Research Product 86-33

DINAA: The Dynamic Intelligence Assessment Aid

Battlefield Information Systems Technical Area

Systems Research Laboratory

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U. S. Army Research Institute for the Behavioral and Social Sciences

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The Dynamic Intelligence Assessment Aid (DINAA) is designed to assist military intelligence analysts in revising judgments of an enemy's most likely avenue of approach as new information arrives. When a message is received, the analyst assesses, for each avenue of approach, the likelihood that the reported event would occur if the enemy were actually using that avenue of approach. DINAA then applies Bayes' Theorem to the user's assessments and generates a set of probabilities.

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DINAA: The Dynamic Intelligence Assessment Aid

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Human Factors in Training and
Operational Effectiveness

FOREWORD

The Battlefield Information Systems Technical Area performs research and development focused on increasing the capacity of Army personnel to acquire, transmit, process, disseminate, and utilize information. Of special interest is research in the areas of information processing and decision making, performance assessment, and user-oriented systems.

The report is a user's manual to accompany the automated Dynamic Intelligence Assessment Aid. The aid is designed to assist military intelligence personnel in predicting an enemy's most likely avenue of approach as new and changing information is received. Use of this automated procedure, which is based on Bayes theorem, is expected to help analysts overcome the tendency to persist in their original predictions despite the arrival of contracting information.

EDGAR M. JOHNSON
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1.0 Introduction

The Dynamic Intelligence Assessment Aid (DINAA), intended for use by U.S. Army intelligence analysts, assists in revising judgements of an enemy's most likely avenue of approach as new information arrives. This information typically arrives in the form of messages and may include factors unforeseen in a conflict situation. DINAA may be used alone in assisting analysts or may be used in conjunction with the Artificial Intelligence/Enemy Courses of Action Aid (AI/ENCOA). AI/ENCOA provides a pre-defined static model for evaluating enemy courses of action and is greatly enhanced by DINAA's ability to account for unexpected and dynamic information.

Initially, DINAA sets probabilities for each avenue of approach based on AI/ENCOA results. If not satisfied with the calculated initial probabilities, or if AI/ENCOA was not run, the analyst may directly modify these "prior probabilities." As messages arrive, the analyst assesses the likelihood of the indicated events occurring for each avenue of approach. DINAA's fundamental step aids the analyst by applying Bayes' Theorem to the adjustment of the prior probabilities and assessed probabilities. After applying Bayes' Theorem, DINAA arrives at the set of posterior probabilities indicating the (possibly new) most likely avenue of approach. These probabilities are then used as the prior probabilities for the next iteration.

Assisting the analyst in the difficult task of quantifying assessed probabilities and odds was a prime consideration in the development of DINAA. An advanced user interface was implemented to meet this requirement. Among the unique capabilities and features developed are the extensive use of pre-generated graphic windows, the automatic detection and use of a mouse device whenever possible, the generation of three types of graphic displays (bar-charts, piecharts, and plots), the textual interpretation of four types of numeric data, the linking of messages with graphic image files, the use of color, and use of a customized character font.

DINAA has no predefined limits on the number of messages it can record and allows the re-assessment or removal of messages at any time. The list of possible avenues of approach can also be modified at any point, but is limited

to a minimum of two and maximum of four avenues. Although at most four courses of action and their associated utility scores may be transferred from AI/ENCOA, none are required. The use may instead directly set initial probabilities.

This report details the installation and operation of DINAA and additionally, in Appendix A, the supplemental Prototype Analyst Workstation (PAWS) files and utilities developed as part of this effort for the Army Research Institute.

2.0 Installation

Installation of DINAA itself is reasonably straightforward. All required files are contained on a single diskette. The more difficult aspect of installing DINAA relates to making sure you have the correct programs resident in memory before using a mouse device or printer. These aspects of installation are described below, under software requirements.

2.1 Hardware Requirements

DINAA will operate on any IBM PC with a color monitor, color/graphics adapter board, and at least 256K RAM. A hard disk, mouse, and printer are not required, but are highly recommended for ease of use. DINAA was developed on an IBM PC-XT with a Taxan 440 color monitor, Persyst BoB color graphics board, 640K RAM, Mouse Systems M2 mouse, and an EPSON FX-80 dot matrix printer.

2.2 Software Requirements

DINAA runs under the PC-DOS (2.0 or greater) operating system and, in its simplest installation, requires no additional software. The driver routine and modified AI/ENCOA software are needed if data is to be transferred into DINAA.

If a mouse is to be used, a Microsoft-compatible resident device driver must be loaded. DINAA was developed with Mouse Systems' MSMOUSE.COM resident driver and should also work with the Microsoft driver loaded, but this has not been available for testing. These programs usually come with the mouse when purchased. DINAA may have to be modified to accomodate other mouse drivers.

Additional software is also required for hardcopy printouts of screen displays, as DINAA relies on resident programs such as GRAPHICS.COM, which accompanies the DOS operating system, or EPSON.COM, which accompanies the Mouse Systems mouse, to perform a screen dump. GRAPHICS.COM is a resident program which responds to the user pressing the SHIFT-PRTSC keys by dumping the screen contents to a graphics printer. EPSON.COM performs the same task, but does it better than GRAPHICS.COM, as it realizes that the DINAA background color should not appear on the pri out.

2.3 Transferring Disk Contents

If DINAA is to be used in conjunction with AI/ENCOA on a hard disk system, change the directory to where AI/ENCOA is located using the DOS ChDir command, place DINAA Disk 1 in Drive A, and type "COPY A:*.*". If DINAA is to be used in a standalone mode, the only requirement is that the DINAA files be copied, i.e. "COPY A:DINAA.*".

3.0 System Operation

DINAA incorporates a mouse device for selecting commands and for entering data whenever possible. An arrow on the screen follows the movement of the mouse and is used to point to commands to be executed. Groups of related commands are combined into menus which may be exited by clicking outside the box containing them. This holds true even for the toplevel menu which is always visible at the top of the screen, so that if the user clicks outside of the toplevel menu, the button will have to be clicked again inside the menu to see the options. Commands are selected by pointing the arrow, and pressing and releasing ("clicking") the left button of the mouse. Whenever a command is selected, the area of the screen around the command is inverted, and remains inverted as long as that command is active. A command may be cancelled by clicking outside the box containing the command.

If DINAA does not detect the required mouse device driver when it starts up, all mouse operations are simulated by the use of keyboard cursor movement keys and the RETURN button. When using cursor movement keys, motion of the arrow may speeded up by depressing the SHIFT key in conjunction with the movement key. Clicking the left mouse button is simulated by hitting the RETURN key. When the mouse is used, these keys are, for the most part, disabled by DINAA. Only when DINAA requires the entry of text or data does control revert to the keyboard. When entering text or data at the keyboard, the BACKSPACE key may be used to correct mistakes.

In the event of an attempt to perform an invalid operation, such as trying to assess a message before two avenues of approach have been specified, or attempting to plot the probabilities history before any messages have been entered, an error message window will pop up explaining why the operation was not allowed. The user must then click the mouse button to continue.

3.1 Starting DINAA

DINAA may be started in one of two ways, either with a driver linking AI/ENOCA results to DINAA initialization, or by itself, in a standalone mode.

3.1.1 Starting with AI/ENCOA results

In order to use DINAA in conjunction with AI/ENCOA, the user must have copied all files from Disk 1. The system is started by typing "DRIVER" at the DOS level. This driver provides a mechanism for AI/ENCOA to pass information to DINAA by way of common storage locations. The driver routine starts with the display shown in Figure 1. From this point, enter "A" to begin AI/ENCOA. When exiting from AI/ENCOA, this screen will reappear, at which point the user should then enter "D" to start up the DINAA system. DINAA will read the avenues of approach, courses of action, and utility scores set in AI/ENCOA and will come up with the screen shown in Figure 2.

3.1.2 Starting DINAA alone

To use DINAA as a standalone aid, the DINAA.* files must have been copied from Disk 1. Simply typing "DINAA" will then bring up the screen shown in Figure 2. To begin executing commands and to erase the title screen, move the arrow outside of the title box and click the left mouse button.

3.2 Help Information

A brief summary of available commands is available in DINAA. To see the help screen, the arrow must be moved to point at "HELP." The user may then need to click the button to get the screen shown in Figure 3, depending on what the previous menu state was. Moving the arrow down until the "DINAA Information" becomes inverted and then clicking the button causes a new screen to be displayed, as in Figure 4. This screen shows which commands are available under each heading.

3.3 Initialization

If DINAA has been started without first running AI/ENCOA, or if AI/ENCOA did not pass at least two avenues of approach to DINAA, the user will be required to initialize DINAA by specifying at least two avenues of approach and, optionally, the courses of action and utility scores. If enough information is provided to DINAA, an initial set of probabilities for avenues of approach

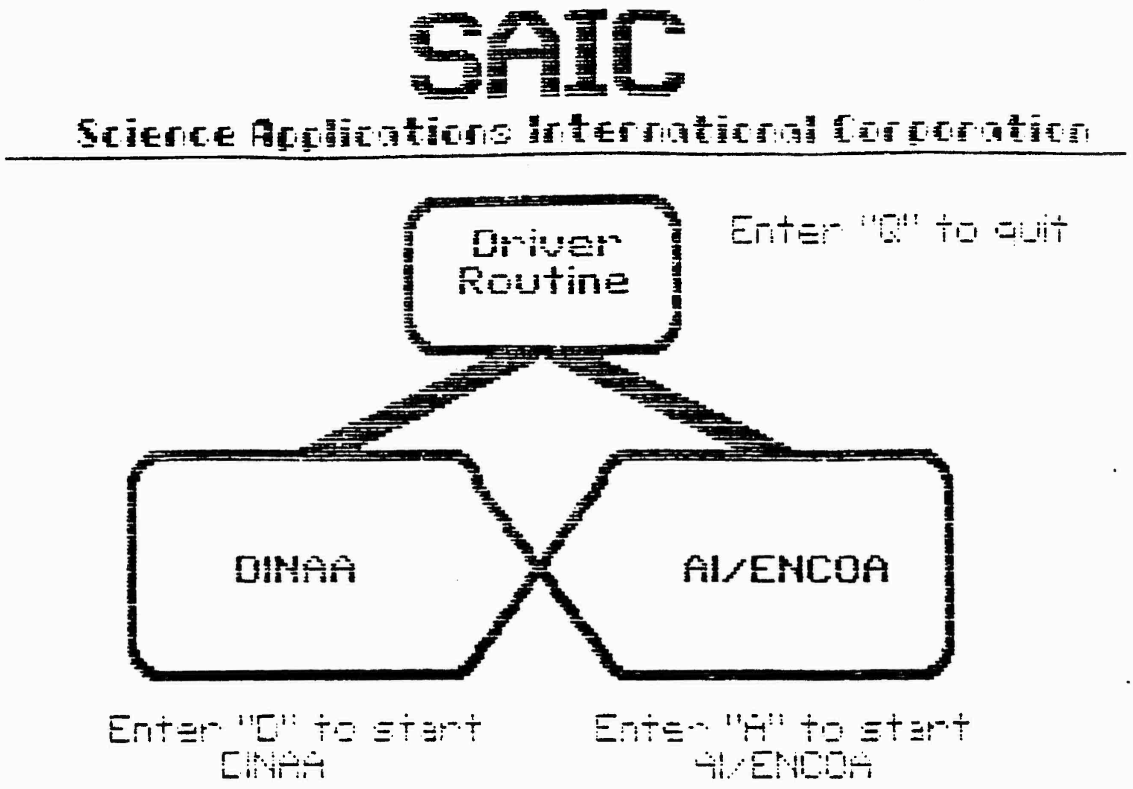


FIGURE 1. DINAA - AI/ENCOA SCREEN

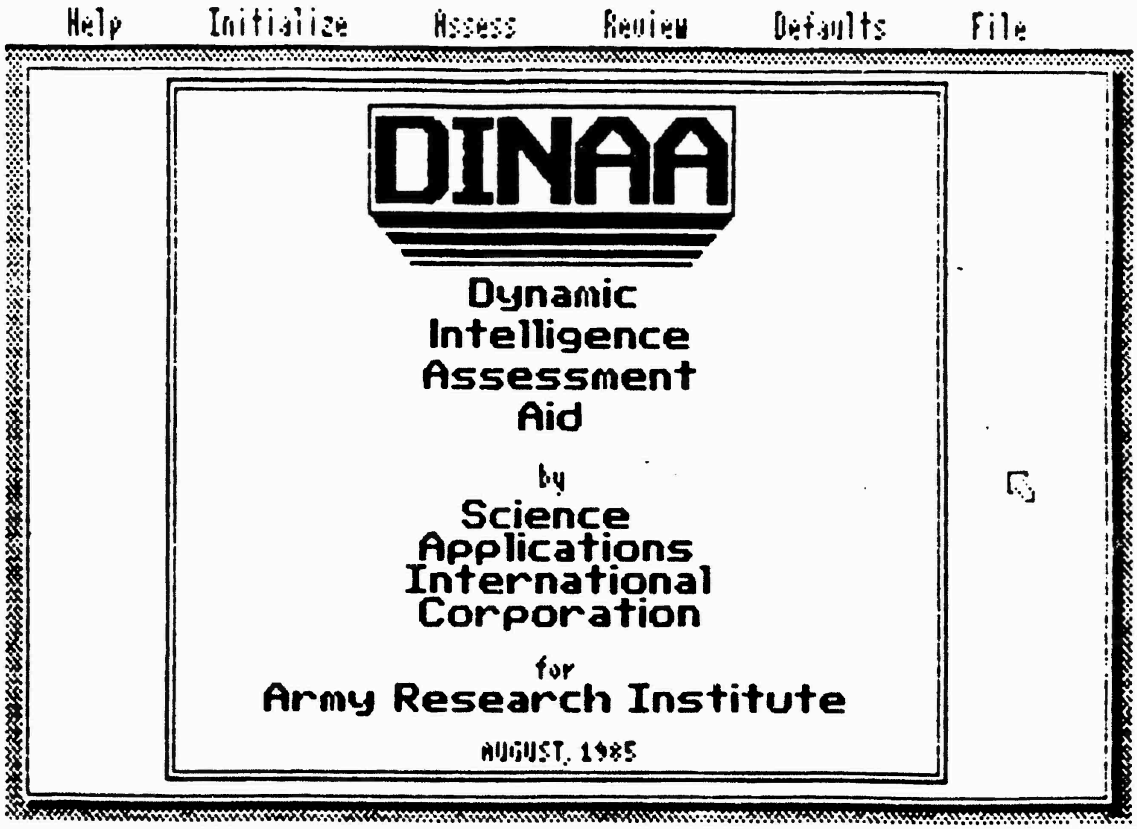


FIGURE 2. DINAA TITLE SCREEN

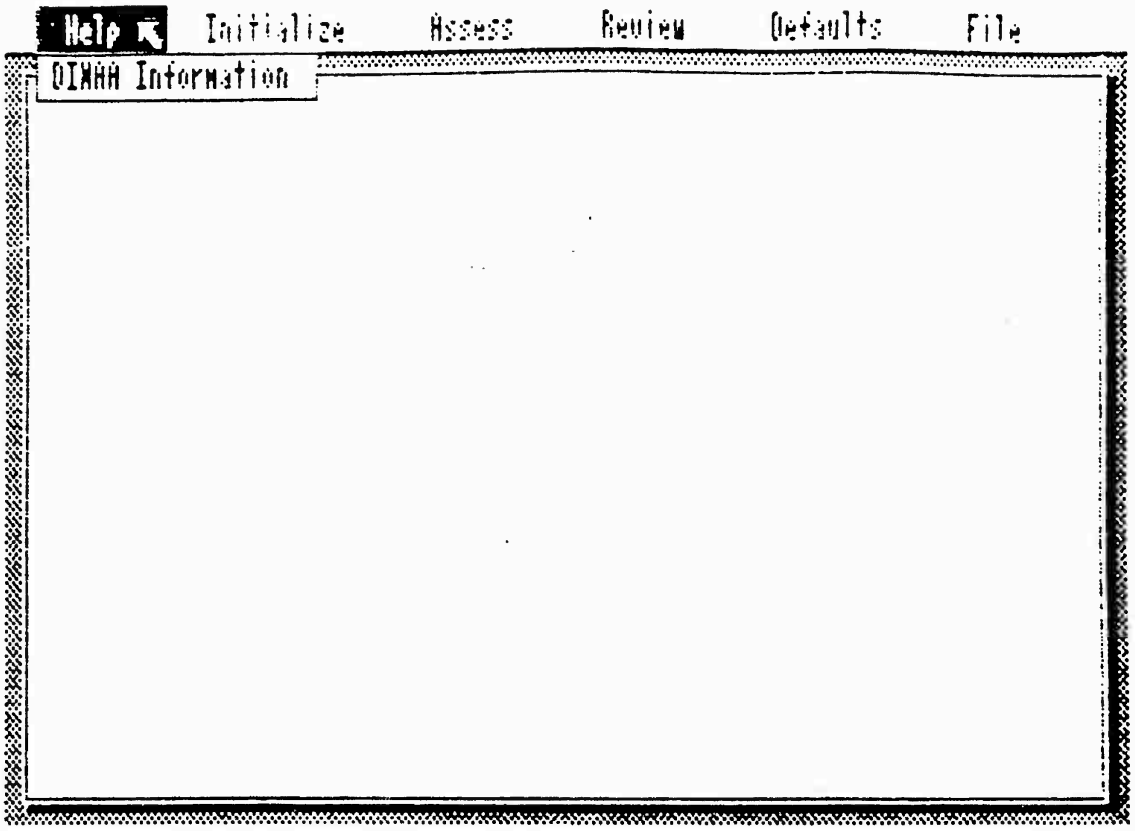


FIGURE 3. HELP OPTION

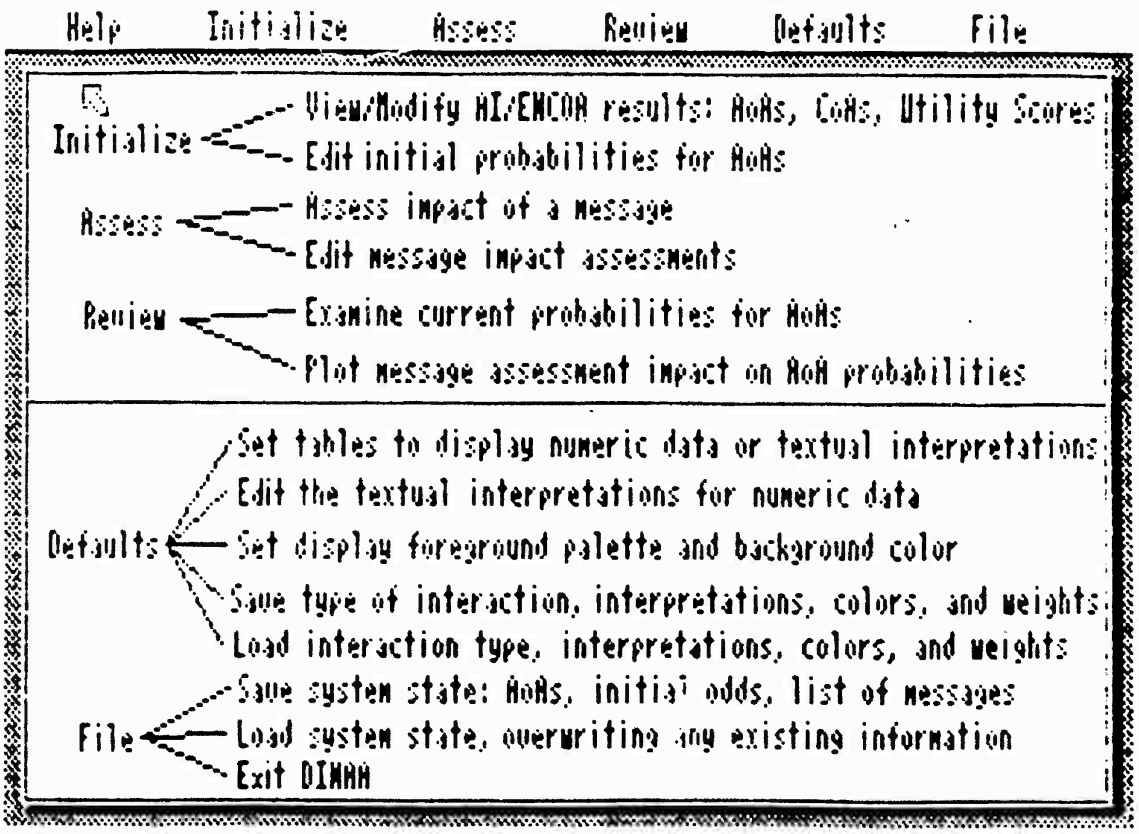


FIGURE 4. COMMAND SUMMARY DISPLAY

will be calculated based on a method of weighting utility scores, summing the weighted scores for each avenue of approach, and normalizing. If DINAA does not have enough information to perform this calculation, it will assign equal probabilities to each AoA. In any event, the user may set or directly modify the initial probabilities. To perform any of the initialization functions, the arrow must be moved to point to "Initialize" at which point the screen shown in Figure 5 will appear.

Even if AI/ENCOA has been run, and DINAA has enough information to calculate initial probabilities, the initialization functions provide the valuable facility for inspection and modification of the initial state at any point in the use of DINAA.

3.3.1 Setting Avenues of Approach, Courses of Action, Utility Scores, and Utility Score Weights

The user should select the "Set AoAs and Utility Scores" option under the "Initialize" heading to set or inspect any of the AoAs, CoAs, utility scores, or utility score weights. The window that pops up, which is in table format, can be described as a group of related cells, with some cells holding names of AoAs, others holding utility scores, and so on. These cells are sensitive to arrow location and may be modified by pointing at them and clicking. Only the calculated probability cells are not subject to direct modification (Section 3.3.2 describes procedures for direct modification of initial probabilities).

An avenue of approach may be modified by pointing to a cell immediately under the heading "Utility Scores by Region," as shown in Figure 6. DINAA will ignore clicks in an unnamed cell unless there are no unnamed cells to the left of it. The options which pop up allow the insertion, renaming, or deletion of an AoA. As AoAs are inserted, all related data items are set to zeroes for the AoA. The options for the cell disappear, and the cell is left inverted, waiting for an AoA name. The name must be followed by the RETURN key to enter it. As AoAs are deleted, other AoAs are pulled from the right so that all AoAs are shown in the leftmost columns. Courses of action may be similarly edited under the "Course of Action" column heading.

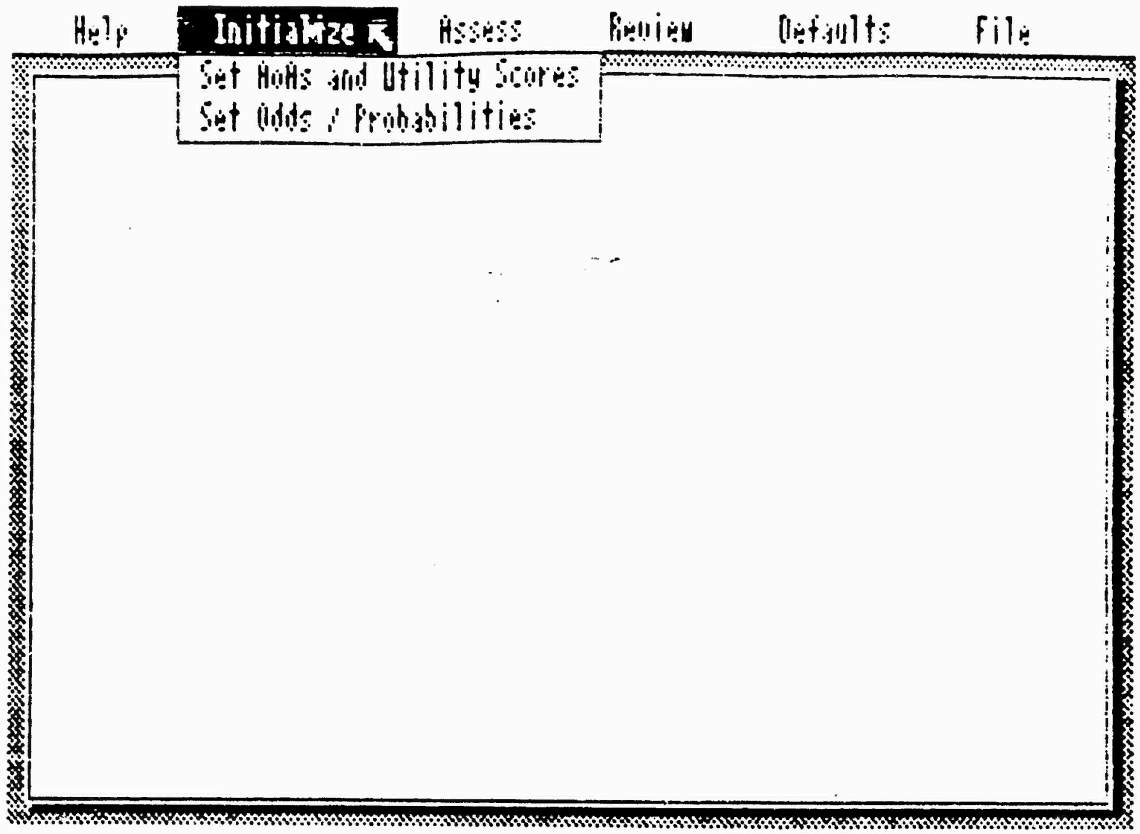


FIGURE 5. INITIALIZATION OPTIONS

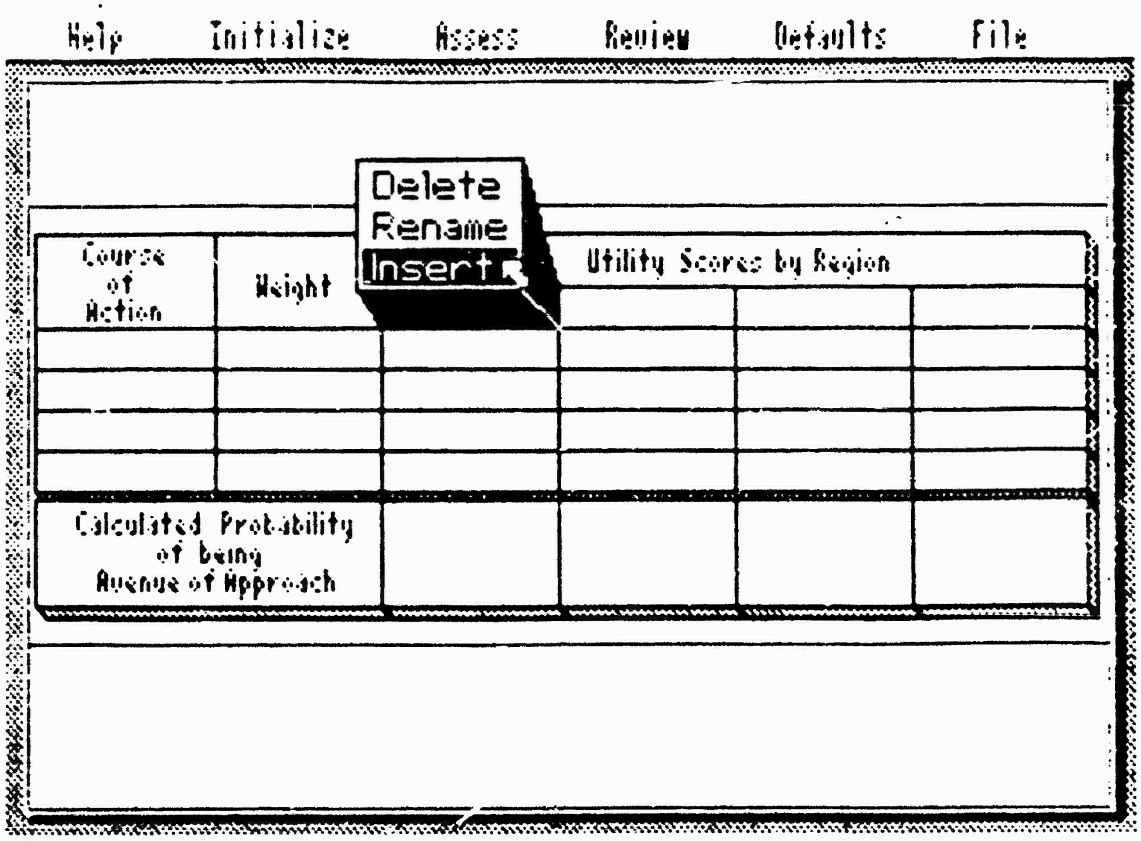


FIGURE 6. NAMING AVENUES OF APPROACH

Utility scores and weights, as with the other cell types, may be set by pointing at the cell and clicking. Figure 7 shows what will appear on the screen when this is done while using textual interpretations. A menu of optional settings appears, and clicking one of the options sets the utility score. Clicking outside the menu, as always, causes the menu to disappear without making changes. If textuals interpretations are not being used, as shown in figure 8, the user must enter utility scores and weights using the keyboard, followed by the RETURN key.

Any time a cell is changed, all dependent cells are updated, much like a spreadsheet, so that newly calculated AoA probabilities are immediately visible.

3.3.2 Setting Initial Probabilities and Odds

By clicking the "Set Odds/Probabilities" option under the "Initialize" heading, the initial settings may be viewed in pie chart, barchart, or table form. They may be modified while tables of odds or probabilities are displayed. Figure 9 shows the screen with the menu of options for this feature.

Figures 10 to 16 illustrate an exercising of the options. In Figure 10, the most likely AoA is shown together with the ratio of its probability to each of the other AoAs in numeric form. Each number in this Figure indicates the number of times the most likely AoA is more probable than each of the others. Figure 11 shows the same information using textual interpretations. In Figure 12, the cell indicating the most likely AoA is modified in the standard way. Figure 13 shows how the likelihood ratios may be modified. Use of pie charts to indicate relative chances of the AoAs is illustrated in Figure 14. In Figure 15 is seen a table of probabilities. This table may be modified much like that for odds. As with the odds, any change to these settings will cause the updating of the message list, if any. Shown in Figure 16 is a bar chart of the absolute probabilities for AoAs. Odds and probabilities are related and should be used together in assigning initial settings or message assessments.

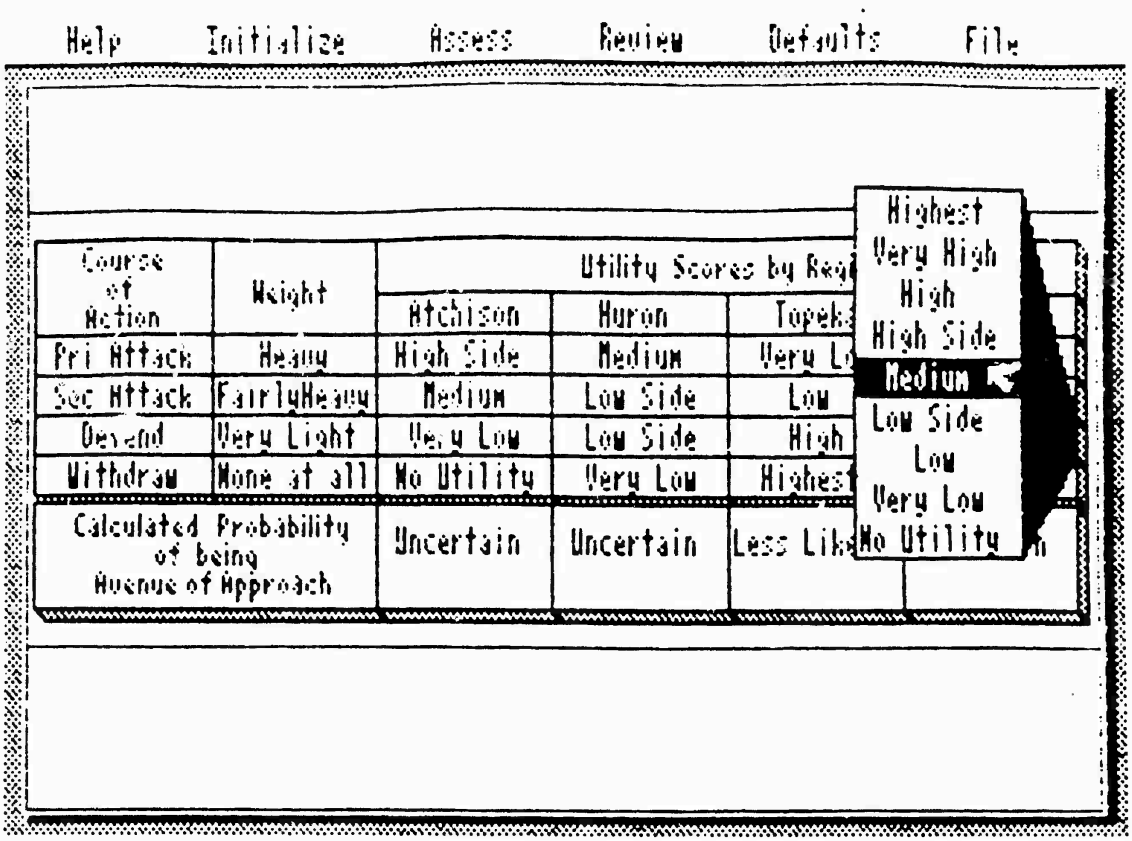
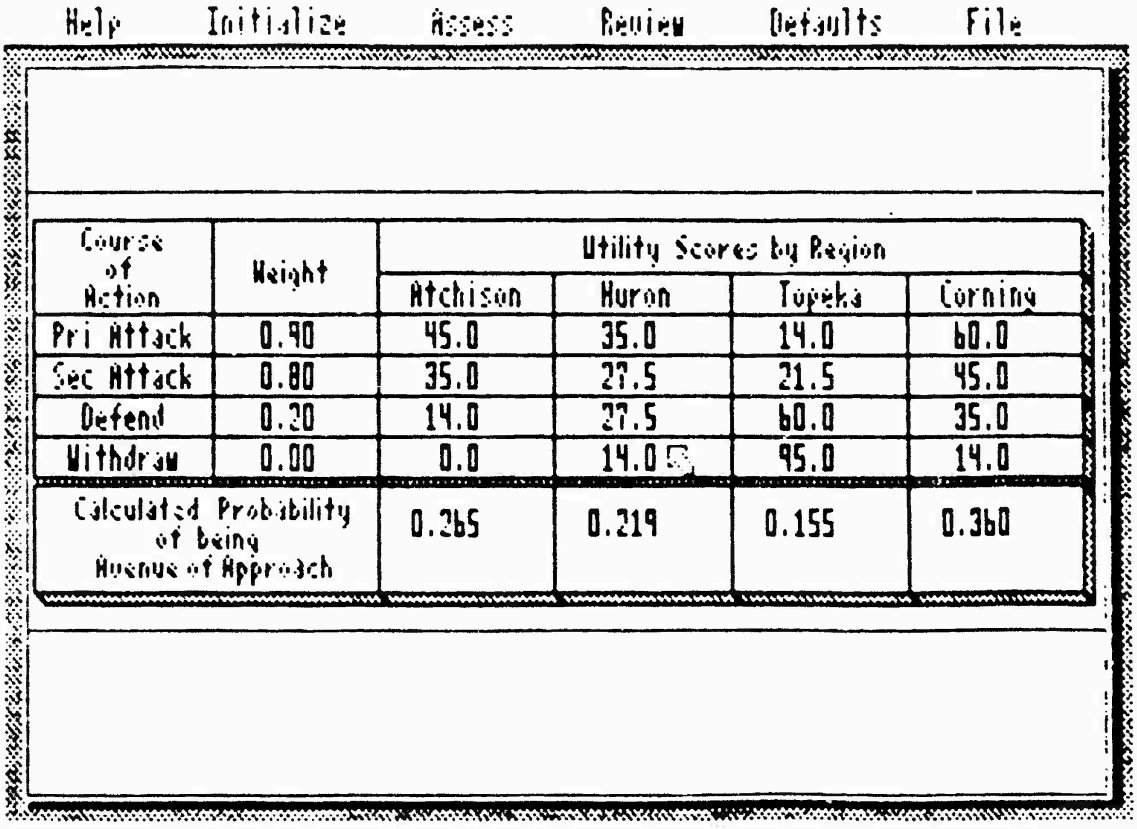


FIGURE 7. SETTING UTILITIES USING INTERPRETATIONS



Course of Action	Weight	Utility Scores by Region			
		Atchison	Huron	Topeka	Corning
Pri Attack	0.90	45.0	35.0	14.0	60.0
Sec Attack	0.80	35.0	27.5	21.5	45.0
Defend	0.20	14.0	27.5	60.0	35.0
Withdraw	0.00	0.0	14.0	95.0	14.0
Calculated Probability of being Avenue of Approach		0.265	0.219	0.155	0.360

FIGURE 8. NUMERIC TABLE OF UTILITIES

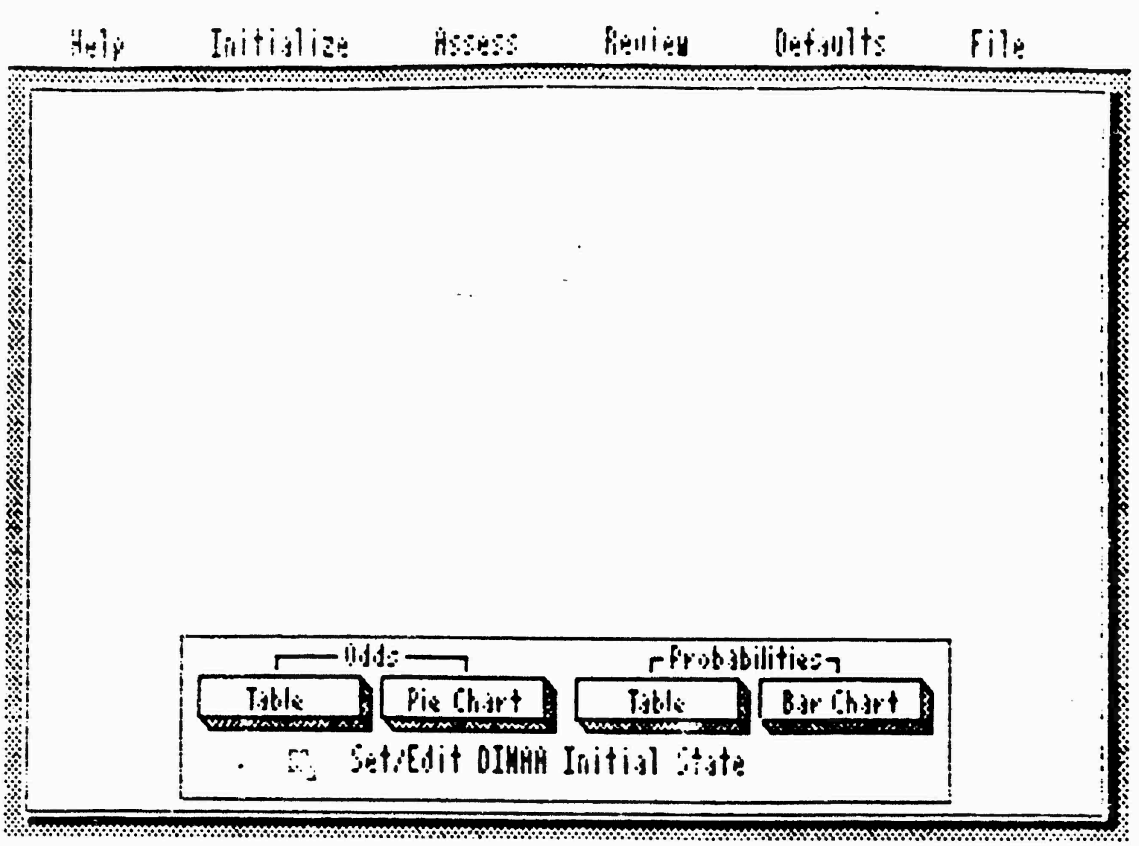


FIGURE 9. INITIALIZE ODDS/PROBABILITIES MENU

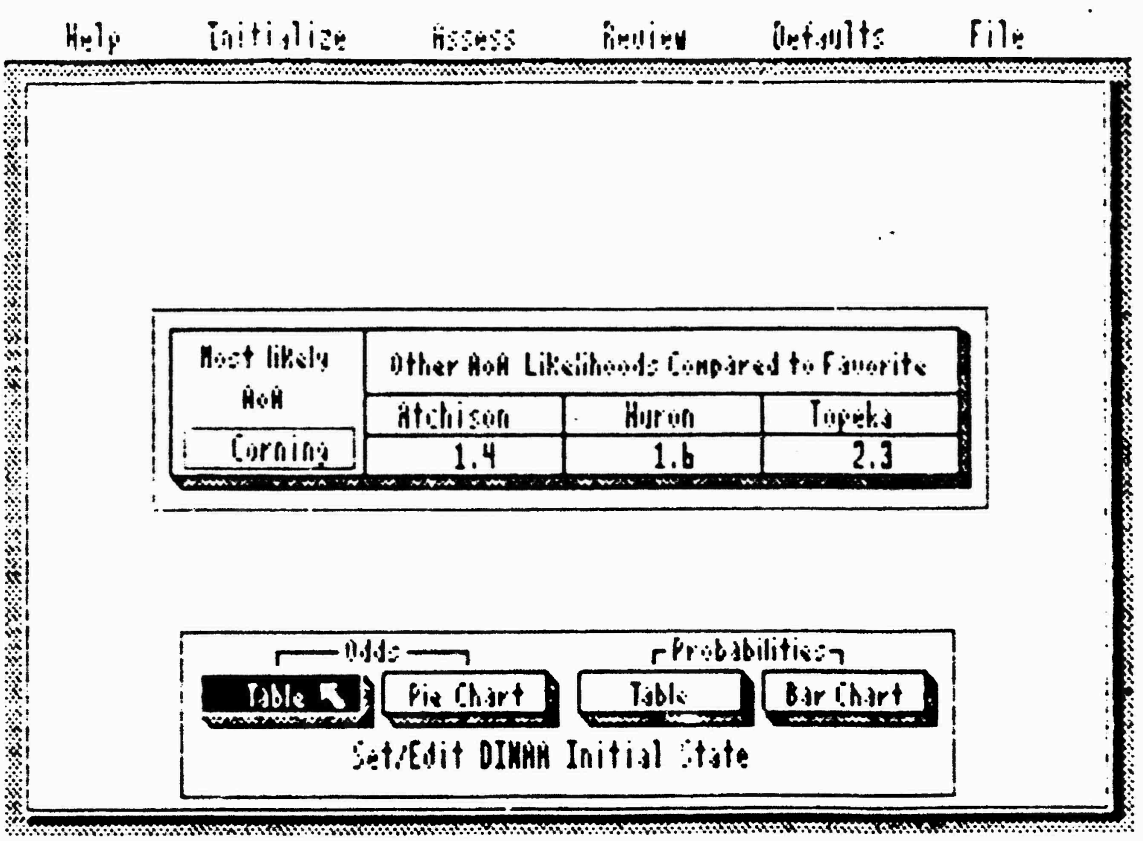


FIGURE 10. NUMBER OF TIMES AoAs ARE LESS LIKELY THAN FAVORITE AoA

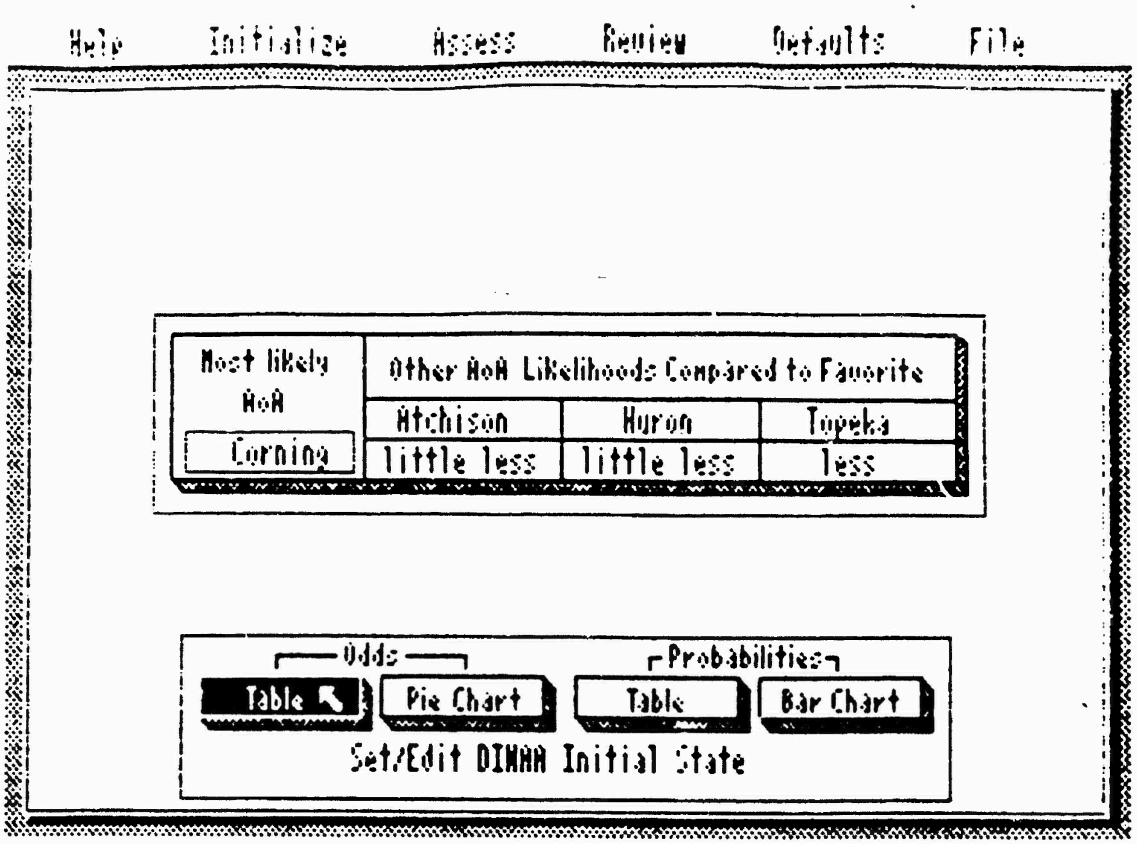


FIGURE 11. TABLE OF INITIAL ODDS

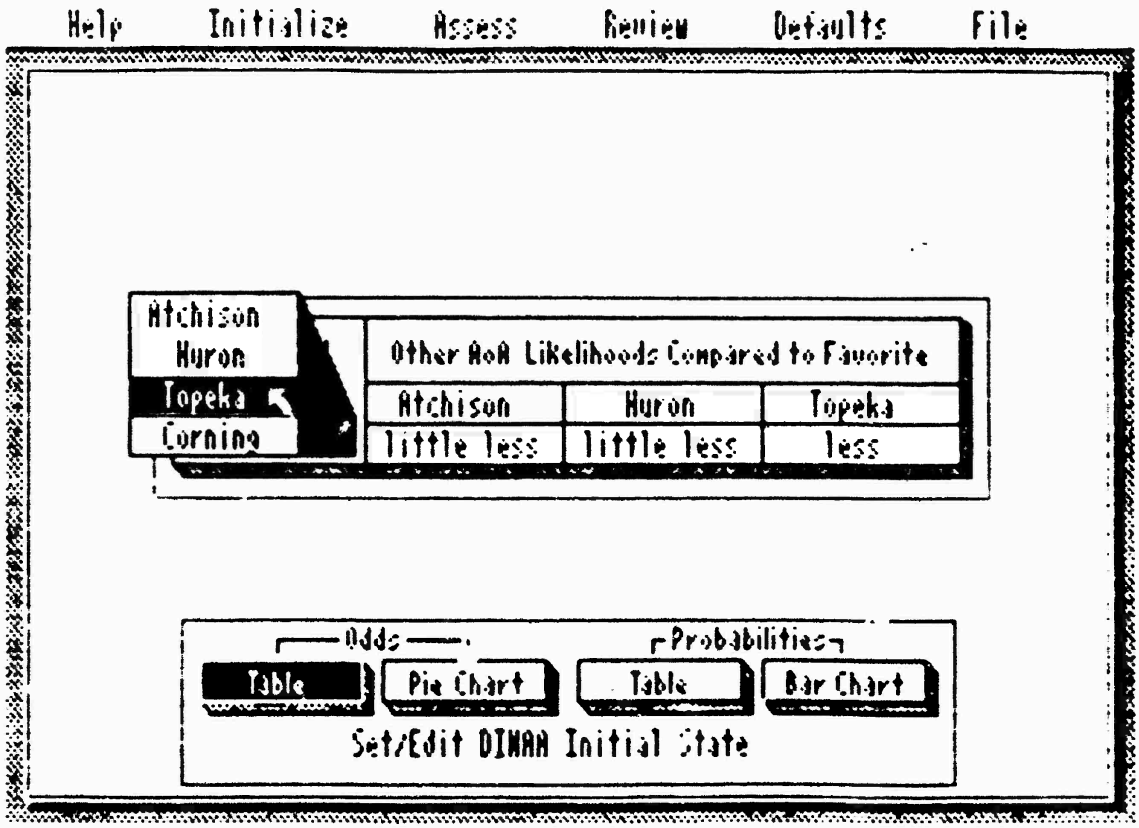


FIGURE 12. SETTING INITIAL MOST LIKELY AoA

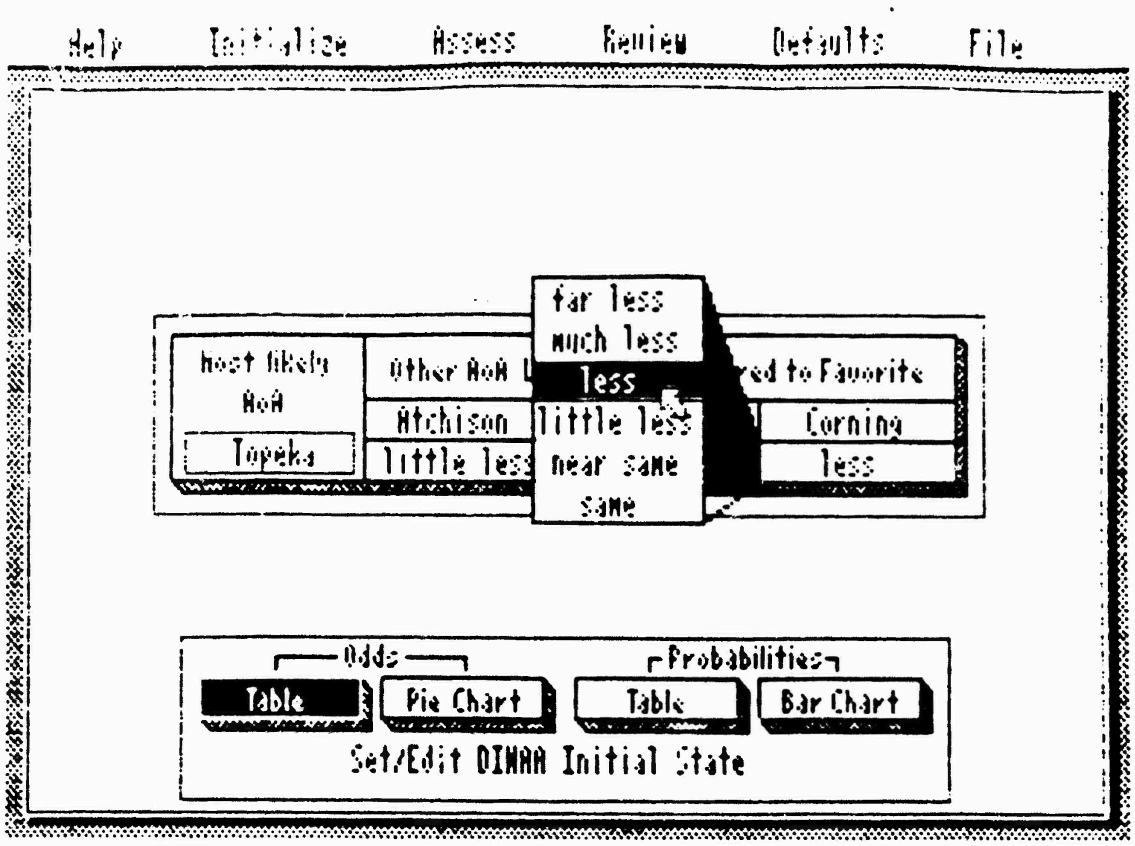


FIGURE 13. SETTING AOA LIKELIHOODS

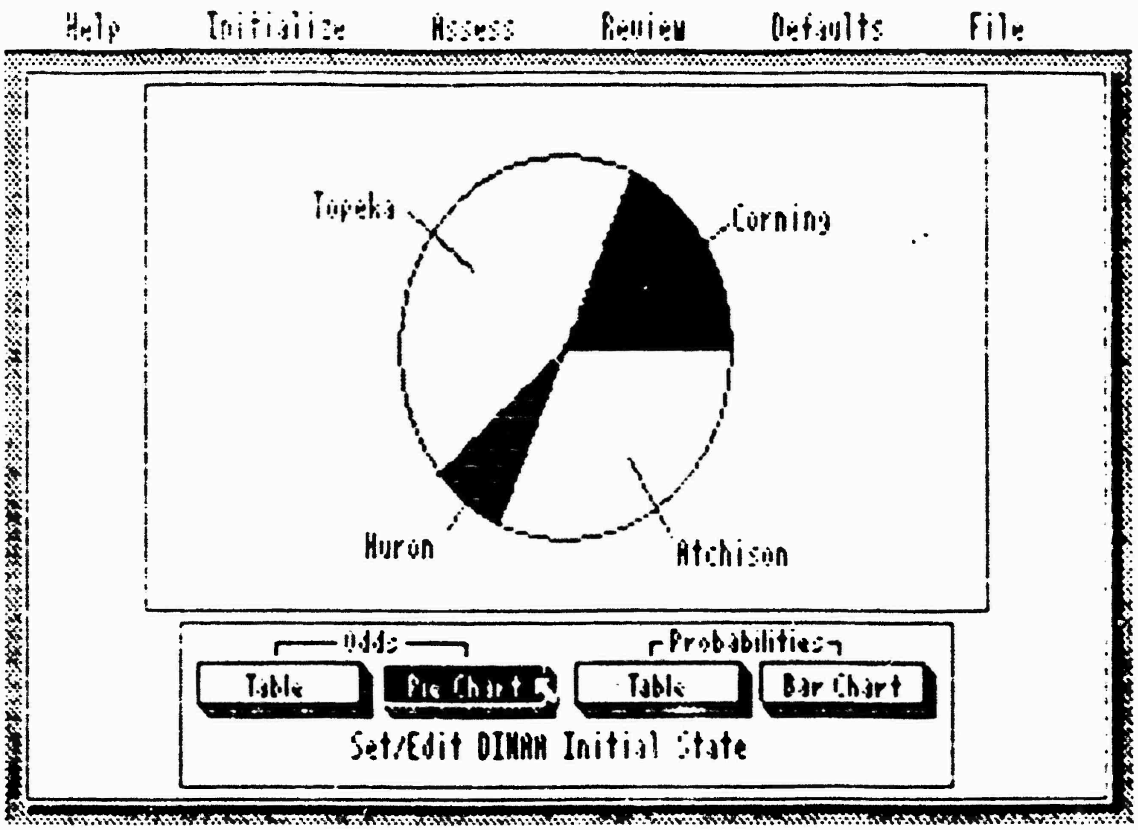


FIGURE 14. PIE CHART OF INITIAL ODDS

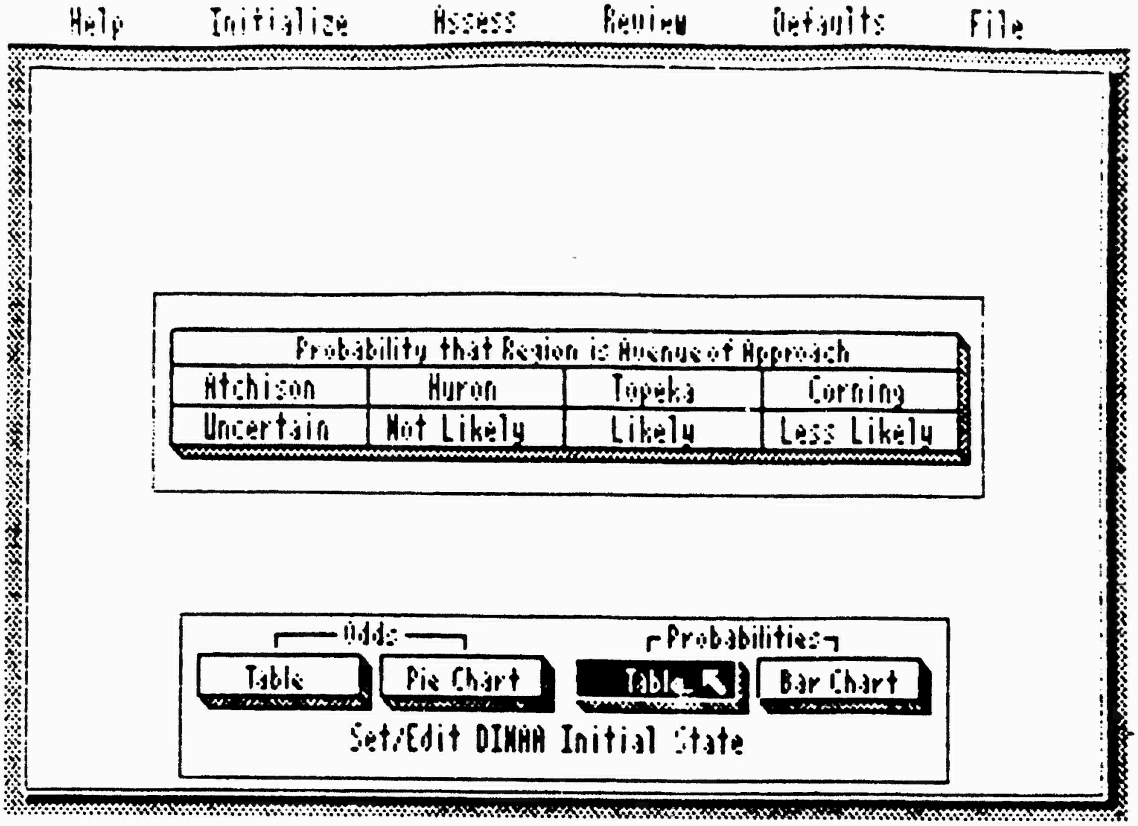


FIGURE 15. TABLE OF INITIAL PROBABILITIES

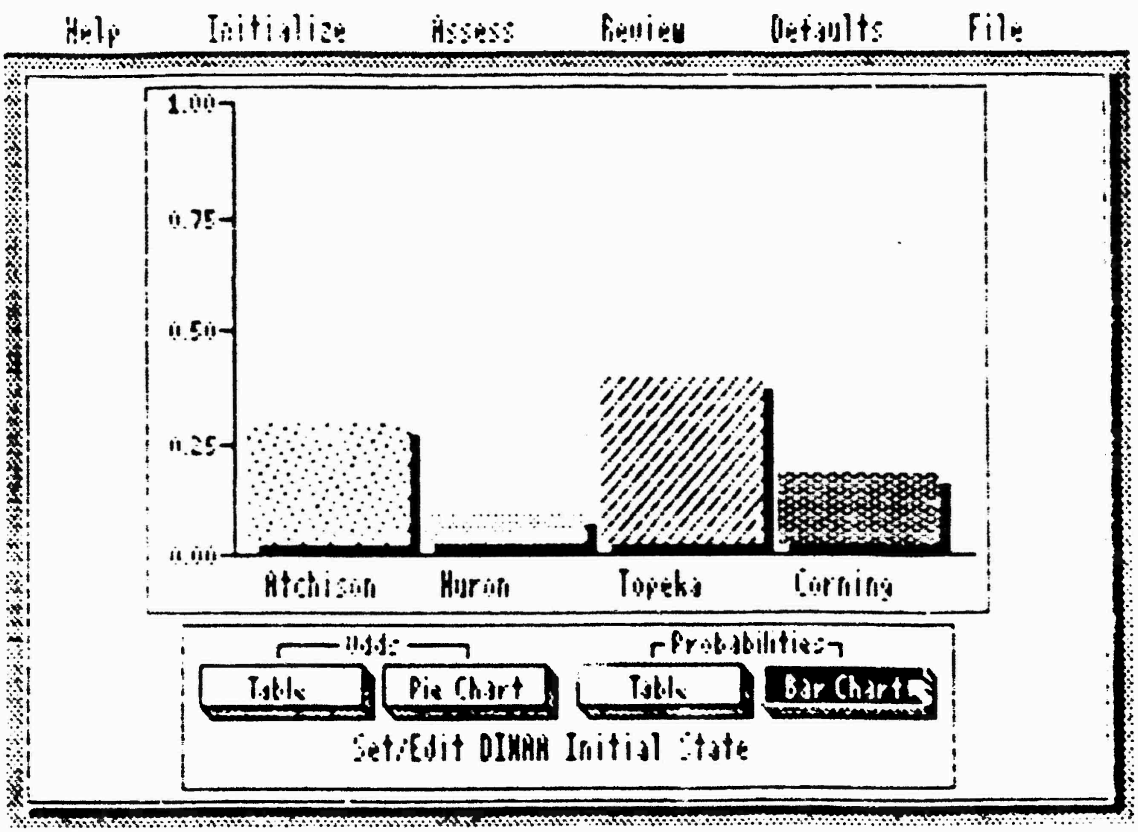


FIGURE 16. BAR CHART OF INITIAL PROBABILITIES

3.4 Assessing Messages

Select the "Assess" heading to assess new information or reassess old information. Detailed information about messages may be obtained by reviewing assessments. Figure 17 shows the options for this menu.

3.4.1 Creating a Message Datum

When a message is received, the user must create the structure holding the prior probabilities, assessments, and links to other messages in the list by selecting the "Create New Data Item" option under "Assess." A window pops up, as in Figure 18, and DINAA waits for the user to enter a name tag for the message. Hitting RETURN without entering a name tag will cause the "Create New Data Item" command to be ignored. After a name is given to the message, DINAA brings up the menu associated with setting probabilities and odds for messages. At this stage, the user may select the new item for editing of odds and probabilities. It is important to note here that when a data item is created, the probability of seeing that item for each avenue of approach defaults to 1.00, so that if the user fails to make an assessment about that item, the item will have no effect on overall probabilities.

3.4.2 Viewing Predefined Message Information

A capability of DINAA useful for training purposes is the ability to link previously created PC-PAINT ".PIC" files to DINAA, so that when a message is received, the analyst may view a graphic file illustrating the information of the received message. These files typically contain maps, text, or any other information that can be described within a graphic screen image. To link a screen image file to a message, it must be named MSG-x.PIC, replacing x with the number of the message to be linked to. When the "DESCRIBE" option is selected from the "Set Odds/Probabilities" command, DINAA looks up the message number and refers to the current DOS directory to find files matching the MSG-x.PIC pattern. If a file is found, DINAA loads it onto the screen and waits for a button click to continue. The message number used by DINAA refers only to the recency of a message relative to the rest of the message list, so that deleting a message in the middle of the list, and thus decrementing all

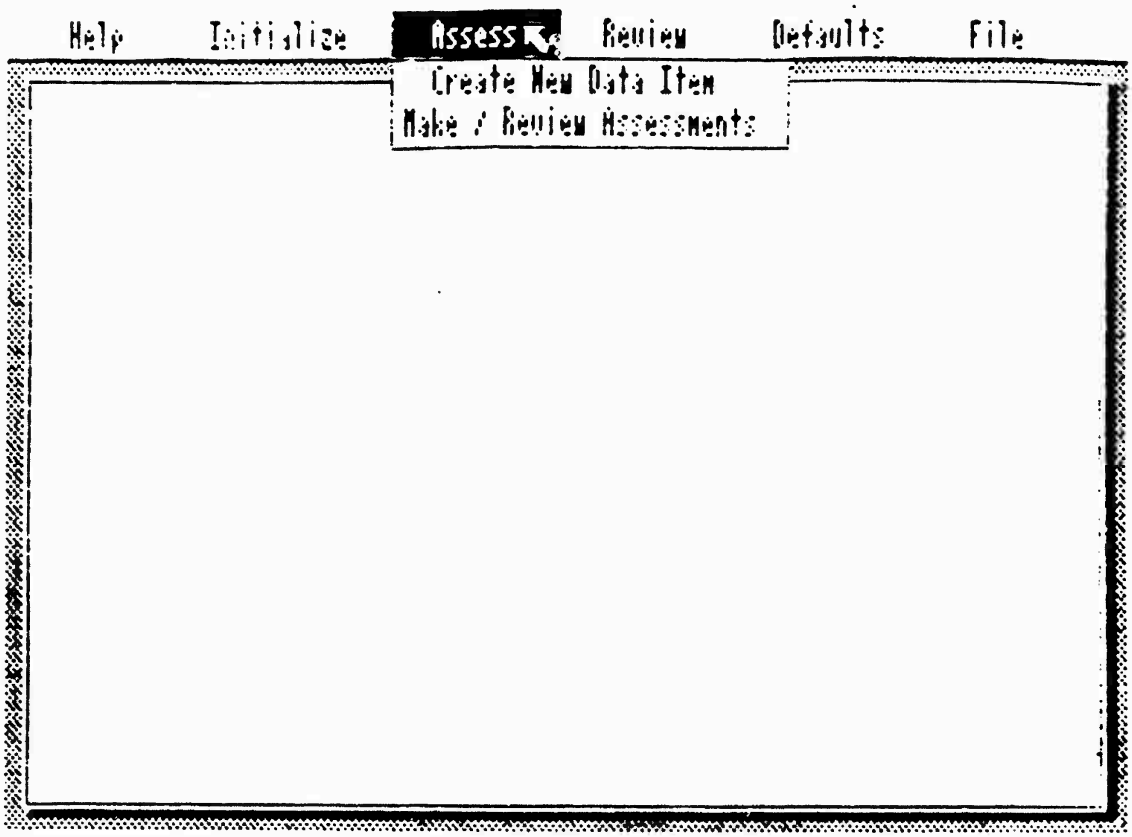


FIGURE 17. ASSESSMENT OPTIONS

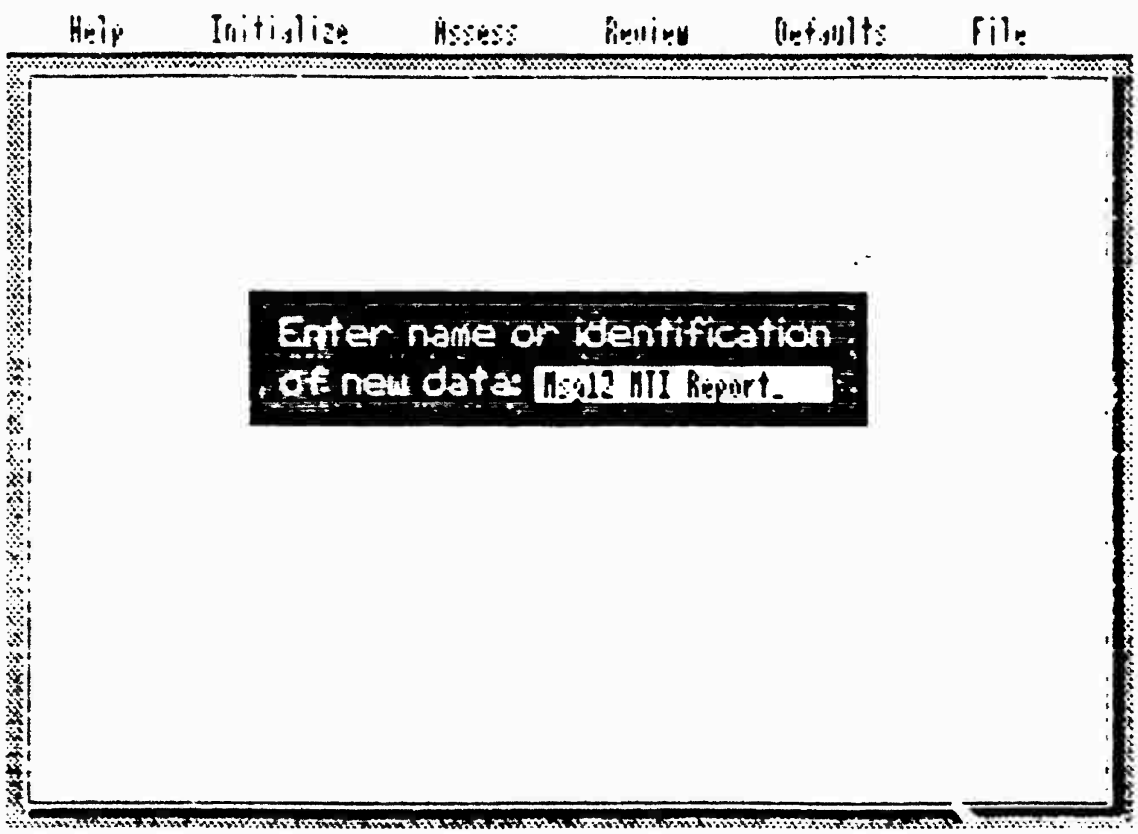


FIGURE 18. NAMING A MESSAGE

following message numbers, may upset links of messages to the intended information files.

3.4.3 Setting Probabilities and Odds for Datum

Figure 19 shows the options for setting and reviewing assessments for a message datum. Although the displays look similar to those of the "Initialize" command of the "Set Odds/Probabilities" options, the displays of this menu have different meanings and are more detailed. They all show the DINAA system state as it was before and after the message was assessed. Assessments for a message indicate how likely that datum is to occur, supposing a given region is the avenue of approach. In this menu, the entire message list by may be scrolled through by clicking the arrow at the up and down pointing arrows to the right of the datum column. A message and its effects may be entirely removed by first selecting, or clicking, the message and then clicking the "Remove" option. Shown in Figures 20-24 are a series of steps that may be taken in setting and reviewing the assessment of a message and its effects on posterior probabilities. Keep in mind that the posterior probabilities and odds for the last message entered make up the current AoA probabilities and odds.

3.5 Reviewing Probabilities and Odds

Figure 25 illustrates the options available under this heading. Under this facility, the current AoAs and their likelihoods may be inspected, but not modified.

3.5.1 Viewing Current Probabilities and Odds

Shown in Figure 26 is a screen depicting a piechart of current relative probabilities. The options available here are the same as those available for viewing initials odds, with the exeception that no changes are allowed.

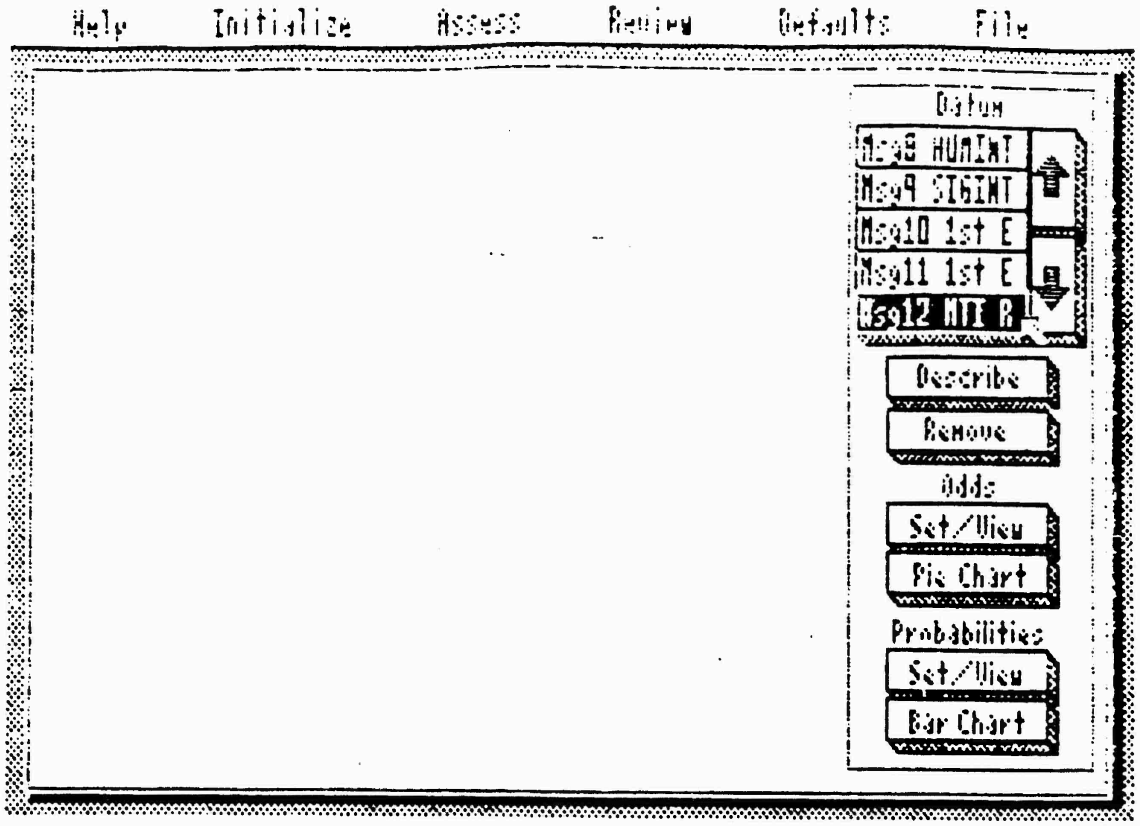


FIGURE 19. SET/REVIEW ASSESSMENT MENU

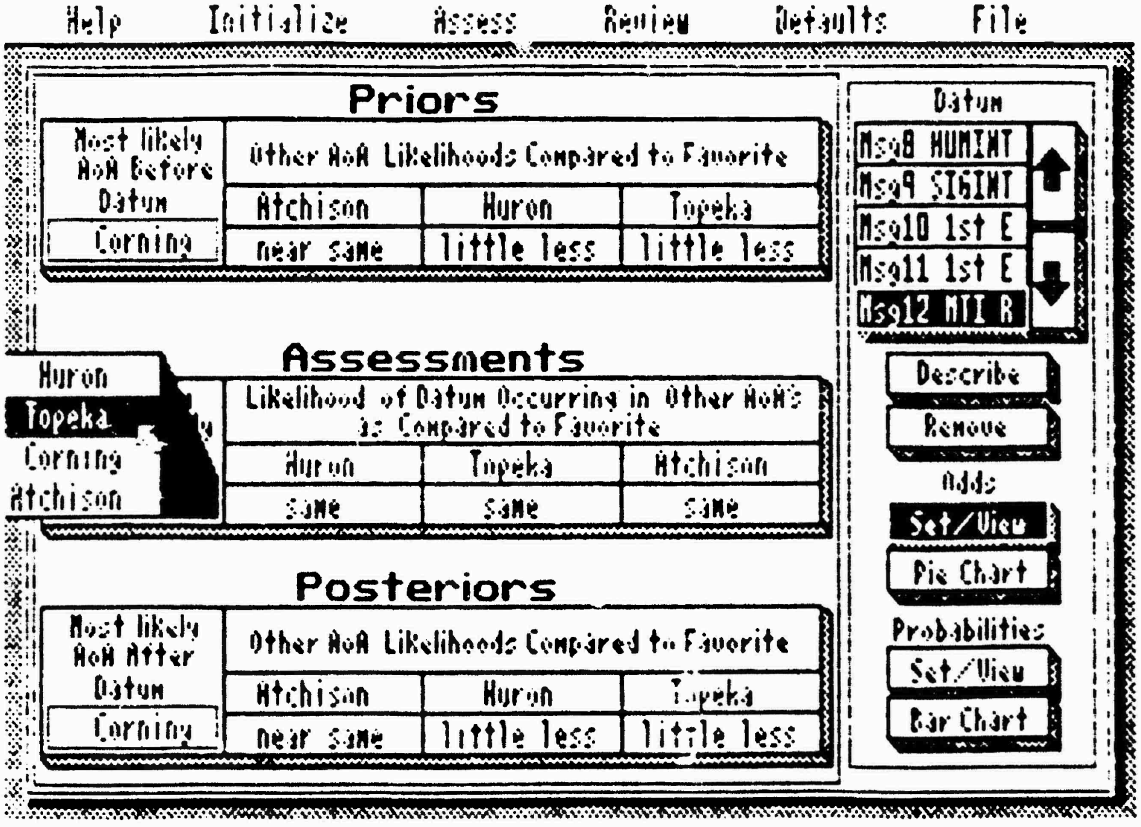


FIGURE 20. SETTING AoA FOR WHICH DATUM IS MOST LIKELY TO OCCUR WITHIN

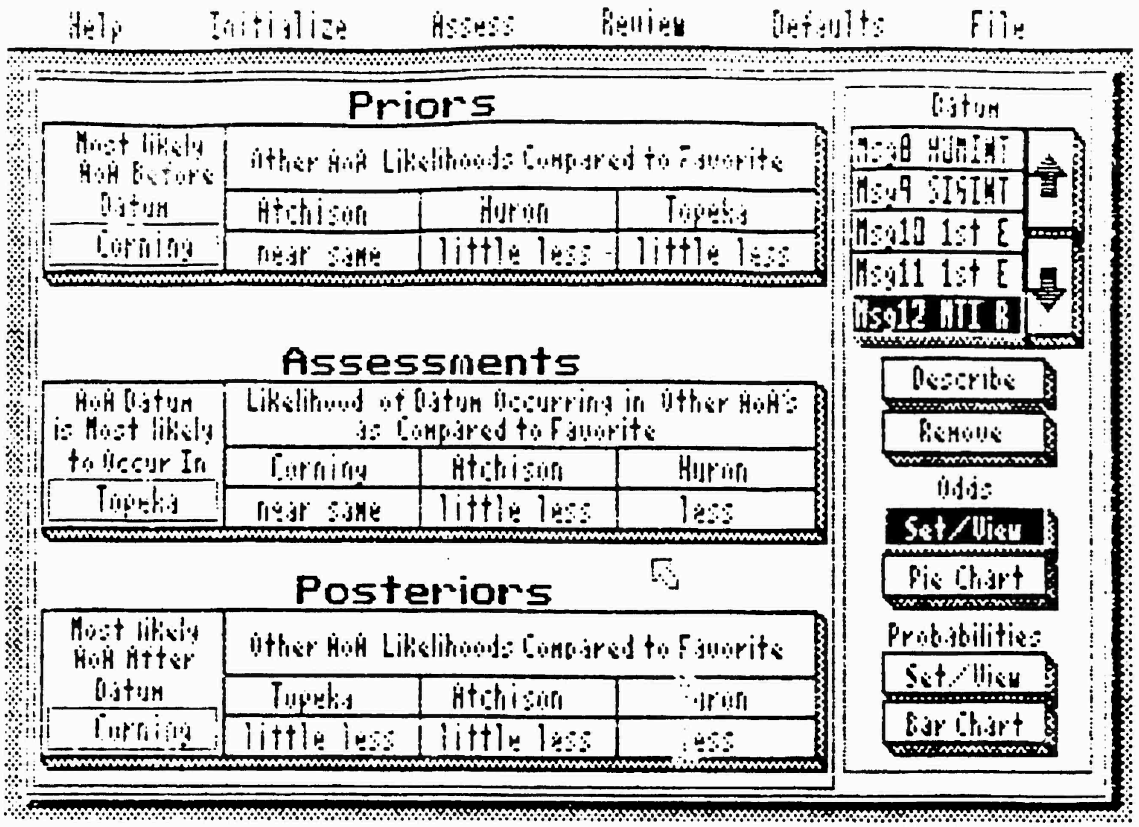


FIGURE 21. TABLE OF ASSESSED ODDS

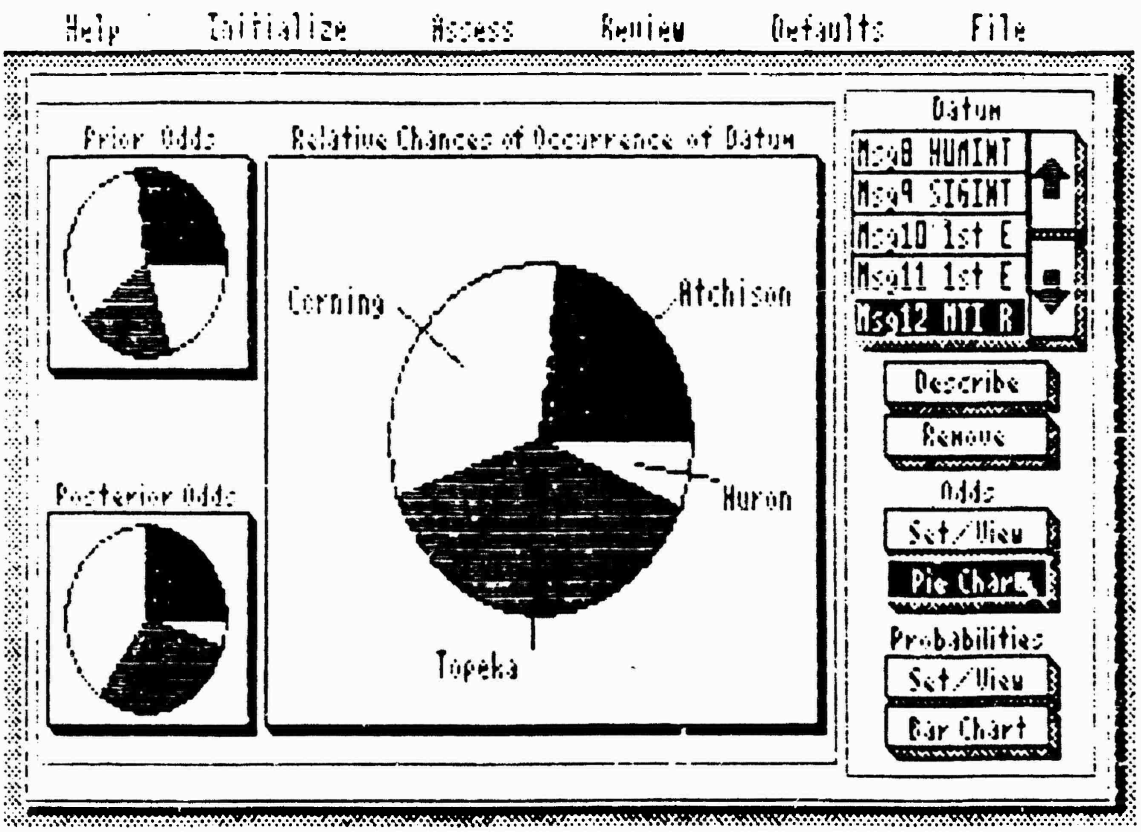


FIGURE 22. PIE CHART OF ASSESSED ODDS

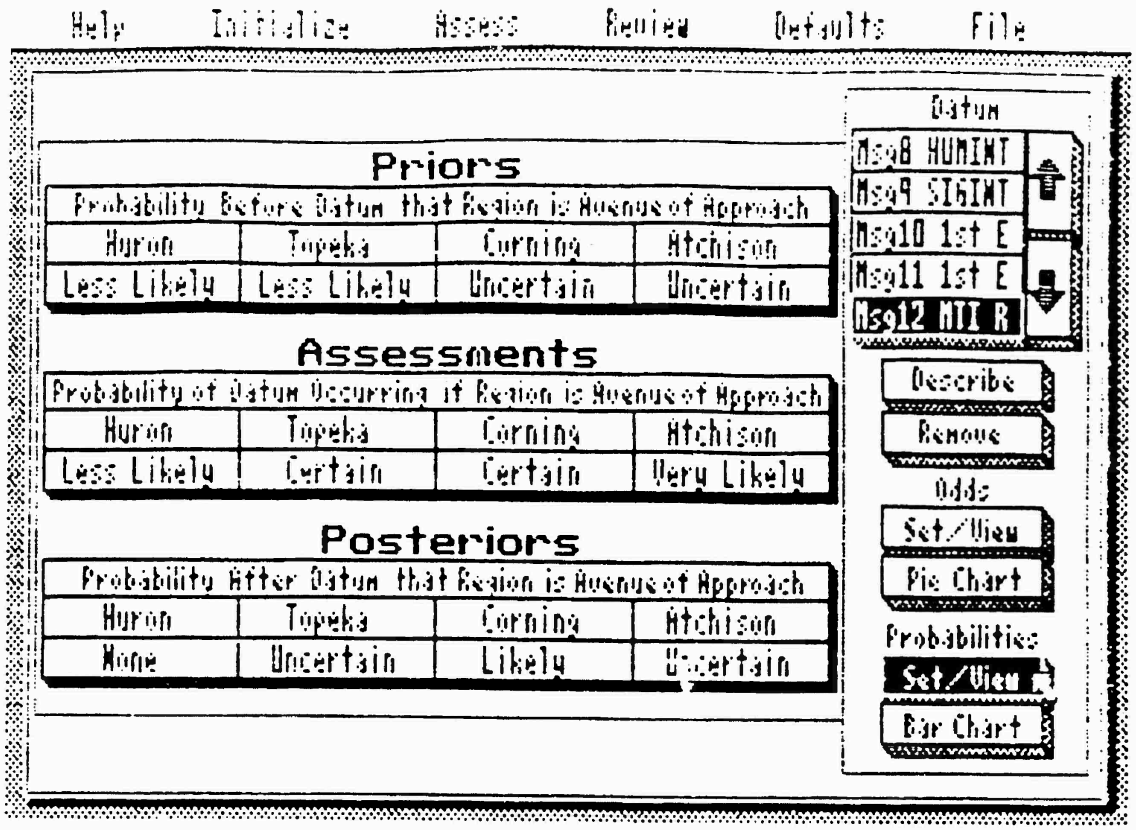


FIGURE 23. TABLE OF PROBABILITIES ASSESSED FOR MESSAGE

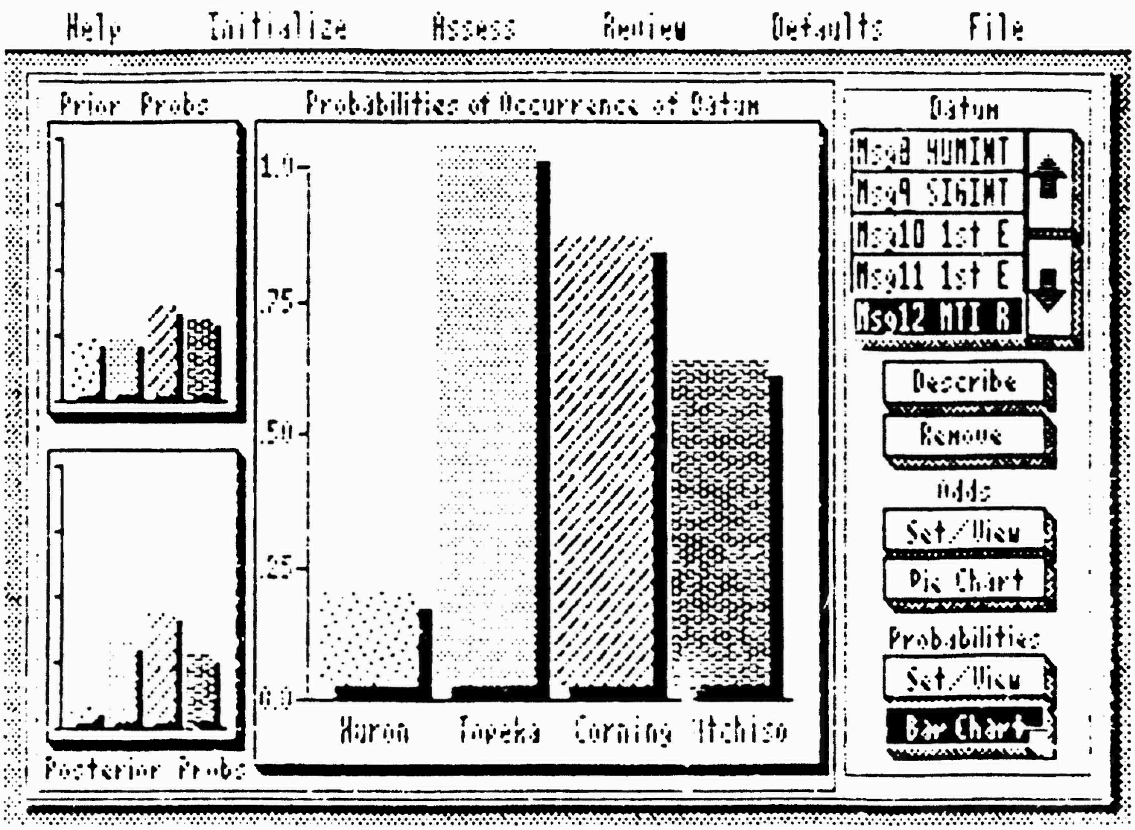


FIGURE 24. BAR CHART OF MESSAGE ASSESSMENT

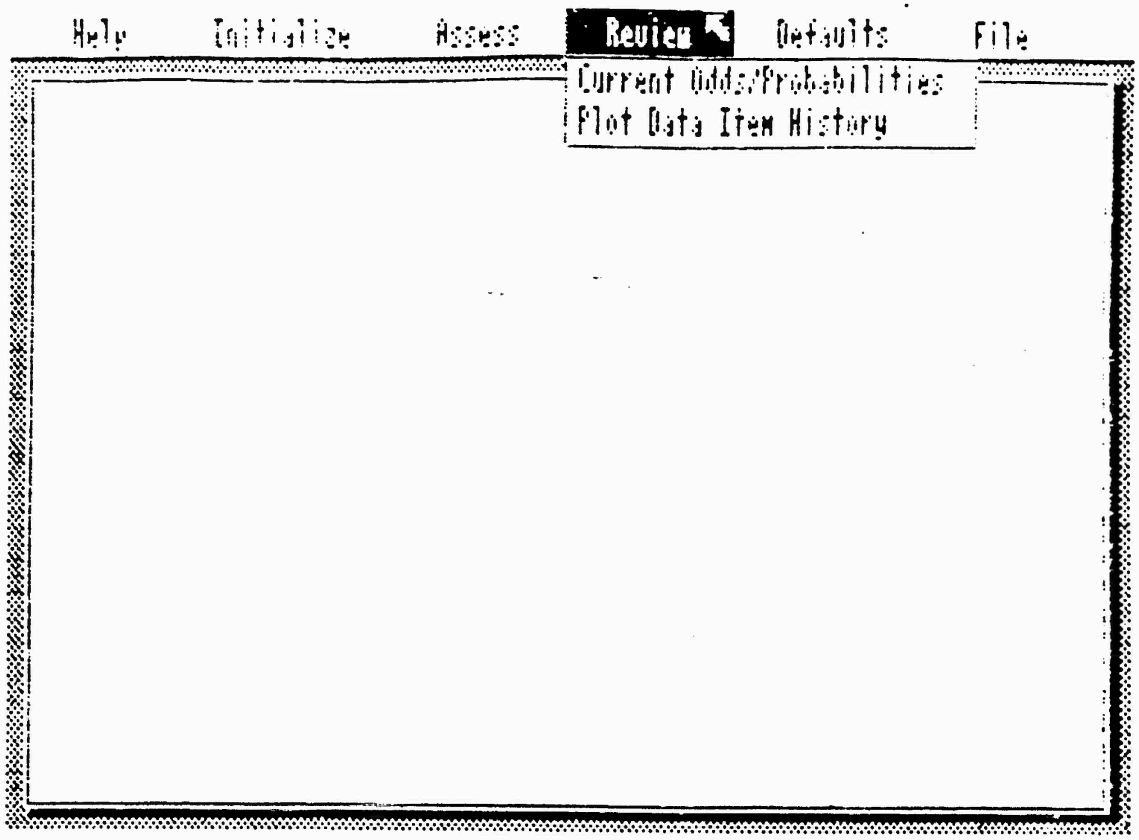


FIGURE 25. OPTIONS FOR REVIEW MENU

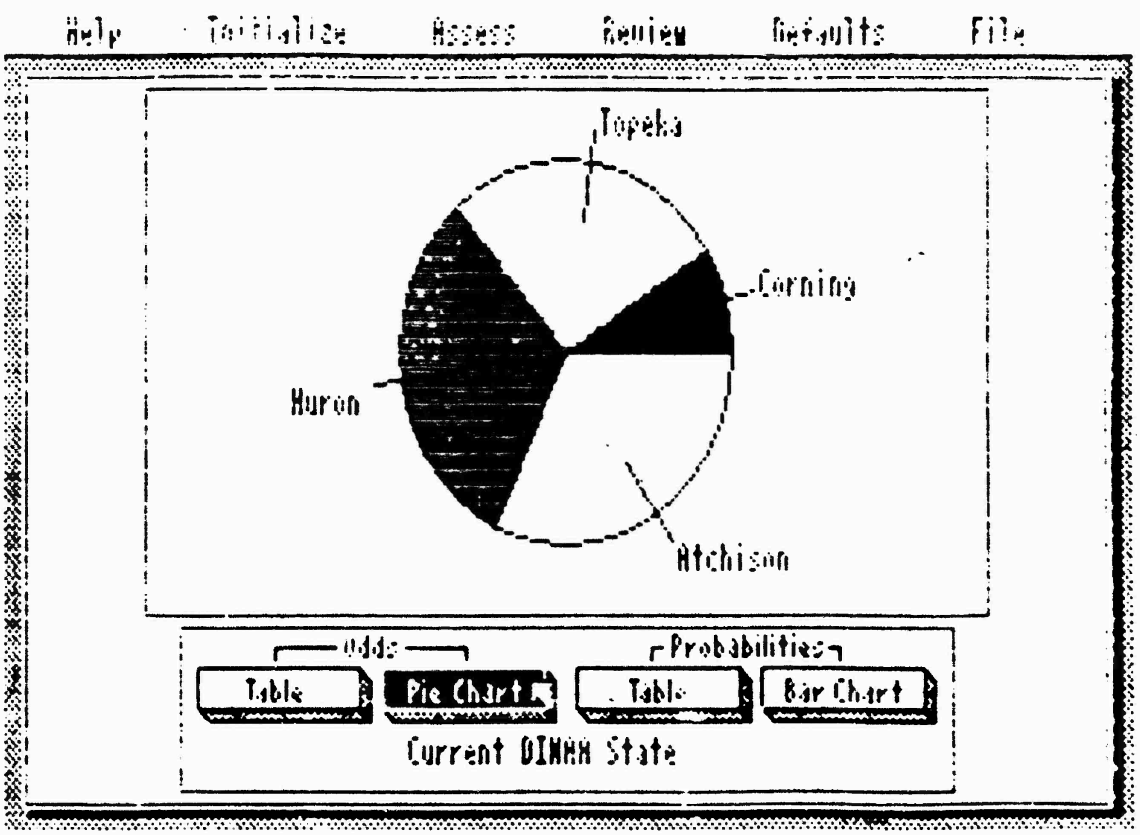


FIGURE 26. PIE CHART OF DINAA STATE

3.5.2 Tracing Plot of Messages' Impact on Probabilities

As more messages come in, the user may want to trace their effects on the probabilities of the Avenues of Approach. Selecting the "Plot Data Item History" option under the "Review" heading will perform this function. Figure 27 shows a possible plot. As seen in Figure 27, the plot may become tangled as probabilities change. In this event, the user may select the "Clear Grid" option to erase the grid, and then select AoAs to be plotted individually. Figure 28 shows two of four AoAs plotted. The Data Item Numbers in these plots refer only to the order in which the data items were created, and make no reference to the meaning or name of an item. Further information on a data item may be obtained by clicking the arrow inside a Data Item Number box. A menu will pop up allowing inspection of the message, as well as the assessments for it, using the same format as that for inspecting current probabilities. This is seen in Figure 29.

If more than ten messages have been assessed, the plot will initially be generated only for the last ten items. The user may scroll left and right through all of the items by clicking inside the arrow boxes to the sides of the Data Item Number boxes.

3.6 Setting Defaults

Several aspects of the DINAA interface may be modified through the default settings for type of data displayed, the textual interpretations of data, and the screen attributes. Figure 30 shows the options available for defaults.

3.6.1 Setting Type of Data Displayed

By selecting "Type of Interaction", Figure 31, table displays may be altered by selecting either "Numeric" or "Textual" data displays. The textual interpretations may be altered as described below.

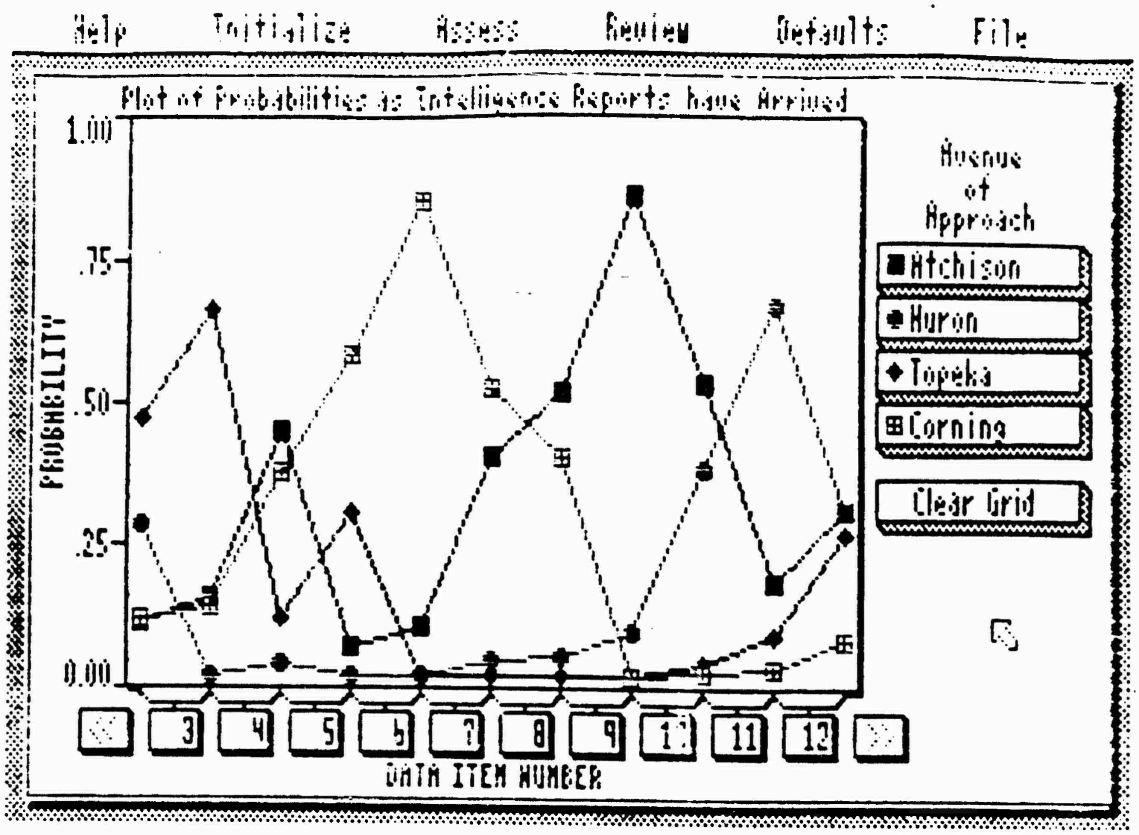


FIGURE 27. INITIAL PLOT OF ALL AoA PROBABILITIES

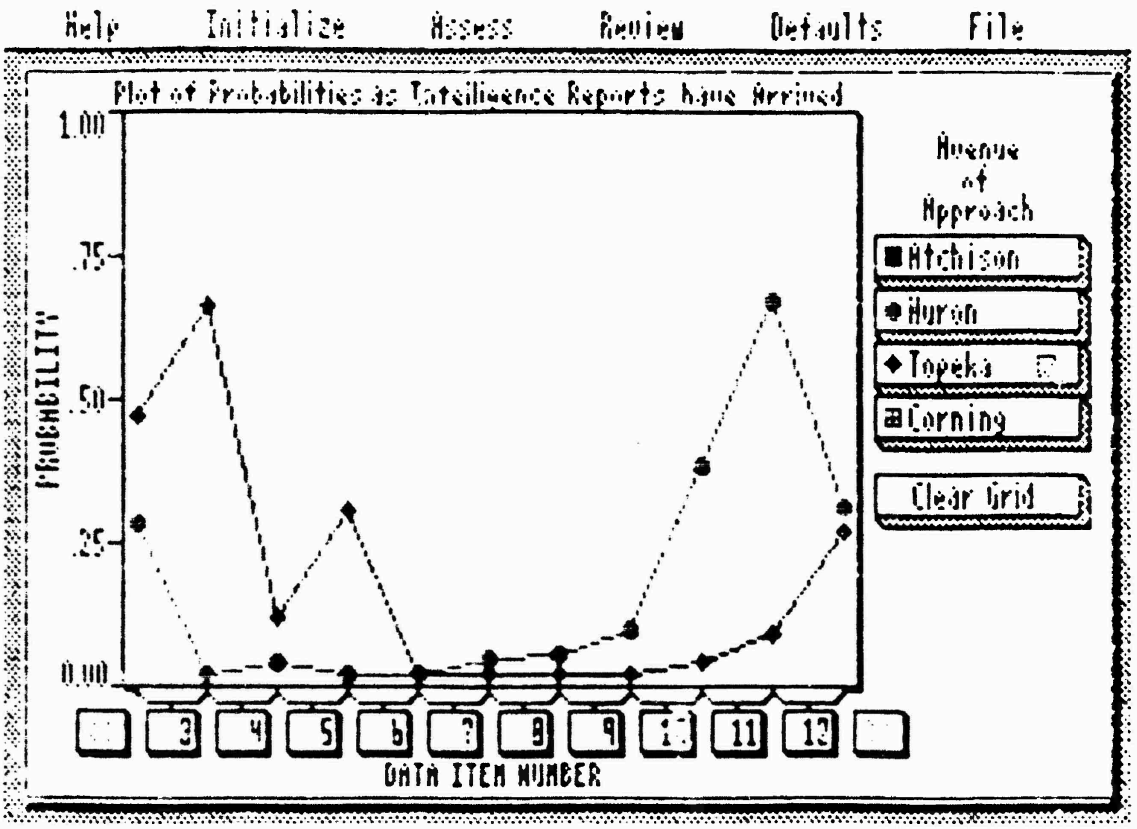


FIGURE 28. PLOT OF SELECTED AoAs

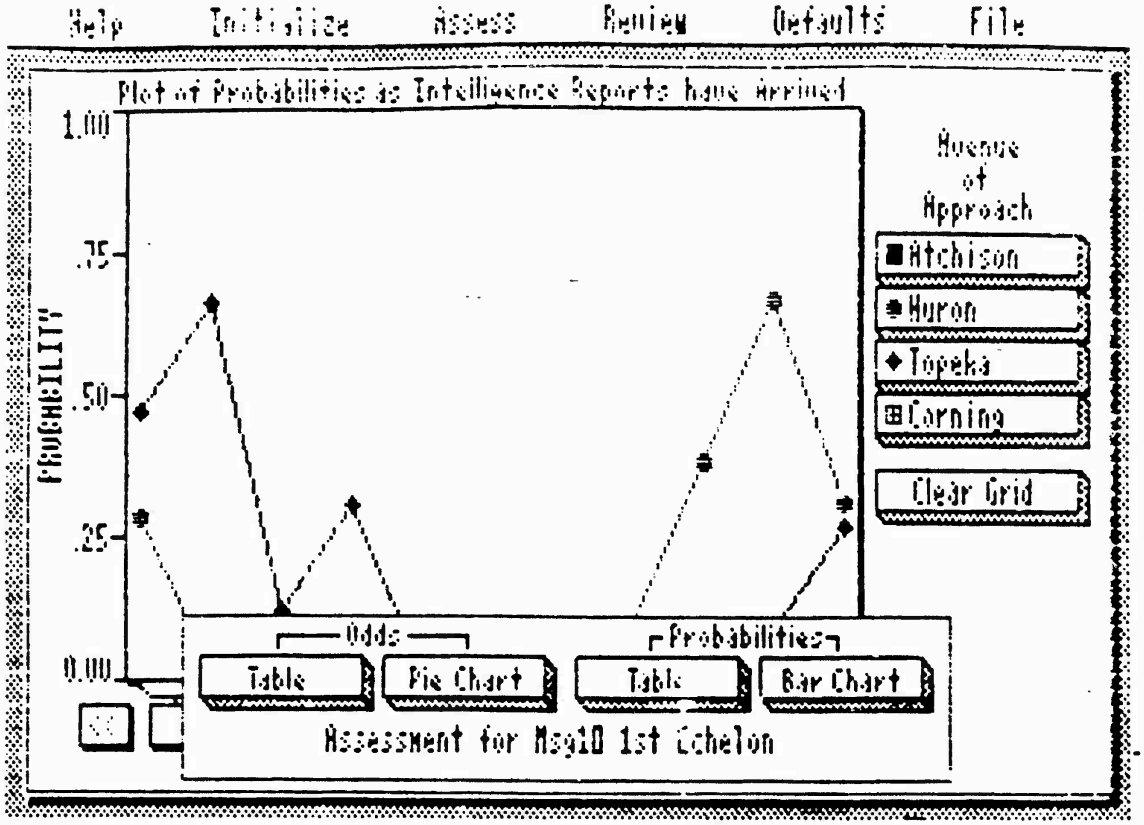


FIGURE 29. MENU FOR EXAMINING ASSESSMENT FROM WITHIN A PLOT

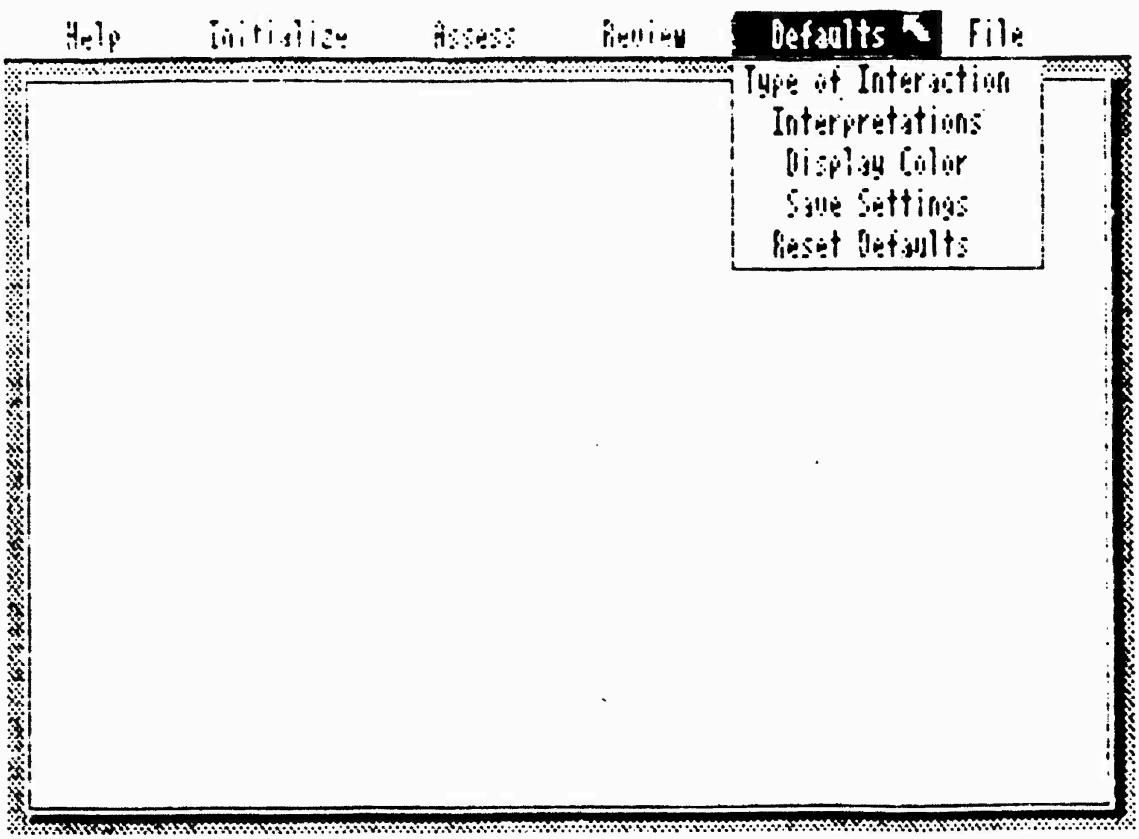


FIGURE 30. OPTIONS FOR DEFAULTS MENU

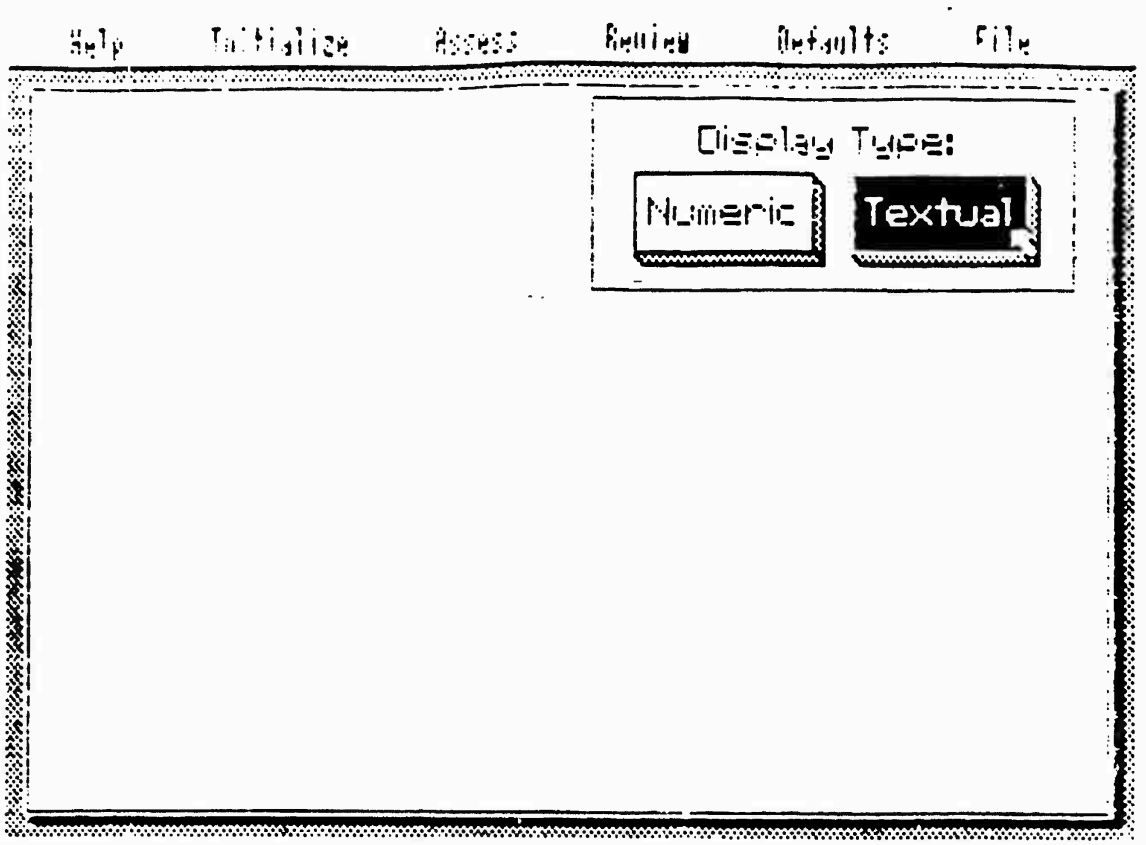


FIGURE 31. INTERACTION TYPE MENU

3.6.2 Setting Textual Interpretations of Data

Four types of data may be seen in the DINAA system: odds, probabilities, utility scores, and utility weights. In order to help an analyst describe a probability as "High," without actually having to specify a number, DINAA allows the definition of four sets of numeric interpretations. Figures 32-35 show these interpretation sets as delivered with DINAA. The number of interpretations, the associated text, and the value ranges may be easily modified to suit other conditions and preferences. The cells behave much as in other table displays, with the note that value range cells are in descending numeric value and are specified by entering the lowest value for an interpretation. Each type of data has both an upper and lower bound on acceptable values to which interpretations must adhere. When DINAA looks for an interpretation of numeric data, it finds the highest range such that the numeric data is greater than lowest value for that range.

3.6.3 Setting Screen Palette and Background Color

The DINAA screen may use any one of six color palettes and one of sixteen possible background colors. These may be set with the "Palette" and "Background" options of the "Display Color" command, shown in Figure 36. Click in boxes with arrows pointing up to increment palette or background color number, and click in boxes with down-pointing arrows to decrement.

3.6.4 Saving and Loading Defaults

Figures 37 and 38 show the menus for saving and reloading defaults for the DINAA interface. The settings for defaults include the type of interaction, the interpretation settings, the screen color palette and background color, and additionally, the set of weights applied to utility scores in calculating initial probabilities.

3.7 Filing Messages

The AoA names, courses of action, utility scores, initial probabilities, and the entire set of messages assessed may be saved and reloaded. Figure 39

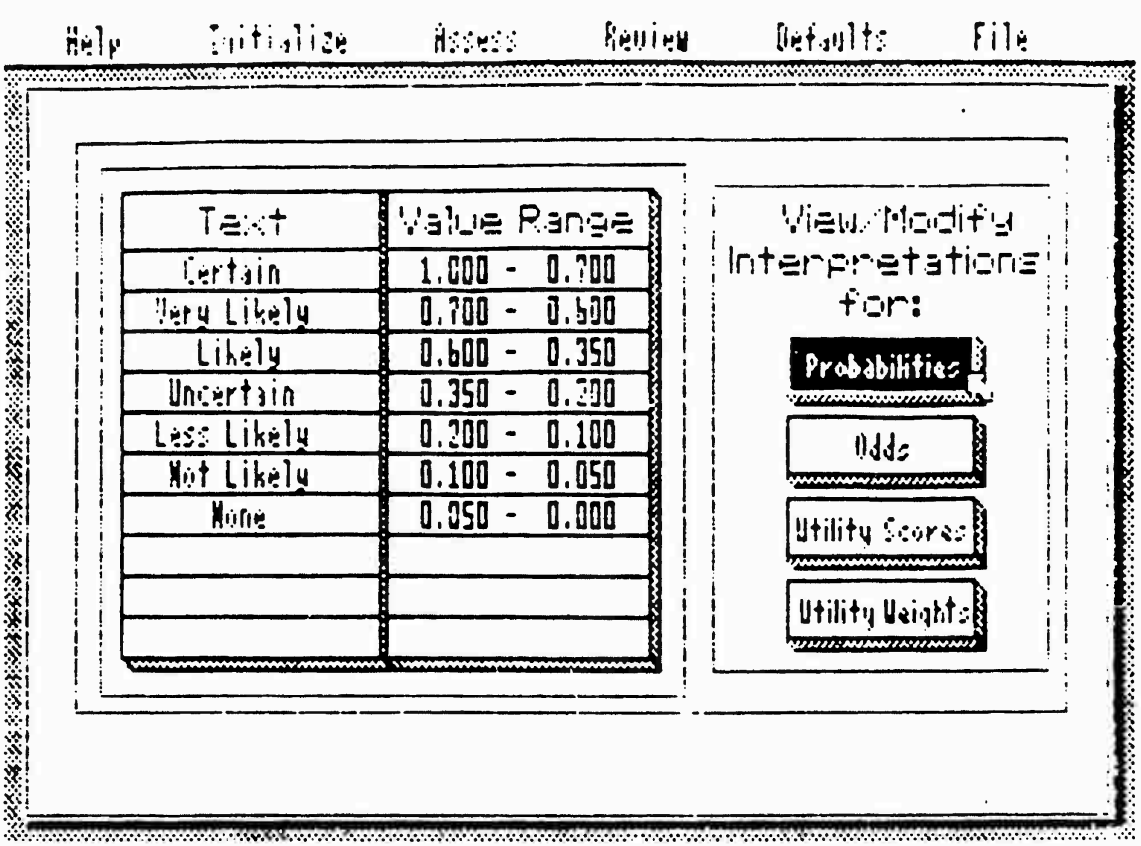


FIGURE 32. SUPPLIED PROBABILITIES INTERPRETATIONS

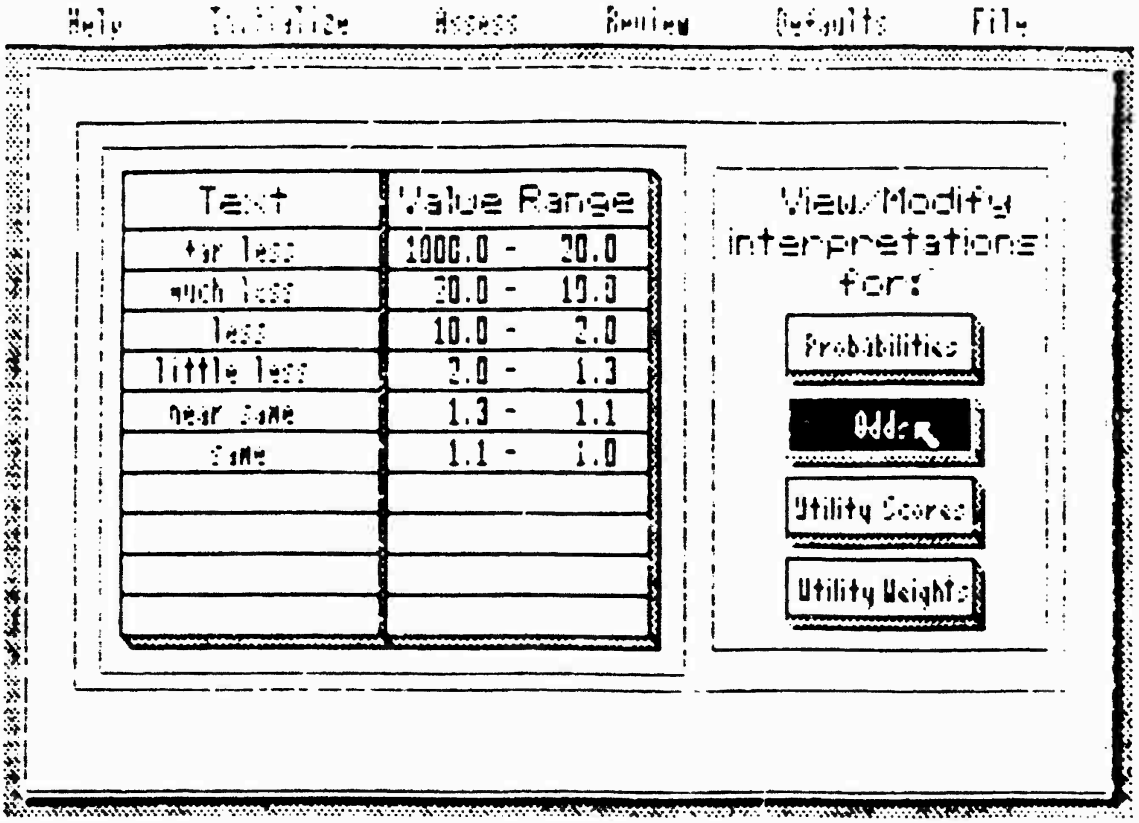


FIGURE 33. SUPPLIED ODDS INTERPRETATIONS

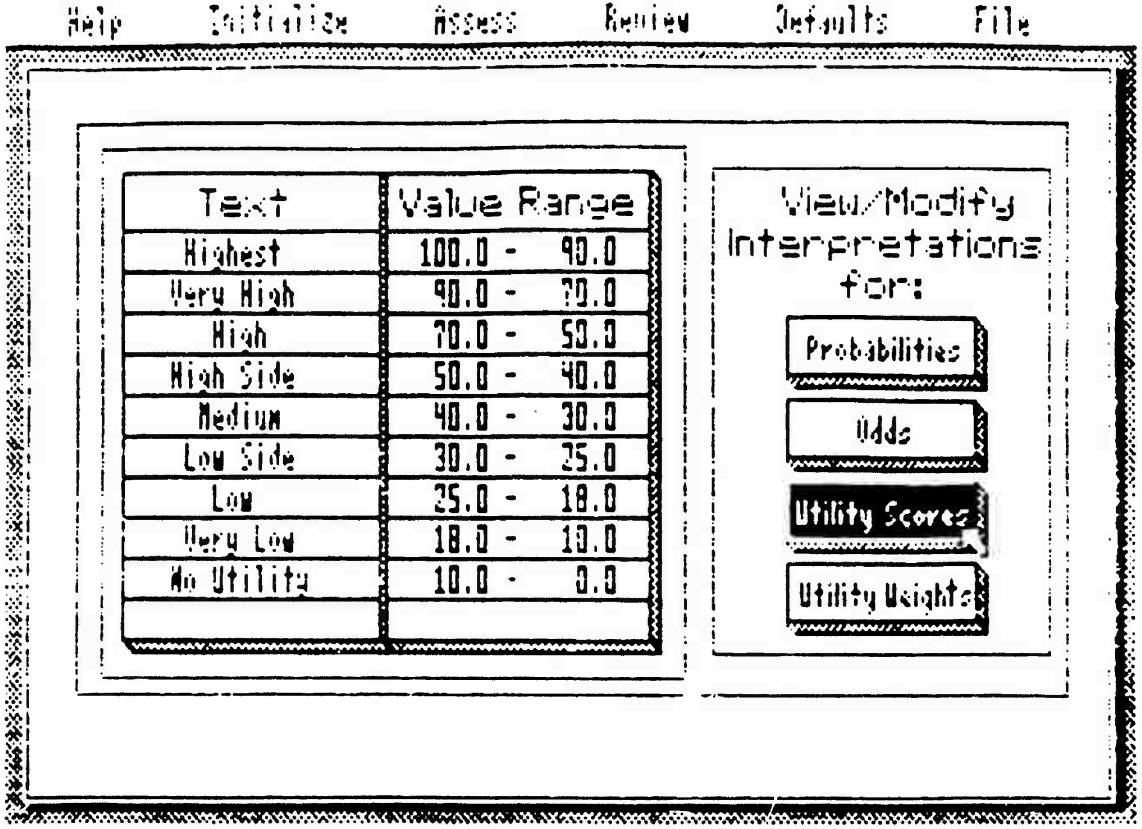


FIGURE 34. SUPPLIED UTILITY SCORES INTERPRETATIONS

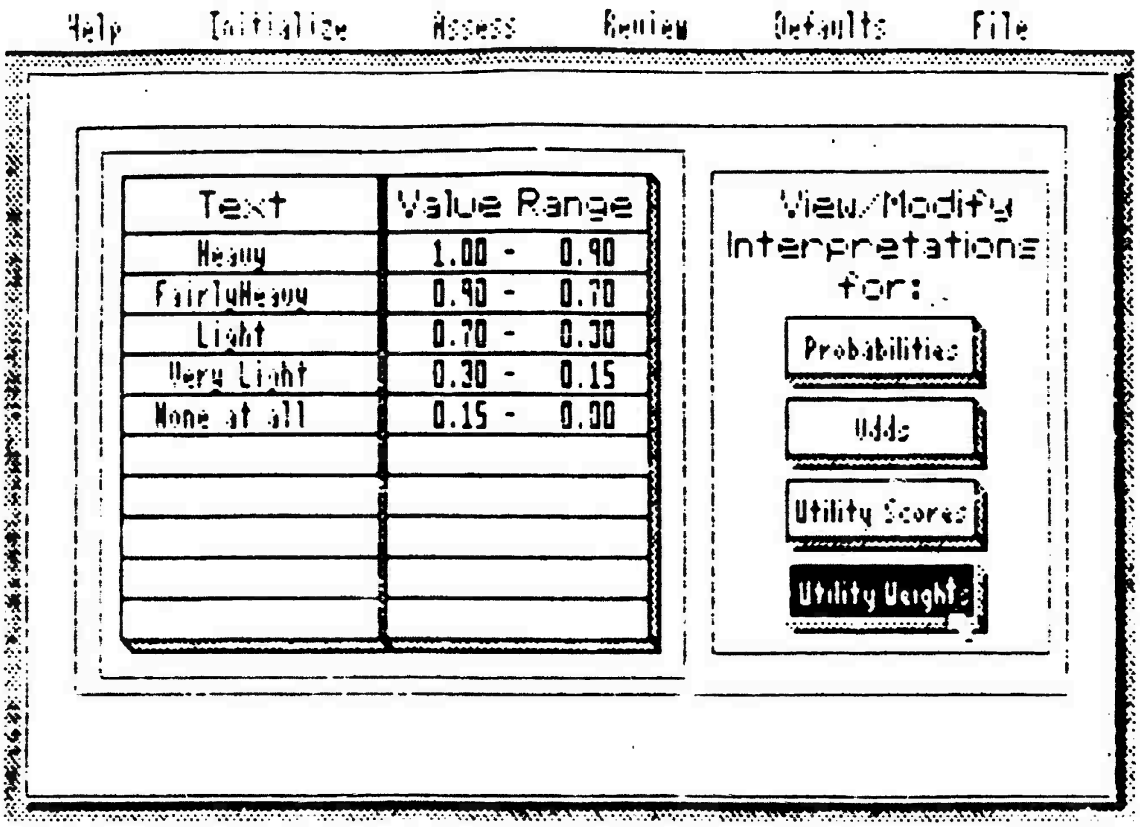


FIGURE 35. SUPPLIED UTILITY WEIGHTS INTERPRETATIONS

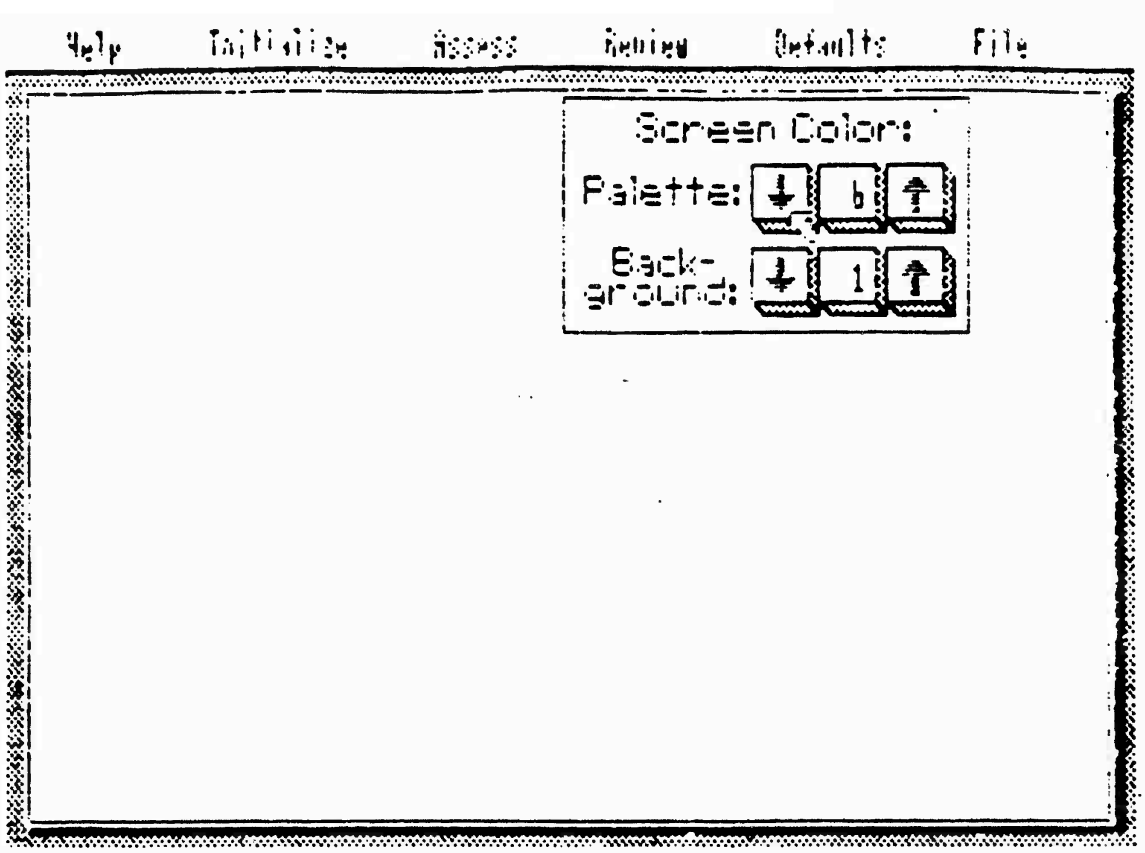


FIGURE 36. SET SCREEN ATTRIBUTES MENU

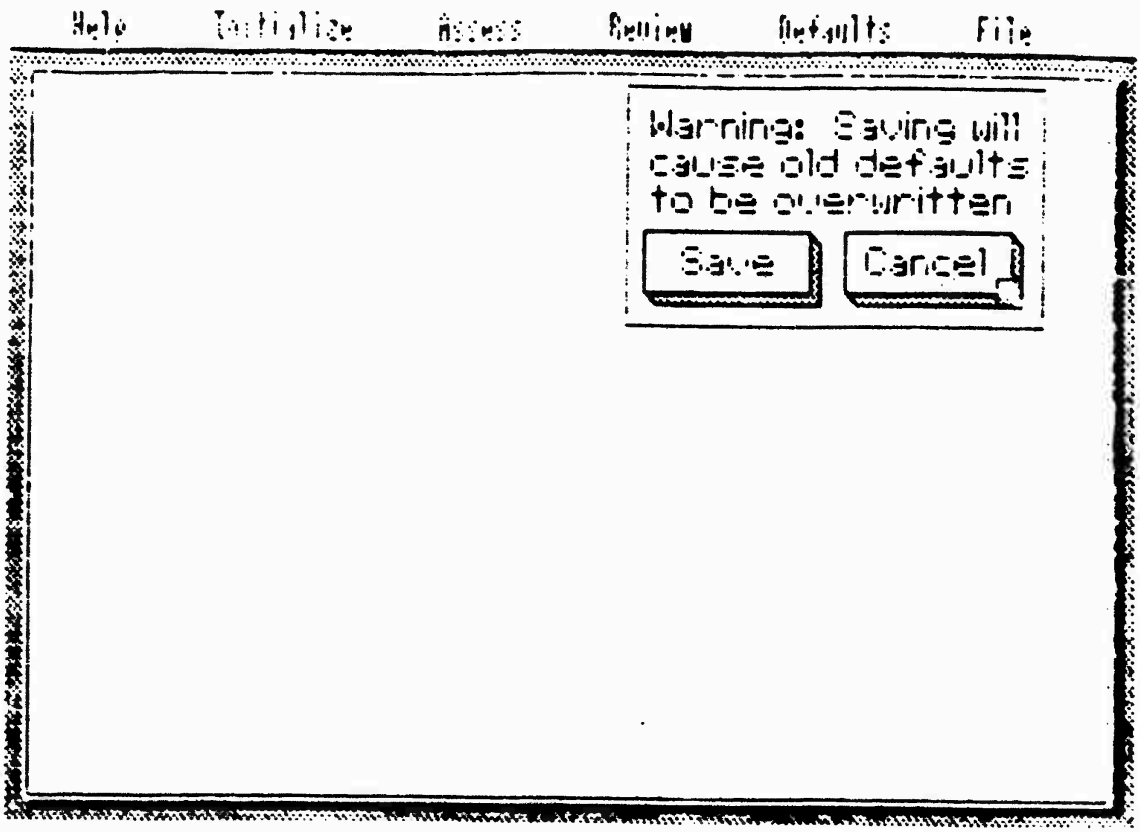


FIGURE 37. SAVE DEFAULTS MENU

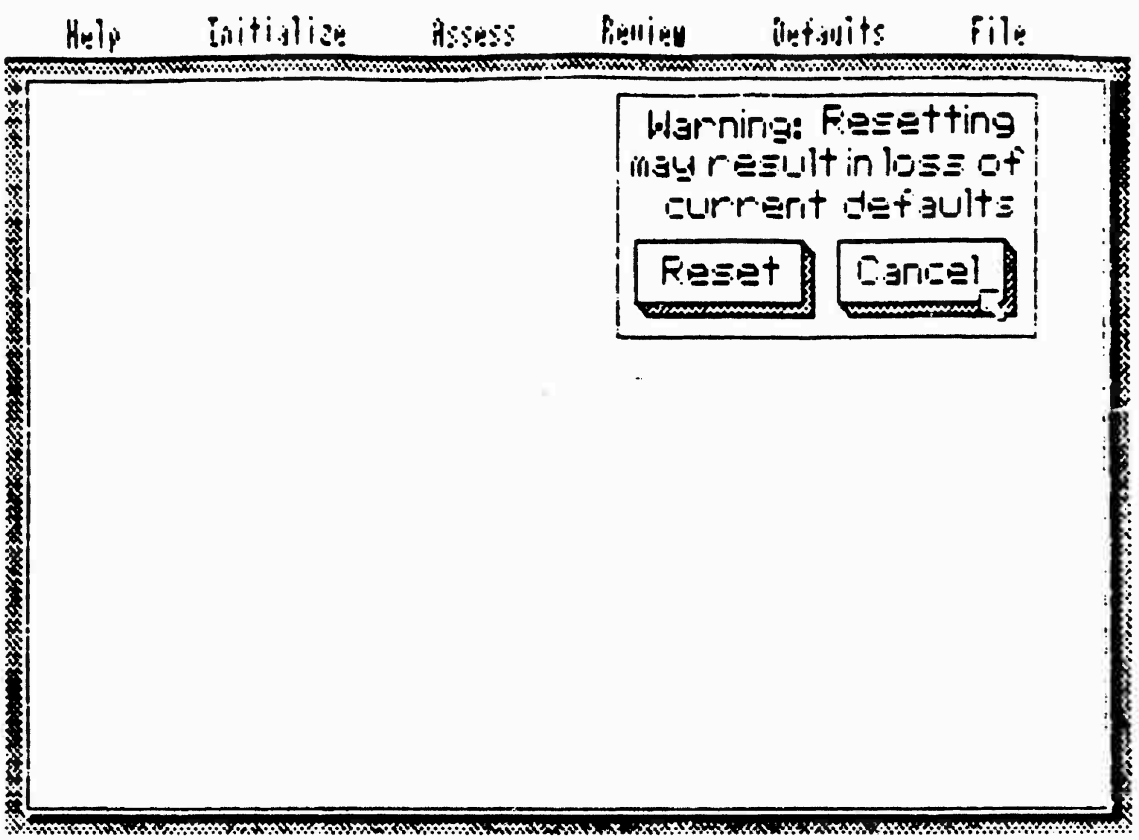


FIGURE 38. RESET DEFAULTS MENU

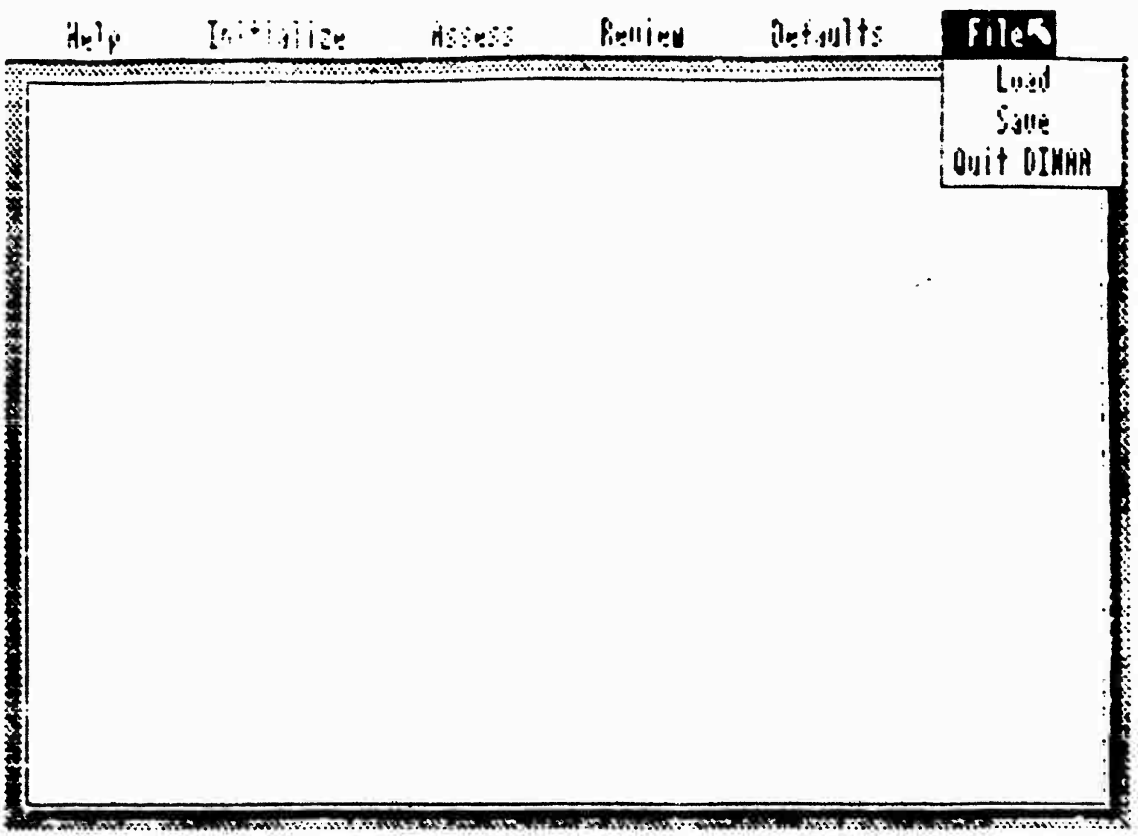


FIGURE 39. FILE OPTIONS

shows these functions listed under the "File" heading. The menu for loading a saved DINAA state is shown in Figure 40. If DINAA finds more than ten saved DINAA files (indicated by a ".DIN" tag), the user may use the up and down pointing arrow boxes to scroll through them. After selecting a file, clicking the "LOAD" will perform the actual loading of the DINAA state. When a new state is loaded, the entire current state is wiped out; two sets of messages may not be loaded together to make one long list of messages.

The DINAA state may be saved to disk by filling out the filename box of Figure 41, and then clicking the "Save" box. Filenames may be no longer than eight characters.

3.8 Returning to DOS

Pointing to the "File" heading and selecting the "Quit DINAA" option are the first steps required to leave DINAA. A second menu, in Figure 42, will appear asking the user to verify the decision to exit. Whether DINAA exits to DOS or the DRIVER.COM program depends on whether DINAA finds the driver program on the disk. If it does find the driver, DINAA will always exit to it, from which point the user must enter "Q" at the keyboard to finally exit to DOS. In the event that DINAA does not find DRIVER.COM, it will simply return directly to DOS.

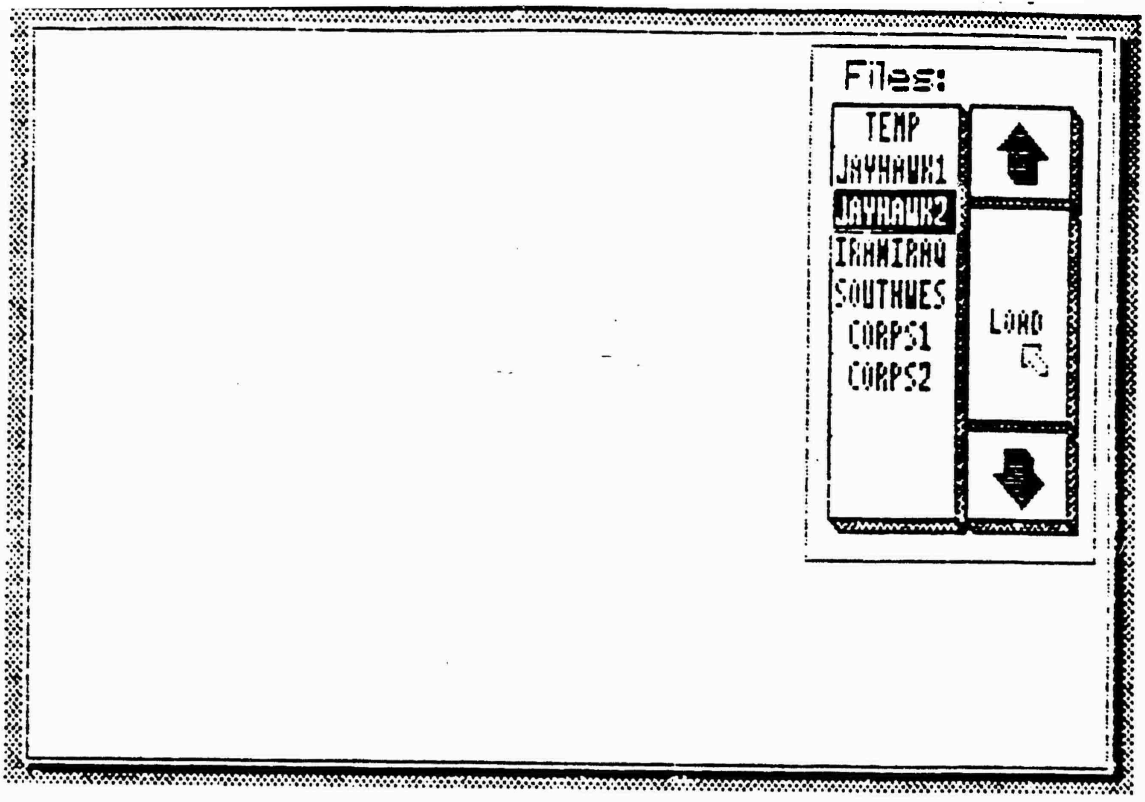


FIGURE 40. LOAD STATE MENU

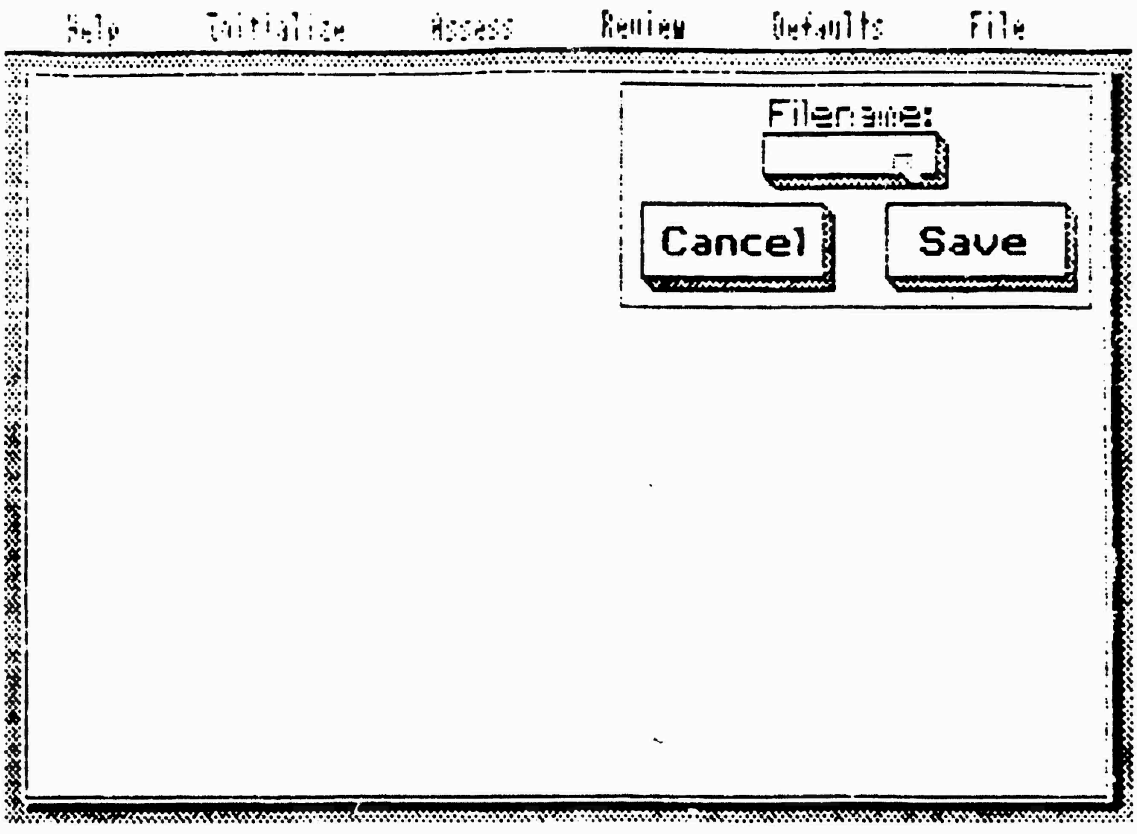


FIGURE 41. SAVE STATE MENU

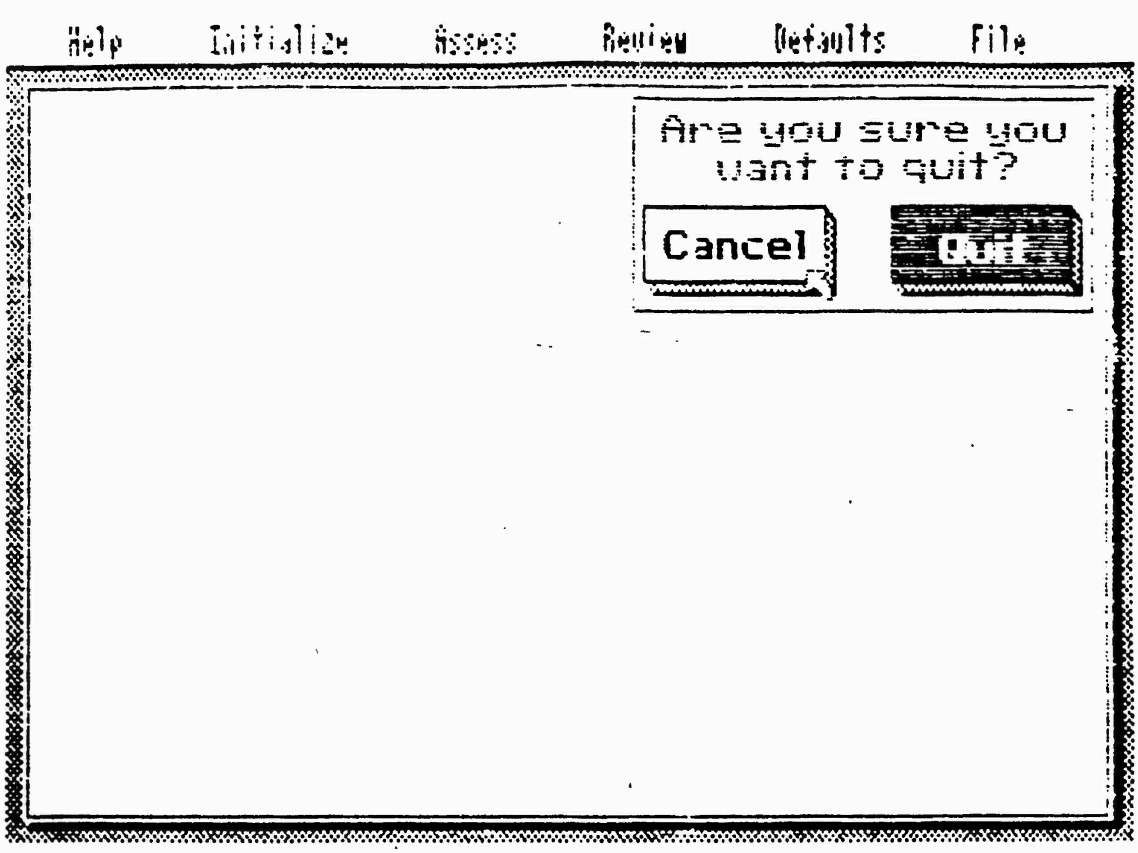


FIGURE 42. QUIT VERIFICATION MENU

4.0 Conclusion

The Dynamic Intelligence Assessment Aid has been carefully designed to provide maximum ease of use, while retaining powerful capabilities. DINAA clearly provides a great improvement in ease of use over past Bayesian decision aids and develops some of the most sophisticated interaction techniques currently available on an IBM PC, all while maintaining compatibility with the previously developed AI/ENCOA. It is the authors' belief that these features provide DINAA with a significant advantage over other intelligence assessment aids.

Questions about the design and operation of DINAA should be directed to Mr. Matthew A. Probus. General questions about the application of Bayes' Theorem to this type of decision analysis should be directed to Dr. Michael L. Donnell.

Appendix A - Supplemental PAWS Files and Utilities

As an additional item under the work agreement with the Army Research Institute, SAIC has developed additional tools and files for use with the Prototype Analyst Workstation (PAWS) developed by Vector Research, Inc. for ARI.

PAWS has the capability to provide pre-defined information to a student intelligence analyst receiving and assessing messages in several conflict scenarios. This information is matched with messages when the scenario is created, and may be in the form of textual files, or in the form of graphic screen images usually representing maps. Text files can be written with any editor, but graphic files had to be generated by Vector Research's ARTIST program.

Vector Research had developed several scenarios for use with PAWS, along with textual help files for each, but with few graphic image files. ARI indicated to SAIC a need for more graphic aid files to help intelligence analysts visualize the scenarios. SAIC had to develop two tools to do this.

The first program, VIEWGPH.COM was written to quickly display PAWS graphic files outside of PAWS, so that screen dumps of existing graphic files could be made and edited in a standard 16K screen image format by invoking the resident program CAPTURE.COM, supplied with PC-PAINT. To immediately see any PAWS file of the form *.GPH, copy VIEWGPH.COM from disk 3 and type "VIEWGPH filename", where filename is the .GPH file minus the ".GPH" tag. Exit VIEWGPH by hitting any key.

A second program, MAKEGPH.COM, was written to convert a PC-PAINT generated screen file to the ARTIST format, since PAWS can only load graphic files in the ARTIST format. PC-PAINT, marketed by Mouse Systems, was judged to be more powerful and easier to use than Vector's ARTIST program, and was used to develop eighteen graphic image files relating to the messages of the IRAN-IRAQ scenario developed by Vector Research. These files were then run through the MAKEGPH filter to put them in the ARTIST format and incorporated into the IRAN-IRAQ scenario by modifying the PAWS' MESSAGES.TGD file. To use these

files from within PAWS, copy every message file from disk 3 ("COPY A:MSG*.GPH" and "COPY A:MESSAGES.TGD") to the directory containing the PAWS Iran-Iraq scenario. To use MAKEGPH, copy the MAKEGPH.COM file from disk 3 and type "MAKEGPH filename", replacing filename with the .PIC file to be converted and leaving off the ".PIC" tag.

Appendix B - Disk Contents

Diskette 1: (All files are binary data files or executable code)

DRIVER.COM - DINAA and AI/ENCOA interface routine

DRIVER.PIC - Screen image file

DINAA.COM - DINAA main program

DINAA.DAT - Contains DINAA windows, character font, and defaults.

DINAA.000 - Execution overlay file

DINAA.001 - Execution overlay file

DINAA.002 - Execution overlay file

AIENCOA.COM - Compiled version of modified AI/ENCOA program

AIENCOA.000 - Execution overlay file

AIENCCA.001 - Execution overlay file

AIENOCA.002 - Execution overlay file

AIENCOA.003 - Execution overlay file

Diskette 2: (All files are Turbo Pascal source code)

DRIVER.PAS - DINAA - AI/ENCOA interface controlling procedure

DINAA.PAS - DINAA data types and driver code

MAIN.PAS - Main menu driver

UTIL.PAS - Utility functions common code

MOUSE.PAS - Mouse interface to device driver,

- keyboard mouse simulation procedures

INIT.PAS - Initialize menu option routines

ASSESS.PAS - Assess and Review menu option routines

DEFAULT.PAS- Default menu option routines

FILE.PAS - File menu option routines

AIENCOA.PAS- Modified AI/ENCOA source code

Diskette 3: (PAWS related files)

VIEWGPH.PAS

VIEWGPH.COM

MAKEGPH.PAS

MAKEGPH.COM

MESSAGES.TGD

MSG1.GPH

MSG2.GPH

MSG8.GPH