

## **Humans in Aerospace Field Exam 2010**

### **Core Human Factors Exam Question**

Sketch the human information processing model.

- Discuss how memory (both long and short term) and attention influence this model.
  - Discuss the difference between focused, divided, and selective attention
- Define situation awareness and discuss how it relates to the information processing model.
- What is vigilance, how does it relate to workload, and give an example of a system where vigilance could be an issue for human performance?
  - Which parts of the information process model are affected by vigilance (or a lack thereof)
  - Do problems with vigilance likely cause errors of commission or omission, and why?
  - How could you design a system to counter the negative effects of vigilance (using the example you gave above)?
  - For the example you gave for the vigilance discussion, discuss the measures you could use to assess workload, which is the most appropriate and why?

### **Humans and Automation Elective Question**

The FAA asks you to evaluate a new multi-modal display for en-route air traffic control. This display uses seat vibrations for altitude deviations and spatial audio to represent both longitudinal and lateral aircraft position, as if the controller were sitting in the middle of the sector. The company that makes this display claims that the display will increase sector throughput, increase controller situation awareness, and reduce overall workload, such that two positions can be combined into one.

1. What is your assessment of the use of multimodal technologies in this scenario? Be sure to address your concerns (both good and bad) in the context of multiple resource theory.
2. Can you assess the company's claims without running an experiment? Explain.
3. How would you address the company's claims if you could run an experiment? Be very specific about independent and dependent variables, as well as other experimental design considerations.

## Aerospace Biomedical Engineering Elective Question

Considering astronaut performance in space, please answer/discuss/or model (as appropriate to fully illustrate) the phenomenon/results discussed below.

1. Physiological deconditioning is often stated as a potential “show stopper” for a human Mars mission. For example, current bone losses during 6–month missions on the International Space Station are ~1.5–2% per month in the lumbar spine and proximal femur. In addition, muscle losses of 30% atrophy are recorded and up to 40% muscle strength loss. Note: this data has been collected on astronauts that have performed prescribed exercise countermeasures.
  - A) (20% of answer) Give a **prioritized list** of physiological systems that are most adversely affected by long-duration spaceflight.
  - B) (40% of answer) Describe, in detail, **one (1) physiological system** (muscle, bone, cardiovascular, or neurovestibular) and the effects of launch, long-duration microgravity exposure, and return to 1 G.
  - C) (40% of answer) Is exercise an appropriate countermeasure for musculoskeletal deconditioning? Why or why not. Give **three (3) suggestions** to better quantify the effectiveness of countermeasures for bone loss during long-duration missions.
  
2. Extravehicular Activity (EVA) and Life Support.
  - A) Describe and illustrate the basic components of the current Extravehicular Mobility Unit (EMU) and Portable Life Support System (PLSS)
  - B) For future planetary EVA systems (e.g., lunar, 1/6 G OR Mars, 3/8 G), **provide three (3) detailed engineering/design advancements** and **two (2) life support advancements** for an advanced suit compared to the EMU.