Stockholm, 2023-09-13

Technical Note
Screens of Cognitive Assessment Software, as generated for the Orbital Architecture (ORBARCH) activity

The current Technical note aims to document all screens presented to crew within the Cognitive Assessment software, v. 2.0, which is to be used during upcoming missions.

All screenshots are presented in the order the crew will see them, in Annex I of this document.

Please note that screens 5, 7, 11, 12, 13, 16, 19, 22, 32, 33 are repeated during the assessment with slightly different stimuli as part of the assessment they are part of.

More specifically:

- Screen 5 – 7 are presented multiple (20) times in sequence, with variable times between screen 5 and 6 (1-8 seconds), each time.
- Screen 12-13, indicate on the lower part, the feedback the user receives while pressing the labeled keys, Left Shift Key and Right Shift Key, accordingly.
- Screens 11, 16, 19, and 22 are repeated 20 times each, with 3 seconds between each presentation, with different stimuli. These potential stimuli are:
  - The letter on the center which can take values:
    - 'C', 'H', 'K', 'N', 'R', 'W', 'X', 'Y'
  - The white square, which can appear in one of the 8 "free" spots of the grid, meaning any but the center.
- Screen 32 and 33, have "active elements that change during 9 minutes of assessment.
  - The elements on the top left of the screen
    - Button F5 is green and could occasionally go gray.
    - Button F6 is grey and can occasionally go pink.
    - Gauges F1 to F4 are grey with a sliding pointer.
      - If the user makes an error in their input, they will have a pink indication on their bottom.
      - If the user indicates a correct fluctuation in their levels, they will have a green indication on their bottom

- The elements on the bottom left of the screen
  - The up and down arrows can change based on user input
  - The Numbers can change based on user input when the up and down arrows are on the corresponding column
  - The letters and numbers under the label communications change between assessments in a random manner, but retain the format XXXNNN, where X is any letter and N is any number.
- The bottom center and bottom right of the screen:
  - The numbered arrows (1 through 8):
    - If the user uses the numpad corresponding numbers they can toggle them between grey (inactive) and green (active).
    - In certain cases the arrows turn pink for a while indicating that they are not togglable. They turn grey after 5 to 15 seconds of being pink.
    - The six green rectangles fluctuate based on certain "flow rates" (indicated on the bottom right). Their base and width is set, and the top side will fluctuate up and down.

Kind regards

Michail Magkos
Principal Investigator for Orbital Architecture
Research Engineer
Division of Ergonomics, CBH
KTH, Royal Institute of Technology
Phone: +46 76 4507 195
magkos@kth.se

ANNEX

Screens of ORBARCH Cognitive Assessment Software

Orbital Architecture
Cognitive Assessment

Welcome to the Cognitive Assessment.
Before starting, we would request you to indicate your perceived stress and
tiredness in the next screen.

[Press SPACE when you are ready to proceed]

Perceived Stress and Tiredness

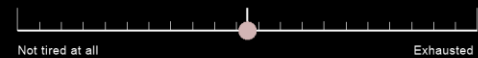[Please use the sliders to indicate your responses to the following prompts.]

Perceived Stress

How stressed do you feel?

Not stressed at all · · · · · · · · · · · · · · · · As stressed as can be

Perceived Tiredness

How tired do you feel?

Not tired at all · · · · · · · · · · · · · · · · Exhausted

[Press SPACE when you are ready to proceed]
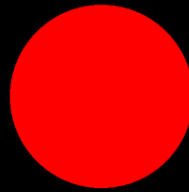
Psychomotor Vigilance Task

In this test, you will react to a visual stimulus (red circle) presented at the center of the screen.

Do not press anything when you see the white cross.

Press the SPACE key as soon as you see the red circle.

[Press SPACE when you are ready to proceed]

[Press SPACE to start Assessment]

[Respond to the red circle, not the cross]
Respond by pressing the space key

KTH
100 44 Stockholm
08 790 xx xx | info@kth.se | www.kth.se

Psychomotor Vigilance Task

[This is the end of the Psychomotor Vigilance Task]

[Press SPACE to Proceed.]

n-Back Working Memory Task

In the following tests, you will be presented with a series of stimuli in sequence.

These stimuli will be delivered through two dimensions that will be presented simultaneously.

The first dimension of the stimuli is the audiovisual one, where you will be presented with a letter both visually and phonetically, always located at the center of a 3 by 3 grid.

The second dimension is a visuospatial stimulus, where you will be presented with a white square in one of 8 possible locations (around the letter).

The assessment will begin at stage 1-back and will end at stage 4-back.

In each of the stages, your goal is to identify matches between the current and the previous 1,2,3 or 4 stimuli (1-back until 4-back match)
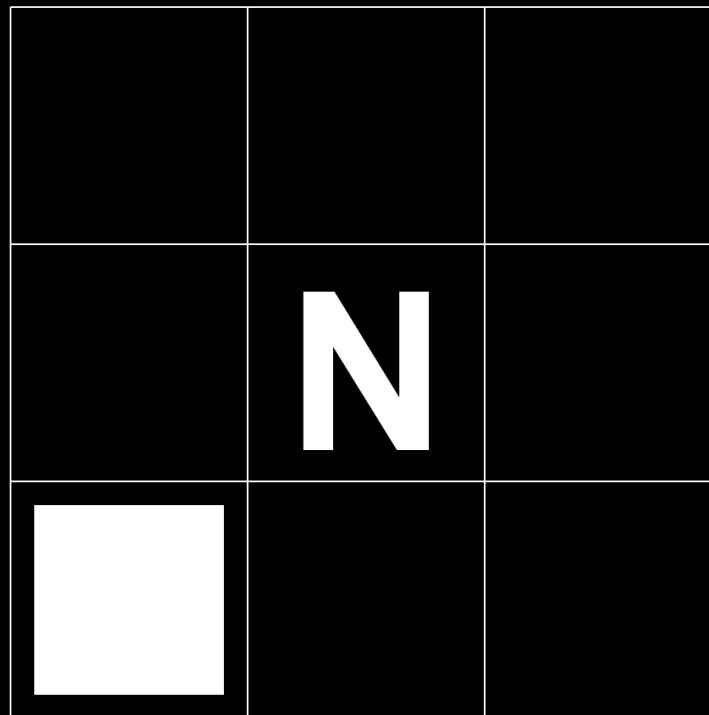
To indicate a match with a letter, use the [Right Shift] key
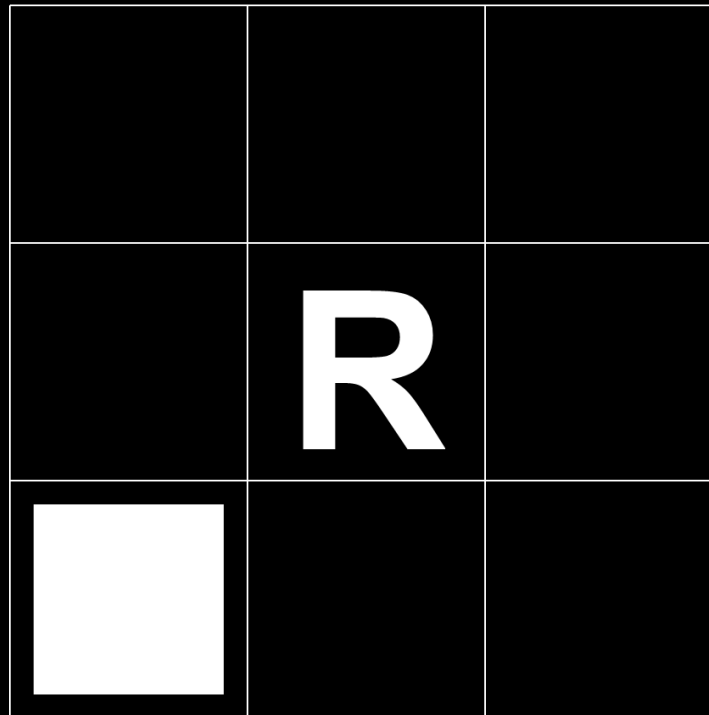To indicate a match in the white square, use the [Left Shift] Key.
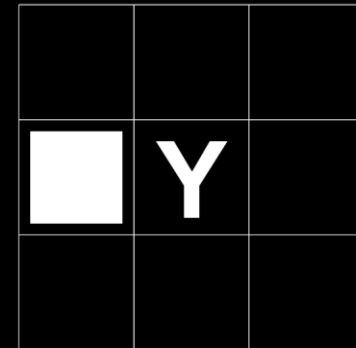
[Press SPACE when you are ready to proceed]

Match [1]-back.

N

Match [1]-back.

R

[L Shift: Match Square]
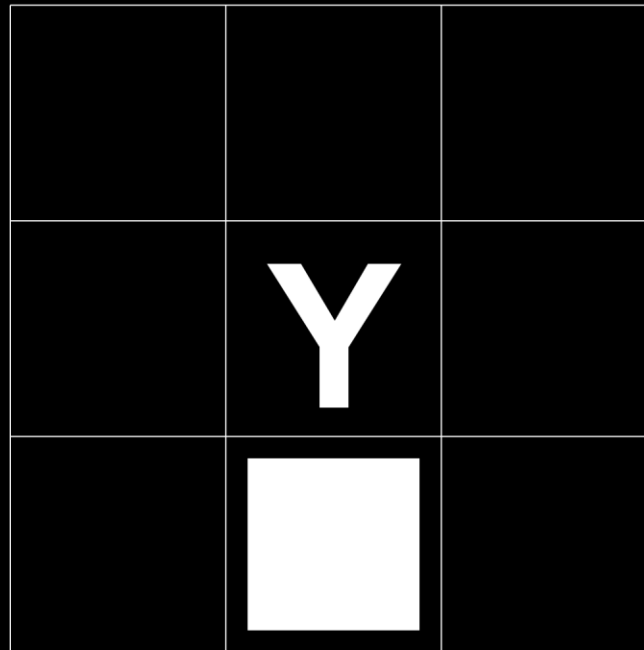
[R Shift: Match Letter]

1-Back Working Memory Task

In this stage, you will need to indicate if there is a match 1 step(s) back in the sequence you will be presented with.

To indicate a match wih a letter, use the [Right Shift] key

To indicate a match with the white square, use the [Left Shift] Key.

[Press SPACE when you are ready to proceed]

Match [1]-back.

Y

[Indicate if there is a match using the buttons]

Match [1]-back.

[Indicate if there is a match using the buttons]

Match [1]-back.

[Indicate if there is a match using the buttons]

[L Shift: Match Square]

[R Shift: Match Letter]

1-Back Working Memory Task

[This concludes the 1-back stage of the n-Back Assessment]

[Press SPACE when you are ready to proceed]

2-Back Working Memory Task

In this stage, you will need to indicate if there is a match 2 step(s) back in the sequence you will be presented with.

To indicate a match wih a letter, use the [Right Shift] key

To indicate a match with the white square, use the [Left Shift] Key.

[Press SPACE when you are ready to proceed]

Match [2]-back.
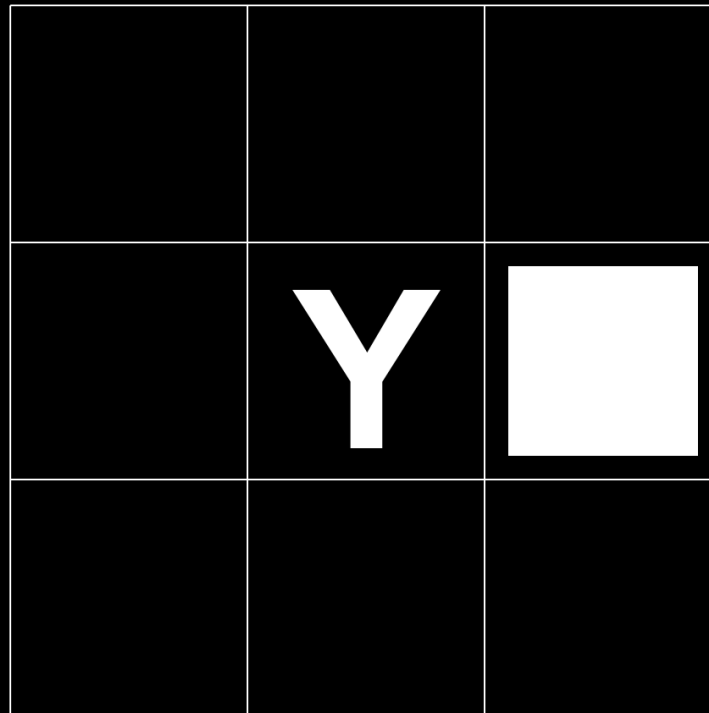

[Indicate if there is a match using the buttons]

[L Shift: Match Square]　　　　　　　　　　　　　　　[R Shift: Match Letter]

2-Back Working Memory Task

[This concludes the 2-back stage of the n-Back Assessment]

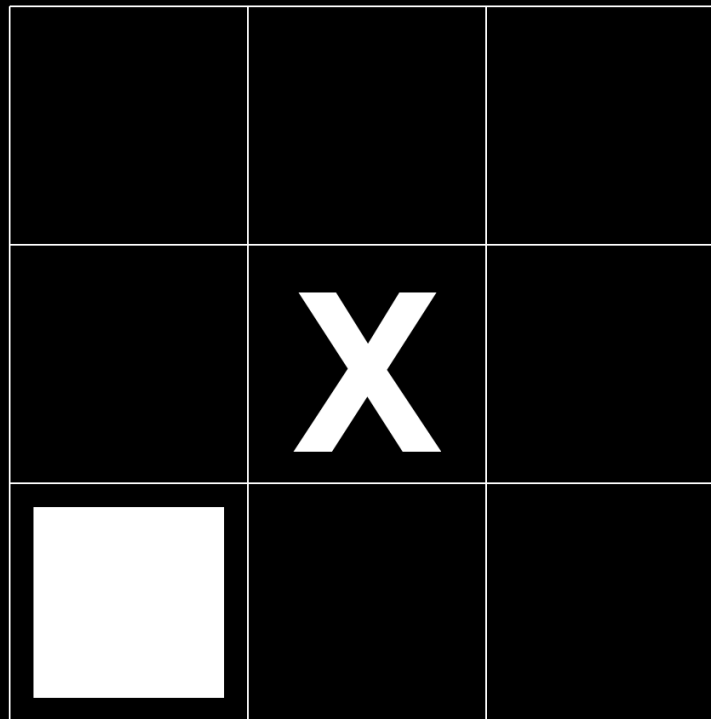[Press SPACE when you are ready to proceed]

3-Back Working Memory Task

In this stage, you will need to indicate if there is a match 3 step(s) back in the
sequence you will be presented with.

To indicate a match wih a letter, use the [Right Shift] key

To indicate a match with the white square, use the [Left Shift] Key.

[Press SPACE when you are ready to proceed]

Match [3]-back.

[Indicate if there is a match using the buttons]

[L Shift: Match Square]   [R Shift: Match Letter]

3-Back Working Memory Task

[This concludes the 3-back stage of the n-Back Assessment]

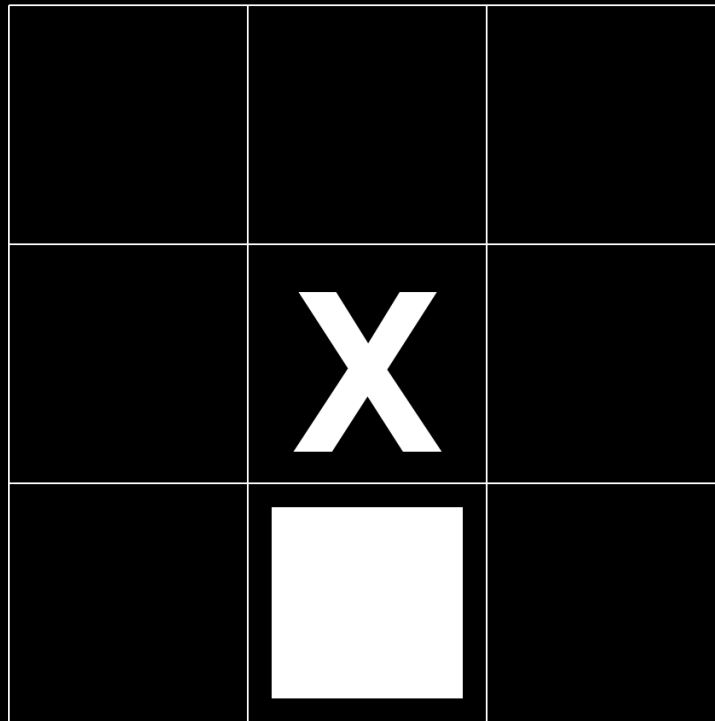[Press SPACE when you are ready to proceed]

4-Back Working Memory Task

In this stage, you will need to indicate if there is a match 4 step(s) back in the sequence you will be presented with.

To indicate a match wih a letter, use the [Right Shift] key

To indicate a match with the white square, use the [Left Shift] Key.

[Press SPACE when you are ready to proceed]

Match [4]-back.
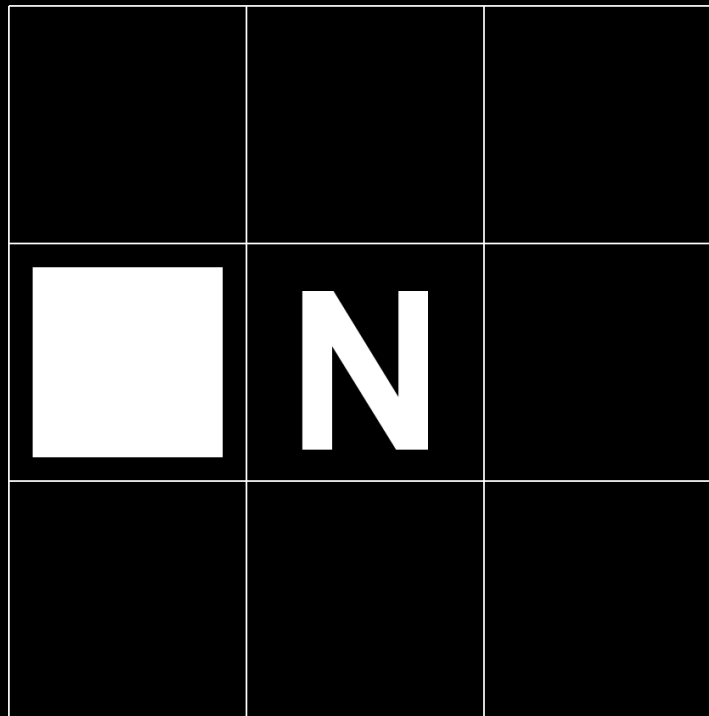
[Indicate if there is a match using the buttons]

[L Shift: Match Square]

[R Shift: Match Letter]

4-Back Working Memory Task

[This concludes the 4-back stage of the n-Back Assessment]

[Press SPACE when you are ready to proceed]

n-Back Working Memory Task

[This is the end of the n-Back Task]

[Press SPACE when you are ready to proceed]

Multi-Attribute Task Battery

You have completed the first two tasks. Proceed to the Multi-Attribute Task Battery assessment next.

[Press SPACE when you are ready to proceed]
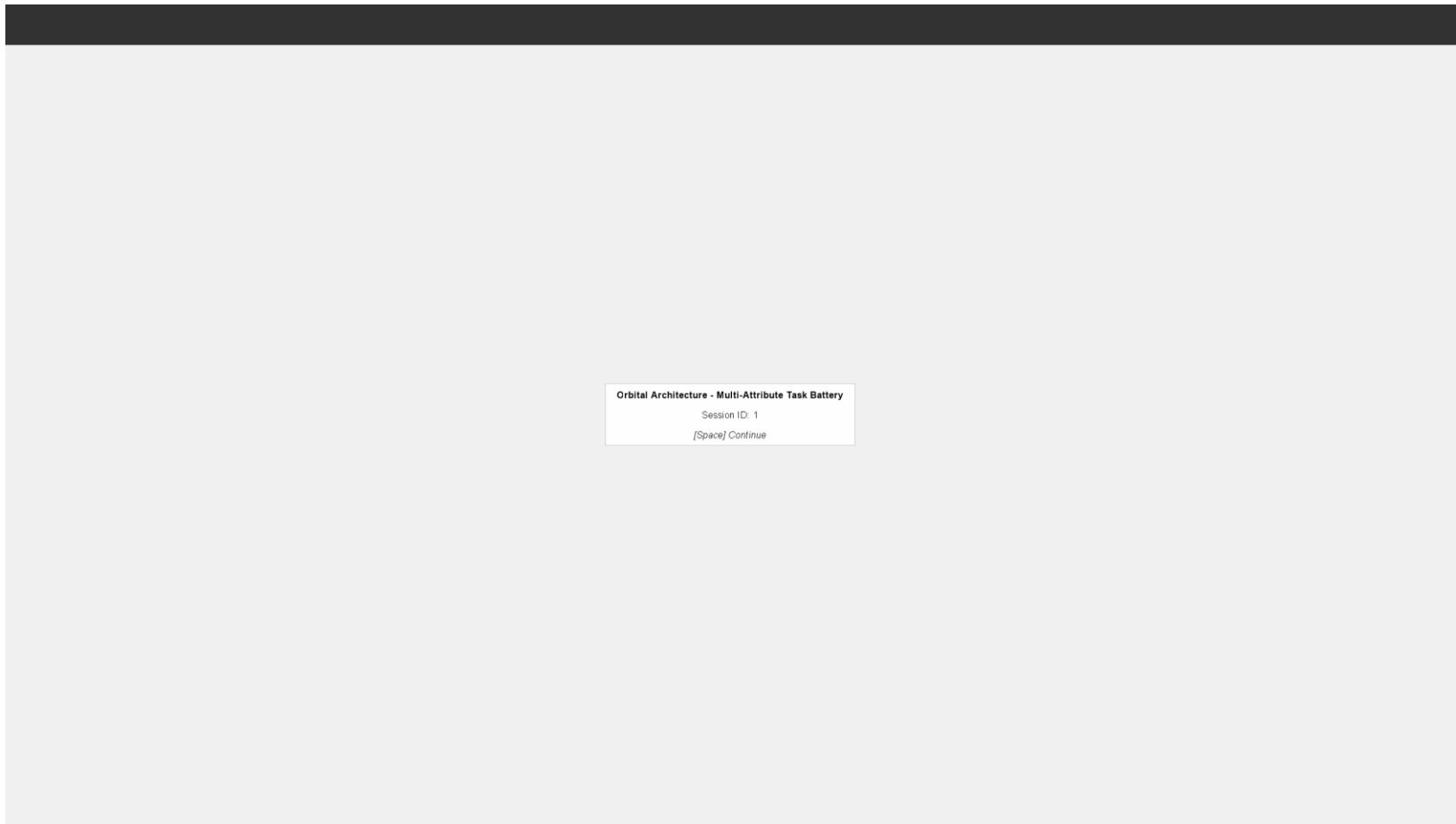
Orbital Architecture - Multi-Attribute Task Battery

Session ID: 1

[Space] Continue

Presentation of Multi-Attribute Task Battery

Multi-Attribute Task Battery is a multitasking environment simulation software package, first developed in 1992 by Comstock and Arnegard.

Because it requires participants to control several tasks simultaneously, this software provides a detailed understanding of the mental processes involved in managing complex and dynamic situations.

NOTE:

Make sure the NumLock key is active (meaning you can use the NumPad on the keyboard)

Press SPACE to continue

System Monitoring Task

In the monitoring task, you will control a set of **six gauges**.

You will have to correct the system, if necessary, by pressing the corresponding function key: when the green light (key [F5]) goes out; when the red light ([F6]) comes on; or when one of the moving arrows moves to the end of one of the four level gauges (keys [F1], [F2], [F3], [F4]).
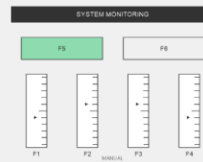
Controls:

1. To reset one of the four gauges (F1 - F4) to the nominal level you should use the corresponding Function keys (F1 - F4).

2. To reset the F5 light to green (nominal), use the F5 function key.

3. When the F6 light turns red (alert), use the F6 function key to reset it.

Press SPACE to continue

Communications Task

In the communication task, you will have to respond to sound instructions about changes to the frequencies of their radios. Some messages are addressed to you (your callsign), but you have to ignore the other messages (addressed to other callsigns).

Your own callsign name is written on the top of the task.

COMMUNICATIONS

RIV952

NAV 1   121.4

NAV 2   124.6

COM 1   121.1

▲▼ COM 2   121.9   ◄►

MANUAL

Controls:

1. To select the radio to be changed, use the [UP] and [DOWN] keyboard arrows.

2. To change the frequency (number) of the selected radio, use the [RIGHT] and [LEFT] keyboard arrows.

Press SPACE to continue

Resource Manager

In the resource management task, you have to have to maintain the levels of the two main tanks (A and B) by using a set of back-up tanks and pumps, each of which has a specific flow rating.

Your task is to switch the numbered pumps on and off to bring tanks A and B as close as possible to their normal levels.

Normal levels for the A and B tanks are indicated by the small black rectangle to the left of A tank and right of the B tank.

Pumps can sometimes break down, which is indicated when they turn red.

The flow rates of different pumps is indicated on the right side of the task
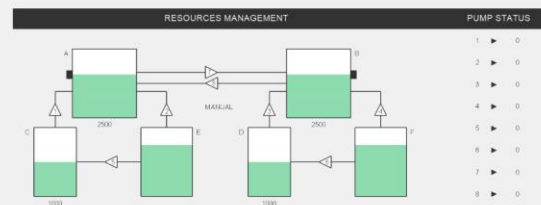
Controls:

To turn on and off the pumps use the number keys of the NumPad corresponding to the pump (triangle) label.

Press SPACE to continue

Presentation of tasks

The challenge for the participant is to complete all these tasks simultaneously.

Press SPACE to continue

SYSTEM MONITORING

F5	F6

F1   F2   F3   F4

MANUAL

COMMUNICATIONS

HSR259

NAV 1   111.9

▲▼   NAV 2   135.7   ◄ ►

COM 1   114.9

COM 2   114.8

MANUAL

RESOURCES MANAGEMENT

A

7

8

B

1   2   MANUAL   3   4

2500   2500

C   E   D   F

5   6

1000   1000

PUMP STATUS

1	▶	0
2	▶	0
3	▶	0
4	▶	0
5	▶	0
6	▶	0
7	▶	0
8	▶	0

SYSTEM MONITORING

F5

F6

F1 F2 F3 F4

MANUAL

COMMUNICATIONS

HSR259

NAV 1   111.9

▲▼ NAV 2   135.7   ◀▶

COM 1   114.9

COM 2   114.8

MANUAL

RESOURCES MANAGEMENT

A

B

7

8

1   2   MANUAL   3   4

2380   2380

C   E   D   F

5   6

1000   1000

PUMP STATUS

1   ▶   0

2   ▶   0

3   ▶   0

4   ▶   0

5   ▶   0

6   ▶   0

7   ▶   0

8   ▶   0

Orbital Architecture
Cognitive Assessment

You successfully completed all cognitive assessments.

A short questionnaire about your perceived performance remains.

[Press SPACE when you are ready to proceed]

Task Load Index Questionnaire

[Please use the sliders to indicate your responses to the following prompts.]

Mental Demand
How mentally demanding were the tasks?

Very Low — — — Very High

Physical Demand
How physically demanding were the tasks?

Very Low — — — Very High

Temporal Demand
How hurried or rushed was the pace of all the tasks?

Very Low — — — Very High

Own Performance
How successful were you in accomplishing all the tasks?

Perfect — — — Failure

Effort
How hard did you have to work to accomplish your level of performance?

Very Low — — — Very High

Frustration Level
How insecure, discouraged, irritated, stressed and annoyed were you?

Very Low — — — Very High

[Press SPACE when you are ready to proceed]