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NASA TLX Task Load Index Evaluation Program (Workload.exe)

User Guide

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Introduction

The NASA Task Load Index (TLX) provides a standard and widely used protocol for evaluating experimental subject's perceptions of the difficulty they experienced while performing experimental tasks. The index is defined in terms of six rating scales that decompose the difficulty subjects experienced along different psychological axes.

Evaluation of the TLX proceeds in two steps. The first, to be conducted only once for each set of similar experimental trials, seeks to establish an ordering of the six scales according to their relevance in describing the difficulty of the task. This ordering is established by having subjects choose which one in each unique pair of the six rating scales is the more important of the two. The second step, to be conducted after each experimental trial, asks the subjects to provide a quantitative measure of the task difficulty along each of the six different axes. This is obtained by having subjects place a tick on a line between two extremes (for example, "Good" vs. "Poor"). The index is then computed by summing the ratings collected in the second step, weighted according to their relevance as established by the comparisons in the first step.

The TLX protocol as originally developed called for a paper-and-pencil evaluation to collect the information necessary for computation of the index. The initial version was later replaced by a more convenient DOS-based program written in Turbo Pascal, which provided a simple user interface and automated the computations. This brief guide describes the next generation of this software, designed to run under the most recent versions of the Microsoft Windows™ operating system, and augmented with several new features to help organize and simplify the collection of TLX data.

The program, called "Workload", provides four major levels of functionality:

1) A *file manager* that can be used to create and manage a list of experiments and a list of experimental subjects associated with each experiment;

2) An *experiment template editor* that can be used to define and describe each set of weight and rating evaluations that will need to be conducted for each subject;

3) *Weights and ratings evaluation dialogs* that provide a structured interface for the subject to record their impressions of the task in terms of the TLX factors; and

4) A *results dialog* which displays the weights and ratings, and computes the TLX index itself, while also allowing the results to be saved to a spreadsheet file.

Installation

Installation of the software is a simple matter of copying the application program from the distribution CD to your computer's hard drive. To proceed with the installation, first locate the application program on the distribution CD - the program is called

"Workload", and its icon consists of the three letters "TLX" in red and turquoise. Next, drag the icon from the CD to your desktop or to the folder on your hard drive where you would like the program to reside. Alternately, you can use the Windows Explorer copy and paste functions to create a copy of the software in the desired location.

Note that because the software was copied from a CD, it will initially have "Read-only" status and you will not be able to delete it. If you wish to delete the program, click on it with the right mouse button and choose Properties from the pop-up menu. Click on the Read-only box to clear it and close the Properties dialog. You should now be able to delete the program.

Managing Experiments and Subjects

Workload manages experiments and subjects hierarchically, with experiments defined at the top level and subjects defined under experiments. Each experiment has associated with it a *template*, which is used to define the experimental conditions under which weight and rating evaluations should take place. When a new subject is defined, his or her file inherits all of the settings in the associated experiment's template. Thus, the order of usage will usually proceed as follows:

1) Create a new experiment.
2) Edit the template for the experiment, defining all experimental conditions under which weight and rating evaluations should take place.
3) Create new subjects. They will inherit all the definitions in the experiment template.
4) Have the subjects evaluate the weights and ratings for each set of conditions.
5) View and/or save the results.

The following sections explain how to perform each of the above tasks.

Start the Workload program by double-clicking on its icon. If this is the first time you have run the program in its current location, you will be prompted to allow the program to create an "Experiments" directory where all data files will be kept. Click OK to proceed. (If you do not want this directory created, click Cancel and the program will terminate.)

The File Manager dialog will then open. This dialog is where you will perform all management of experiment and subject files. *You should never access the Experiments directory and add, edit, or delete the files contained within.* Use the File Manager instead.

The File Manager dialog is separated into two panes, one for experiments at the top and one for subjects at the bottom. To create a new experiment, click the New button in the Experiments pane. A new entry will appear in the Experiments list, with highlighted text prompting you to enter a name for the experiment. Type in the experiment name and hit Enter.

Once a new experiment has been created or an existing experiment selected by clicking on it, the Edit and Delete buttons for the Experiments pane will be enabled. To delete the selected experiment, click the Delete button. You will be prompted for confirmation before proceeding. To begin editing of an experiment template, either double-click on the experiment's name in the Experiments list, or click the Edit button. Editing experimental templates is covered in the next section.

Once an experiment is selected, the New button in the Subjects pane will also become enabled. To create a new subject for the selected experiment, click the New button in the Subjects pane.

IMPORTANT: *The information in the experiment template is copied into each subject's file when the subject is first created. Changes made to the experiment template after creating a subject will **NOT** be reflected in the subject's file. Therefore, you should complete the experiment template **before** creating the first subject.*

After clicking the New button in the Subjects pane, a new entry will appear in the Subjects list, with highlighted text prompting you to enter the subject's initials. Type in the subject's initials and hit Enter.

Once a new subject has been created or an existing subject selected by clicking on it, the Evaluate and Delete buttons in the Subjects pane will become enabled. To delete the selected subject, click the Delete button. You will be prompted for confirmation before proceeding. To begin evaluation of weights and ratings for the selected subject, either double-click on the subject's initials in the Subjects list, or click the Evaluate button. Evaluation of subjects is described further below.

Editing Experiment Templates

Double-clicking on an experiment or clicking the Edit button in the Experiments pane of the File Manager will open the Experiment Template Editor dialog. Headings near the top of the dialog will tell you which experiment is currently being edited, and will indicate that you are in the Template Editor.

To leave the Template Editor and return to the File Manager, choose Open File Manager from the File menu or click the file folder icon on the toolbar. (To find out what each toolbar button does, hold the mouse pointer over it for a second and a tool tip will appear indicating its function, with a longer description appearing in the status bar at the bottom of the window.)

The Template Editor is separated into two panes, one on the left for Weights and one on the right for Ratings. These are where you define the experimental conditions for which weight and rating evaluations are required. Typically, you will define several ratings entries for each weights entry, since ratings are generally evaluated after each experimental trial, while one set of weights will cover several trials.

Creating a new set of weights

To create a new set of weights to be evaluated, choose New Weights Group from the Workload menu, or click the corresponding toolbar button (the one titled NW). A new entry will appear in the Weights list, with highlighted text prompting you to enter a name for this set of weights. The name you enter should describe the experimental conditions or settings for which these weights will be evaluated. Hit Enter when you are done.

Once a new weights group entry has been created or an existing entry selected by clicking on it, the Delete command in the Workload menu and the corresponding toolbar button (a red X) will become enabled. To delete a weights group, choose Delete from the menu or click the toolbar button. You will be prompted for confirmation before proceeding.

You do not need to explicitly save changes that you have made while using the Workload program. The software does this automatically each time you complete an action.

Creating a new set of ratings

To create a new set of ratings to be evaluated, choose New Ratings from the Workload menu, or click the corresponding toolbar button (the one titled NR). A new entry will appear in the Ratings list, with highlighted text prompting you to enter a name for this set of ratings. The name you enter should describe the experimental conditions or settings for which these ratings will be evaluated. Hit Enter when you are done.

Once a new ratings entry has been created or an existing entry selected by clicking on it, the Delete command in the Workload menu and the corresponding toolbar button (a red X) will become enabled. To delete a ratings entry, choose Delete from the menu or click the toolbar button. You will be prompted for confirmation before proceeding.

Two check boxes at the bottom of the Ratings pane allow you to select additional options for the ratings. The first, if checked, will cause the evaluation of the rating scales to be performed in random order. If not checked, the evaluation will proceed in the standard order described in the NASA TLX documentation. The second, if checked, will append three additional rating scales to the basic six covering visual demand, auditory demand, and global workload. If not checked, only the original six will be used.

Again, you do not need to explicitly save your changes. The software does this automatically each time you complete an action.

Evaluating Subject's Assessment of Task Load

Double-clicking on a subject's initials in the File Manager or clicking the Evaluate button will open the Subject Evaluation dialog. Headings near the top of the dialog will describe which subject from which experiment is currently being evaluated. To leave the Template Editor and return to the File Manager, choose Open File Manager from the File menu or click the file folder icon on the toolbar.

The Subject Evaluation dialog is very similar to the Template Editor dialog. Like the Template Editor, this dialog allows you to create and delete weight and rating entries and to set the options for rating evaluations, except that the changes in this case apply only to the current subject and not to the entire experiment. *This is an important point: Changes you make to an individual subject will* ***not*** *be propagated to other subjects or to the experimental template.*

In addition to the features shared with the Template Editor, the Subject Evaluation dialog also provides functions for evaluating weights and ratings, viewing them, saving them for export to a spreadsheet program, or erasing them. An icon is also shown beside each entry: a red question mark means that this entry has not yet been evaluated, while a green checkmark means that it has.

Evaluating weights

To begin subject evaluation of a weights group, double-click on its name in the Weights list, choose Evaluate Weights from the Workload menu, or click the corresponding toolbar button (the one with a picture of a balance). A new Weights Evaluation dialog will open, titled with the name of the weights group being evaluated, and asking the question "Which factor was most important?".

Below the question, the names of two of the six TLX ratings scales will appear on two large rectangular buttons on the left, with the defining question for the two scales to the right. The two large buttons define the two scales being compared. The subject should be instructed to carefully read the defining question for each of the two scales, and to click the button corresponding to the scale he or she thinks was most important or relevant for the experimental tasks to which this weights group pertains. Once the subject has clicked one of the buttons it will become depressed, and its title will become underlined and will appear as the answer to the question. The subject can simply click the other button if he or she changes his or her mind.

Once a selection has been made for one comparison, the Next button at the lower right of the dialog will become enabled. The subject can click this button to proceed with the next evaluation. The subject can also click the Previous button to go backward and review or change the selections he or she has already made. Each possible pair of rating scales will appear exactly once, in random order.

Once the subject reaches the last of the comparisons, the text on the Next button will change to Finish, and the subject can click this button to complete the evaluation. This will close the Weights Evaluation dialog, save the results, and return control to the Subject Evaluation dialog. Note that if, instead, the subject clicks the dialog's Close button at any time (the small X in the upper right corner), control will return immediately to the Subject Evaluation dialog and results from the Weights Evaluation dialog will be discarded.

After a weights group entry has been evaluated, two additional functions in the Workload menu (and their corresponding toolbar buttons) will be enabled. One of these will allow an evaluated set of weights to be erased, discarding the subject's comparisons and reverting from a green check mark icon back to a red question mark icon. Note that the weights group entry will not be deleted from the Weights list – only its contents will be erased. This option might be chosen if, for example, a subject became distracted during the evaluation or misunderstood the instructions, and the evaluation has to be repeated. If you choose this option, you will be prompted for confirmation before proceeding. The second function enabled when an evaluation has been completed allows you to view the results of the evaluation and optionally save them. This topic is covered further below.

If you would like to review the selections that the subject made during a weights evaluation, double-click on the entry in the Weights list. The Weights Dialog will open again, but now the title bar will indicate the date and time at which the subject performed the evaluation, and you will not be allowed to change any of the subject's selections. Note that in this case, the comparisons will appear in a standard order, not in the original random order used during the evaluation.

Evaluating ratings

To begin subject evaluation of a set of ratings, double-click on its name in the Ratings list, choose Evaluate Ratings from the Workload menu, or click the corresponding toolbar button (the one with a picture of a rating scale). A new Ratings Evaluation dialog will open, titled with name of the ratings group being evaluated, and asking the question "How would you rate this factor?".

Below the question, the name one of the rating scale will appear on the left, with its corresponding defining question on the right. Below these will appear a slider bar with two extreme answers to the question on its left and right. The subject should be instructed to carefully read the defining question for the rating scale, and to move the pointer for the slider bar (click-and-drag) from its position at the extreme left to the location that best reflects their response to the question between the two extremes. The subject can simply move the pointer again if he or she changes his or her mind.

Once the pointer has been moved, the Next button at the lower right of the dialog will become enabled. The subject can click this button to proceed with the next rating evaluation. The subject can also click the Previous button to go backward and review or change the evaluations he or she has already done. Each rating scale will appear exactly once, in random order if this has been requested. There will be either six or nine scales, depending on whether the additional three scales have been requested.

Once the subject reaches the last of the comparisons, the text on the Next button will change to Finish, and the subject can click this button to complete the evaluation. This will close the Ratings Evaluation dialog, save the results, and return control to the Subject Evaluation dialog. Note that if, instead, the subject clicks the dialog's Close button at any time (the small X in the upper right corner), control will return immediately to the Subject Evaluation dialog and results from the Ratings Evaluation dialog will be discarded.

After a set of ratings has been evaluated, the Erase and View Results functions on the Workload menu will become enabled, in the same way as described in the Evaluating Weights section above. The procedure for viewing results is covered in the next section.

If you would like to review the selections that the subject made during a ratings evaluation, double-click on the entry in the Ratings list. The Ratings dialog will open again, but now the title bar will indicate the date and time at which the subject performed the evaluation, and you will not be allowed to change any of the subject's ratings. Note that in this case, the comparisons will appear in a standard order, not in the original random order used during the evaluation if this option was selected.

Displaying Results

Once a completed weights group entry in the Weights list and/or a completed ratings entry in the Ratings list has been selected, the View Results function in the Workload menu will become enabled (as will its corresponding toolbar button – the one with a summation sign, or capital sigma). Selection of this function will open the View Results dialog, which presents a tabulated account of the subject's responses for the selected item(s). The name of the experiment and subject initials will appear at the top of the dialog.

If a completed weights group was selected, then its name, the date and time of its completion, and the weights computed from the subject's comparisons will appear as well. Otherwise, the weights fields will be disabled (grayed out). Similarly, if a completed ratings entry was selected, then its name, the date and time of its completion, and the ratings themselves (on a scale of 0 – 100) will appear. Otherwise, the ratings fields will be disabled. Finally, if both a completed weights and ratings entry were selected, then the TLX workload will also be computed using the selected weights and ratings and displayed. Otherwise, this field will be disabled.

The next section describes the procedure for saving the contents of the Results dialog to a text file in order to import the data into a spreadsheet program for analysis and plotting. If you wish to leave the Results dialog without saving its contents, click the Close button. The dialog can be opened again at any time.

Saving Results

If you wish to save the contents of the View Results dialog to a text file, click the Save button. This will open the Save dialog. This dialog is identical to the standard Windows dialog used to open and save files in other programs, with the addition of a Preview pane which allows you to view the contents of a file before deciding to save your results into it. You can navigate up and down through directories in the usual way, and the dialog will display any text files (files ending in .txt) in the current directory.

You can select an existing file as the target to save your results, or you can type in the name of a new file. If you choose an existing file, a single line of text will be added to the end of the file containing all of the results from the Results dialog. If you enter the name of a new file, the file will be created, a set of headings will be added to the first line of the file, and the results will be added on the second line.

If you have several different text files with output data from the program, and you need to verify their contents before deciding which should receive your data, click once on the file name in the large upper pane of the dialog. The contents of the file will be shown in the large lower Preview pane of the dialog. To select the target file and save your results, either double-click on its name in the upper pane, or click once to select it and then click the Save button.

The output format of the results text is designed to be compatible with spreadsheet software such as Microsoft Excel™. It is arranged as a set of 24 text items separated by commas on a single line, corresponding to all of the items in the Results dialog. The following describes how to load such a file into Excel – the procedure is similar for other programs. Open the file from inside Excel as you would any other Excel file. If the file does not appear in its directory in Excel's Open dialog, make sure the "Files of type" filter at the bottom of the dialog is set to Text Files. Double-click on the file or click once to select it and then click Open.

This will open Excel's Text Import Wizard, which will prompt you to make certain selections concerning the format of the file. You should indicate that the file is delimited, and that the delimiter is a comma. The file should then open as a worksheet with all of the data items in fields under their respective headings. Fields for unavailable items will be empty (for example, if you are saving only weights and not ratings). You may need to widen some columns before their contents will be visible.

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14. ABSTRACT

(U) The NASA Task Load Index (TLX) provides a standard and widely used protocol for evaluating experimental subject's perceptions of the difficulty they experienced while performing experimental tasks. The index is defined in terms of six rating scales that decompose the difficulty subjects experienced along different psychological axes. The NASA TLX protocol as originally developed called for a paper-and-pencil evaluation to collect the information necessary for computation of the index. This guide describes a computerized version of the NASA TLX protocol, designed to run under the most recent versions of the Microsoft WindowsTM operating system, and augmented with several features to help organize and simplify the collection of TLX data. Three additional, optional rating scales may be selected to provide greater diagnostic assessment than that available from the original method. Data may be saved to a comma-separated variable text file for further processing.

15. KEYWORDS, DESCRIPTORS or IDENTIFIERS

(U) workload
NASA TLX