Instantaneous self-assessment of workload technique (ISA)

Jordan and Brennen (1992)

Background and applications

Instantaneous self-assessment (ISA) is a technique that has been developed as a measure of workload to provide immediate subjective ratings of work demands during the performance of primary work tasks such as air traffic control. This paper reports a study that compared the results of ISA with those gathered from other established workload evaluation techniques; subjective ratings collected at the end of the task, mean heart rate and heart rate variability, and error in the primary task of tracking. ISA ratings were found to be correlated significantly with the post-task ratings of workload, heart rate variability, and task performance. Generally each of the techniques was sensitive to variations in task difficulty. However, performance on the primary tracking task was found to be poorer during periods when ISA responses were required, regardless of whether they were spoken or manual responses. This finding suggests that the usefulness of the technique is limited in comparison to less intrusive measures of workload. The ISA workload technique is a very simple subjective workload assessment technique that was developed by NATS for use in the assessment of air traffic controller's mental workload during the design of future ATM systems (Kirwan et al 1997). A very simple technique, ISA involves participants self-rating their workload during a task (normally every two minutes) on a scale of 1 (low) to 5 (high). Kirwan et al (1997) used the following ISA scale to assess air traffic controllers (ATC) workload.

Level	Workload Heading	Spare Capacity	Description
5	Excessive	None	Behind on tasks; losing track of the full picture
4	High	Very Little	Non-essential tasks suffering. Could not work at this level very long.
3	Comfortable Busy Pace	Some	All tasks well in hand. Busy but stimulating pace. Could keep going continuously at this level.
2	Relaxed	Ample	More than enough time for all tasks. Active on ATC task less than 50% of the time.
1	Under-Utilised	Very Much	Nothing to do. Rather boring.

Figure 1 Example ISA workload scale (Source: Kirwan et al 1997)

Typically, the ISA scale is presented to the participants in the form of a colour-coded keypad. The keypad flashes when a workload rating is required, and the participant

simply pushes the button that corresponds to their perceived workload rating. Alternatively, the workload ratings can be requested and acquired verbally. The ISA technique allows a profile of operator workload throughout the task to be construction, and allows the analyst to ascertain excessively high or low workload parts of the task under analysis. The appeal of the ISA technique lies in its low resource usage and its low intrusiveness.

Domain of application

Generic. ISA has mainly been used in ATC.

Procedure and advice

Step 1: Construct a task description

The first step in any workload analysis is to develop a task description for the task or scenario under analysis. It is recommended that hierarchical task analysis is used for this purpose.

Step 2: Brief participant(s)

The participants should be briefed regarding the ISA technique, including what it measures and how it works. It may be useful to demonstrate an ISA data collection exercise for a task similar to the one under analysis. This allows the participants to understand how the technique works and also what is required of them. It is also crucial at this stage that the participants have a clear understanding of the ISA workload scale being used. In order for the results to be valid, the participants should have the same understanding of each level of the workload scale i.e. what level of perceived workload constitutes a rating of 5 on the ISA workload scale and what level constitutes a rating of 1. It is recommended that the participants are taken through the scale and examples of workload scenarios are provided for each level on the scale. Once the participants fully understand the ISA workload scale being used, the analysis can proceed to the next step.

Step 3: Pilot run

Once the participant has a clear understanding of how the ISA technique works and what is being measured, it is useful to perform a pilot run. Whilst performing a small task, participants should be subjected to the ISA technique. This allows participants to experience the technique in a task performance setting. Participants should be encouraged to ask questions during the pilot run in order to understand the technique and the experimental procedure fully.

Step 4: Begin task performance

Next, the participant should begin the task under analysis. Normally, a simulation of the system under analysis is used, however this is dependent upon the domain of application. ISA can also be used during task performance in a 'real-world' setting, although it has mainly been applied in simulator settings. Simulators are also useful as they can be programmed to record the workload ratings throughout the trial.

Step 5: Request and record workload rating

The analyst should request a workload rating either verbally, or through the use of flashing lights on the workload scale display. The frequency and timing of the workload ratings should be determined beforehand by the analyst. Typically, a workload rating is requested every two minutes. It is crucial that the provision of a workload rating is as unintrusive to the participant's primary task performance as possible. Step 4 should continue at regular intervals until the task is completed. The analyst should make a record of each workload rating given.

Step 6: Construct task workload profile

Once the task is complete and the workload ratings are collected, the analyst should construct a workload profile for the task under analysis. Typically a graph is constructed, highlighting the high and low workload points of the task under analysis. An average workload rating for the task under analysis can also be calculated.

Advantages

- ISA is a very simple technique to learn and use.
- The output allows a workload profile for the task under analysis to be constructed.
- ISA is very quick in its application as data collection occurs during the trial.
- Has been used extensively in numerous domains.
- Requires very little in the way of resources.
- Whilst the technique is obtrusive to the primary task, it is probably the least intrusive of the on-line workload assessment techniques.
- Low cost.

Disadvantages

- ISA is intrusive to primary task performance.
- Limited validation evidence associated with the technique.
- ISA is a very simplistic technique, offering only a limited assessment of operator workload.
- Participants are not very efficient at reporting mental events.

Related methods

ISA is a subjective workload assessment technique of which there are many, such as NASA TLX, MACE, MCH, DRAWS and the Bedford scales. To ensure comprehensiveness, ISA is often used in conjunction with other subjective techniques, such as the NASA TLX.

Training and application times

It is estimated that the training and application times associated with the ISA technique are very low. Application time is dependent upon the duration of the task under analysis.

Reliability and validity

No data regarding the reliability and validity of the technique is available in the literature.

Tools needed

ISA can be applied using pen and paper.

Bibliography

- Kirwan, B., Evans, A., Donohoe, L., Kilner, A., Lamoureux, Atkinson, T., & MacKendrick, H. (1997) Human Factors in the ATM System Design Life Cycle. FAA/Eurocontrol ATM R&D Seminar, Paris, France. Internet source.
- Brennen.S.D. (1992). An Experimental Report on Rating Scale Descriptor Sets for the Instantaneous Self Assessment (ISA) Recorder, DRA/TM/CAD5/92017. Defence Research Agency. Portsmouth.
- Jordan.C.S. (1992). Experimental Study of the Effect of An Instantaneous Self Assessment Workload Recorder on Task Performance, DRA/TM/CAD5/92011. Defence Research Agency. Portsmouth.

ERGO

The ERGO System prompts the controller by illuminating a red LED on the ERGO Keypad and on an additional indicator LED. This second indicator may be placed anywhere in controller's field of view (e.g. beside the radar screen). A valid keystroke by the controller will put the indicators out.

The collected data input from all controller positions are stored in a recording file by the ERGO Control Unit and simultaneously sent to the remote ERGO Display Unit. The ERGO Display Unit shows the cumulative data effectively in real time, during the actual recording session.

The EEC evolution was needed, as the original ATCEU implementation had not foreseen any on-line access to the collected data. The hardware architecture and software implementations are totally new and have been developed specially for use during ATC simulations in the Eurocontrol Experimental Centre.

The first version of the ERGO System (April 1992) was limited (by the Main Junction Unit) to observing up to eight controller work positions. Further ERGO developments kept this limit, with the ideea that further extensions would be made using a modules concept, allowing now up to four times eight measured working positions.

The control parameters for an ERGO session may be selected from a range of pre-set values accessed by push buttons on the ERGO Control Unit screen. Pre-set values can themselves be designated from an 'ERGO.INI' file. The currently used names of the controller working positions and some other parameters are also defined in this file.

KEYPAD WITH INDICATOR