seven objectives on the left also correspond to the chapter structure of many theses.



Net representing a generic framework for graduate research projects

The generic net can be linked to a more specific net in which abstract nodes have been replaced with instances of each that are applicable to a particular research project. Each node in the specific net can be linked to a more detailed net that links to specific project documents, research notes, results, draft thesis chapters, and so on.

11 Data Formats

Rep IV supports a number of data formats for information transfer, including the file formats of our earlier grid programs such as PLANET, RepGrid and WebGrid. These are documented in the manuals for these programs. Some of the formats are documented here to support transfer of data from other systems to *Rep IV*.

11.1 Basic grid format

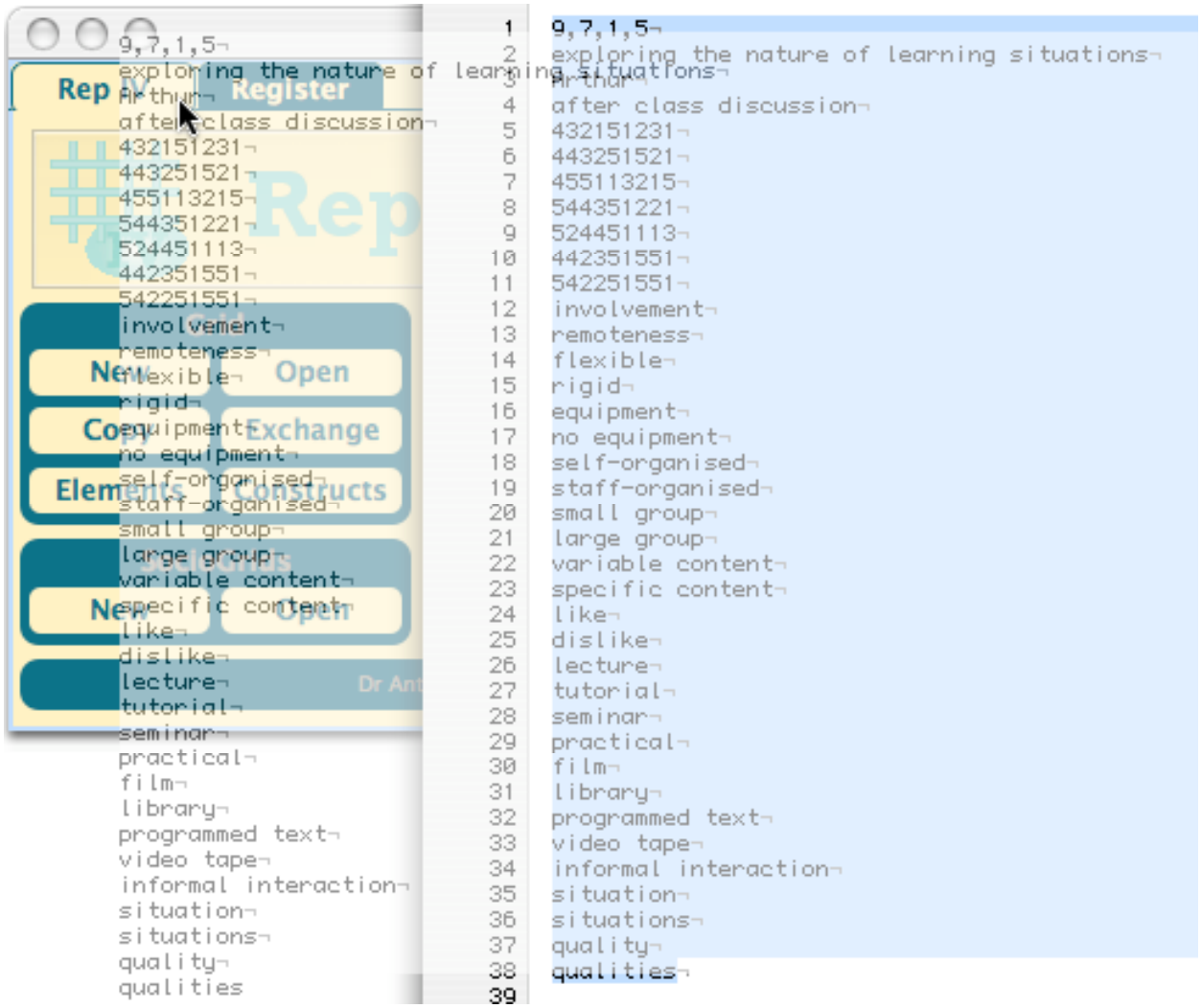
The basic grid format used in Shaw's (1980) original repertory grid elicitation and analysis programs has been adopted by others and also provides a simple format for transfer of any grid data. Grids in this format have the following structure:-

Line 1	4 numbers separated by commas:- Number of Elements—E Number of Constructs—C Lower Limit of Rating Scale Upper Limit of Rating Scale e.g. 9,8,1,5
	The next three lines are optional
Line 2	Purpose
Line 3	Name
Line 4	Note
	The ratings may be entered in one of two formats
Line 5	(packed) Rating of Construct 1 on each Element with no spaces e.g. 12345—ratings may include meta-values, ?!*^~
Line 5	(not packed) Rating of Construct 1 on each Element with no spaces separated by commas e.g. 1,2,3,4,5—ratings may include meta-values, ?!*^~
Lines 6 to 4+C	Ratings of remaining Constructs on Elements
	The remaining list can be truncated and missing information will be filled appropriately
Line 5+C	Description of Left Pole of Construct 1
Line 6+C	Description of Right Pole of Construct 1
Lines 7+C to 4+3*C	Descriptions of remaining Constructs
Line 5+3*C	Description of Element 1
Lines 5+3*C to 4+3*C+E	Description of remaining Elements
Line 5+3*C+E	Singular for Construct
Line 6+3*C+E	Plural for Construct
Line 7+3*E+C	Singular for Element
Line 8+3*E+C	Plural for Element
Line 9+3*E+C	User from whom grid elicited

The grid data on “exploring the nature of learning situations” used in section 5 is shown below in this format.

```
9,7,1,5
exploring the nature of learning situations
Arthur
after class discussion
432151231
443251521
455113215
544351221
524451113
442351551
542251551
involvement
remoteness
flexible
rigid
equipment
no equipment
self-organised
staff-organised
small group
large group
variable content
specific content
like
dislike
lecture
tutorial
seminar
practical
film
library
programmed text
video tape
informal interaction
situation
situations
quality
qualities
```

A file in this format may be opened as a grid in *Rep IV*, or it may be dragged to the *Rep IV* manager window to create a new grid as shown below.



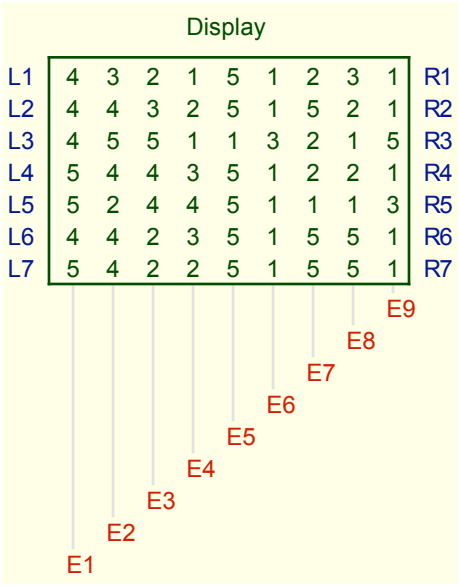
Grid data being dragged and dropped on *Rep IV* manager window

As documented above, some of the lines in the grid data may be omitted and will be filled appropriately. This enables existing grid ratings to be transferred rapidly to RepGrid with other fields being added in the RepGrid editor as required. Below is a minimal version of the grid above.

```
9,7,1,5
432151231
443251521
455113215
544351221
524451113
442351551
542251551
```

If a file with this data is opened, or the data is dragged to a grid window and dropped on it, and the "Display" button is clicked then the output will be as shown below. The elements and constructs have been given identifiers sufficient to support meaningful display and analysis, and

the name, purpose, and full construct and element names may be entered in the appropriate RepGrid fields as required.



Minimal grid data displayed after being dragged and dropped

11.2 Spreadsheet grid entry format

A simple format for single or multiple grid data entry using spreadsheet programs was defined for RepGrid 2 and is supported by *Rep IV*. It is based on the "tab-delimited" file format available in most spreadsheet programs.

The format is very simple, consisting of text separated by tab characters, and can also be generated in text editors andword processors, so that it provides another easy way to get data into RepGrid. **M**ultiple grids may be stored in the same spreadsheet, and the format is designed to avoid the need to enter redundant data. For example, if several grids have the same scale this need be entered once only, similarly if several grids use the same elements, or the same constructs, these need be specified once only. This is particularly useful in entering exchange grid data where multiple grids have common elements and/or common constructs.

Data is read in row by row commencing with the first row, and the various value settings persist unless overwritten by later settings. The first cell in a row normally contains a keyword such as "Name", "Note", "Purpose", "Range" or "Grid". The rest of the cells in that row contain data relating to the keyword. The keywords can be any order except that "Grid" must be the final one, and signifies that the grid data follows on several rows. The grid data must be terminated by a blank line (or by being the final data in the spreadsheet). Outside grid data, blank lines, and those not commencing with a keyword, are skipped and may be used to improve appearance and for comments.

The Figure below shows some grid data in Microsoft Excel:

Row 1 is optional and specifies the name for the first grid to be "pets". If this row is omitted the name is set to be "Grid-1".

Row 2 is optional and specifies the note for the first grid to be "test data".

Row 3 is optional and specifies the purpose for the first grid to be "illustrate data transfer".

Row 4 is optional and sets the scale range to be 1 to 9. If this row is omitted the range is set by default to be 1 to 5.

Row 5 is required and specifies that a grid dataset follows, with 3 elements, “dog”, “cat” and “rabbit”. The count of the number of elements in the grid following is obtained from the number of entries on this line.

Rows 6 and 7 specify two constructs and the ratings for each of the elements on these constructs.

Row 8 is blank and terminates the building of the first grid. Further data will belong to further grids.

Row 9 changes the scale to be from -3 to +3. If this line was not present the scale would remain as 1 to 9.

Because the name, note and purpose keywords have been omitted, the name will be generated as “Grid-2” and the note and purpose fields will be the same as those already specified.

Row 10 specifies that a grid dataset follows. Since no new elements are specified, the three elements already specified continue to apply.

Row 11 specifies the first construct of a new grid. Since no pole names are specified, the corresponding construct in the previous grid applies, that is, “remote—friendly”.

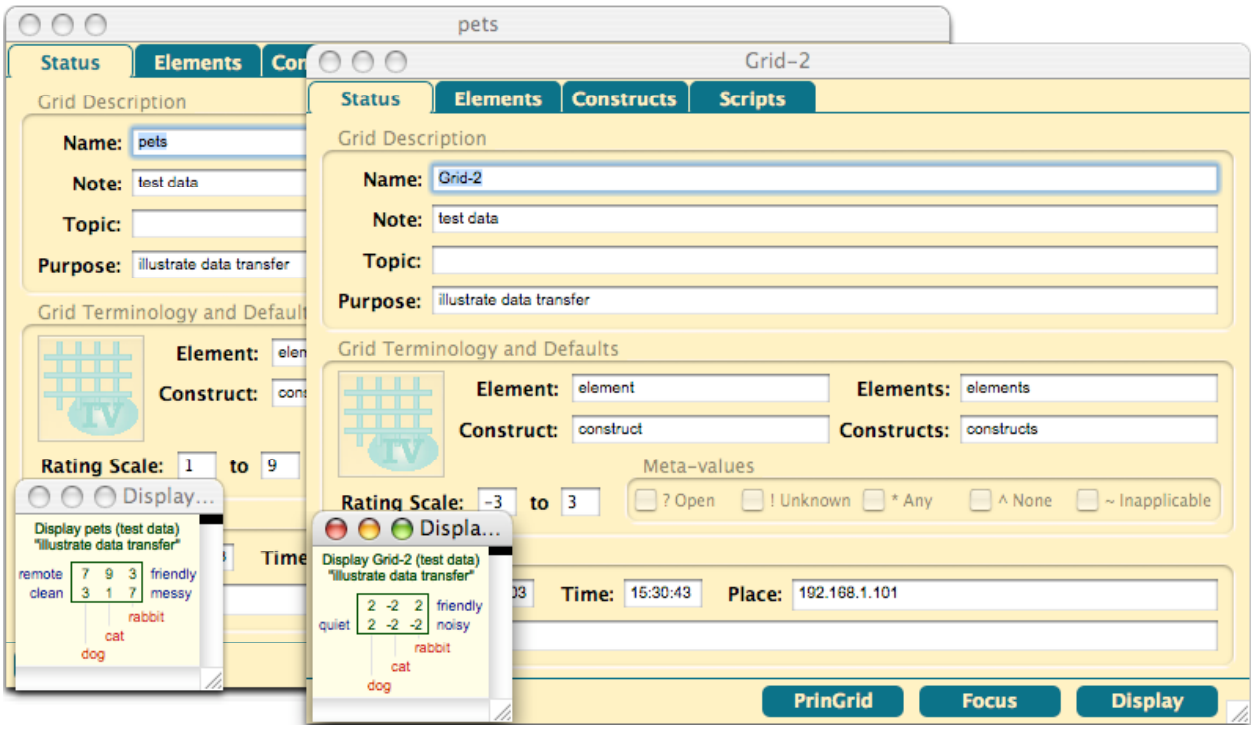
Row 12 specifies another construct.

Row 13 is blank and end of the spreadsheet. It terminates building the second grid.

	A	B	C	D	E	F
1	Name	pets				
2	Note	test data				
3	Purpose	illustrate data transfer				
4	Range	1	9			
5	Grid	dog	cat	rabbit		
6	remote	7	9	3	friendly	
7	clean	3	1	7	messy	
8						
9	Range	-3	3			
10	Grid					
11		2	-2	2		
12	quiet	2	-2	-2	noisy	
13						
14						

Two grids entered in a spreadsheet

If this spreadsheet data is dragged to the *Rep IV* manager window, or is saved using the “Text (tab delimited)”option and opened in *Rep IV,* two RepGrid windows are created, one for each of the grids in the spreadsheet file. These are shown below together with a Display of each grid.



RepGrid windows created when tab-delimited data saved from spreadsheet is opened

12 Example data

The Rep IV release comes with a set of example files that may be used to become familiar with the operations of the various programs. Many of these are related to published research which describes their origins and provides a background to their analysis. This section describes the files briefly with links to any background material.

12.1 Net examples

Novak.rnet: "concept map" example based on (Novak and Gowin, 1984, p.16)—Manual Section 9.1.

Toulmin.rnet: "argument diagram" example based on (Toulmin, 1958, p.105)—Manual Section 9.1.

Toulmin-master.rnet: "argument diagram" master.

Research.rnet: graduate research program planning example from (Shaw and Gaines, 1998)—Manual Section 10.5.

Research-master.rnet: graduate research program planning master.

12.2 Net with associated grid examples

OKA.rnet: elements elicited in organizational knowledge acquisition brainstorming (Gaines, 2003).

OKA.rgrid: grid based on the elements dragged into RepGrid (Gaines, 2003).

12.3 Net with associated URLs examples

Presidents.rnet: concept map with URL's example—Manual Section 10.3.

12.4 Grid examples

Jim Car Choice.rgrid: decision support grid from (Shaw and McKnight, 1981, Ch.6)—Manual Sections 7.9 & 7.10.

Carol.rgrid: decision support grid from (Shaw and McKnight, 1981, Ch.5).

Test Unicode.rgrid: Unicode test grid of material in different scripts—Manual Section 2.3.

Soft Machines.rgrid: manufacturing study grid from (Gaines and Shaw, 1994).

OBAP-130.rgrid: personal assessment grid from (Shaw, 1980, p.130).

Clinical: some grids from (Slater, 1977, pp.32,110)

Learning Situations: grids with common elements/constructs for comparison—Manual Section 7.5.

Computing-Same Elements: information technology grids from (Shaw and Gaines, 1996) for comparison.

Clinical-Same Elements: therapy progress grids from Leach (2001) for comparison.

Geography-Same Elements: geographer grids from (Shaw and Gaines, 1989) for comparison.

12.5 SocioGrids examples

Geog: Sequence of grids from study in (Shaw and Gaines, 1989)—Manual Section 8.

BIAIT: Set of grids with common elements from (Shaw and Gaines, 1983) for use with SocioGrids.

CPSC547: Set of grids with common elements from (Shaw and Gaines, 1996) for use with SocioGrids.

12.6 Data transfer formats

Arthur.txt: One of the learning situations grids in a basic grid format—Manual Section 11.1

Arthur.xcl: One of the learning situations grids in tab-delimited spreadsheet format—Manual Section 11.2

Pets.xcl: Showing how several grids may be entered from tab-delimited spreadsheet data—Manual Section 11.2

13 Versions of Rep IV

There are three versions of *Rep IV* based on the same tools and interfaces.

13.1 The Personal version of Rep IV

The *Personal* version of *Rep IV* is intended to make grid and net tools freely available for personal and educational (non-commercial) use. We have simplified the functionality as much as possible to make it easy to use, and hope that it will find a place in schools and in courses introducing students to personal construct psychology and the representation of construct networks through grids and nets. It should also allow anyone interested in the techniques to explore them personally as they see fit. The greater functionality of the other versions is built on the same foundations with similar user interfaces, so that this version may also be used to explore potential applications of the more powerful versions. For many uses involving the individual analysis of grids with up to 15 elements and 15 constructs the *Personal* version may suffice—our intention is that it should be adequate for many applications.

13.2 The Research version of Rep IV

The *Research* version extends the *Personal* version with facilities for professionals having a background in personal construct psychology who need a full range of grid analysis tools with no limitation on grid size, including the *SocioGrids* tool (Shaw, 1980) to analyze multiple grids. It supports conversational elicitation of new grids, rapid entry of existing grids, and import/export of grid data in a variety of formats, all through researcher-scriptable interaction. For single grids, in addition to Focus and PrinGrid, it provides crossplots, statistics, sorted matches, selective analysis and weighted analysis. For multiple grids having overlapping sets of elements or constructs, *SocioGrids* provides the capabilities to create and analyze composite grids, to compare pairs of grids, to generate a *ModeGrid* of commonly used constructs, and to output *SocioNets* linking those grids having similar patterns of construing.

The *Research* version also supports those facilitating groups of individuals using the *Personal* version. RepNet is extended to allow new types of net to be defined with a syntax of node and line types suited to specific purposes. It supports the saving of nets as clickable images for use in web documents, and user-scriptable import, export and interaction with nets for integration with other applications. For example, an instructor might provide students with the *Personal* version, together with a shorter, more specific manual than this one, and use the *Research* version to provide the students with net syntax master files that have types and terminologies appropriate to the subject area, and to support social interaction through comparisons of students' grids.

13.3 The Web version of Rep IV

The *Web* version extends the *Research* version for those wishing to operate public or private *WebGrid* servers offering the capability to elicit and analyze grids over the Internet or a local network with customized interactive dialogs and privacy of data. It can also be used on a stand-alone machine to enable a web browser to be used for grid elicitation with full multimedia integration.

The web services provided are scriptable by those managing the server, and may be extended to support specialist requirements such as those of knowledge management, clinical trials, social surveys or market research. A typical application is large-scale data collection through grids and questionnaires followed by the use of the multi-grid analysis tools to interpret the data collected.

13.4 Table comparing features of versions of Rep IV

The table below shows the features of the different versions in greater detail.

	Rep IV Version		
Feature	*Personal*	*Research*	*Web*
Full color support in graphic output	Preset	Selectable	Selectable
Unicode (UTF-8) (non-Roman text in nets and grids)	Supported	Supported	Supported
Copy & Paste, Drag & Drop (transfer data to and from other applications)	Supported	Supported	Supported
XML data interchange	--	Supported	Supported
RepNet: Representation Nets (also used for grid analysis plots)	Included	Included	Included
Presets: e.g. argument forms, concept maps	Provided	Provided	Provided
Enter & edit nodes and lines	Included	Included	Included
Copy and paste images to other applications	Bitmap	Vector/bitmap	Vector/bitmap
Multi-page and fit-to-page printing	1-page	Included	Included
Define net syntax of node and line types & styles	--	Included	Included
Set up a default new net	--	Included	Included
Save net as preset master for personal version	--	Included	Included
Annotate nodes	--	Included	Included
Use URL annotation to access web and local files	--	Included	Included
Save net as PNG image for display on web	--	Included	Included
Generate HTML image map (clickable image)	--	Included	Included
Scriptable import/export, interaction & analysis	--	Included	Included
RepGrid: Grid Elicit, Enter and Edit	Included	Included	Included
Maximum size	15 by 15	Unlimited	Unlimited
Enter & edit	Included	Included	Included
Reads PLANET, RepGrid 2 and WebGrid files	To max size	Included	Included
Scriptable rapid entry of existing grid data	Included	Included	Included
Scriptable interactive elicitation (Pegasus)	Included	Included	Included
Meta-values: *open, any, none, not-applicable, unknown*	*Open* only	All	All
Set up a default new grid	--	Included	Included
Annotation of elements and constructs	--	Included	Included
Scriptable import/export	--	Included	Included
RepGrid: Grid Analysis	Included	Included	Included
Display plot	Preset	Selectable	Selectable
Focus plot (sort & hierarchical cluster analysis)	Preset	Selectable	Selectable
Principal Components plot (factor analysis)	1st by 2nd	Selectable	Selectable
Focus matches, sorts and links data as text	--	Included	Included
Principal Components loadings data as text	--	Included	Included

Crossplot of elements on selected constructs	--	Included	Included
Pairwise Comparison plots (Minus & Compare)	--	Included	Included
Statistics (construct ranges, means, correlations)	--	Included	Included
Sorted element and construct matches	--	Included	Included
Analyze only selected elements and constructs	--	Included	Included
Weight elements and/or constructs	--	Included	Included
Minkowski metric with fractional powers for matches	--	Included	Included
Scriptable analysis (e.g. complexity measures)	--	Included	Included
SocioGrids: Multiple Grids Analysis	--	Included	Included
Analyses can be based on common elements or on common constructs or both	--	Included	Included
Composite grids (merge grids for joint analysis)	--	Included	Included
Pairwise Comparison plots (Minus & Compare)	--	Included	Included
ModeGrid (commonly used constructs or elements)	--	Included	Included
SocioNets plot based on common elements/constructs	--	Included	Included
Interactive, incremental SocioNets plot in RepNet	--	Included	Included
ModeGrid & SocioNets data as text	--	Included	Included
Minkowski metric with fractional powers for matches	--	Included	Included
Web Services: WebNet & WebGrid	--	--	Included
Web services run on local machine, LAN or Internet	--	--	Included
WebDoc: document server	--	--	Included
WebNet: clickable nets as web images	--	--	Included
WebGrid: web-based grid elicitation and analysis	--	--	Included
Automatic grid cache for distributed data collection	--	--	Included
Integration with multimedia and other applications	--	--	Included
Scriptable for other languages and puposes	--	--	Included
	Personal	*Research*	*Web*

14 Background material

Articles relating to RepGrid and RepNet and their applications my be found at http://repgrid.com/reports

14.1 References

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