



HUMAN PERFORMANCE AND LIMITATIONS SYLLABUS

Human Information Processing

- Basic information processing:
 - a. Detection (information is received)
 - b. Perception
 - c. Decisions are taken
 - d. Action (responses are selected and executed)
 - e. Feedback
- A functional model of information processing
- Bottom up and top down processing

Attention and vigilance

- Attention mechanisms
- The cocktail party effect
- Two types of attention:
 - o Selective attention
 - o Divided attention
- Lack of attention
- Stress and attention
- Low, optimum, high arousal

Perception

- Definition
- Perceptual illusions: some practical examples
- Subjectivity of perception
 - o Perceived mental models
 - o Three dimensional models
- “Bottom-up/top-down” processing

Memory

- Three types of memory:
 1. Sensory memories
 2. Short-term (working) memory
 3. Long-term memory
- Sensory memory
 - o Sensory memory for sound – the echoic memory
 - o Sensory memory for sight – the iconic memory
 - o Sensory adaptation - habituation
- Working memory
 - o Definition
 - o Limitations Short Term Memory
 - o Methods of increasing Short Term Memory: chunking and association



- Long term memory
 - o Semantic memory
 - o Episodic memory
 - o Procedural memory (motor programmes)
 - o Factors affecting Long Term Memory:
 - Expectation
 - Suggestion
 - Repetition
 - Amnesia
- Motor memory (skills)
 - o Definition
 - o Developing motor programmes:
 - a. The cognitive phase
 - b. The associative phase
 - c. The automatic phase
 - d. Transition between the phases
 - o Errors associated with motor programmes
 - a. Action slips
 - b. Environment capture – habituation

Response selection

- Actions – response – feedback
- Response error (error of commission)
- Response or reaction time
- Learning principles and techniques
 - o Types of learning:
 - Classical / operant conditioning
 - Insight
 - Observational learning / imitation
 - Experience
 - Skill learning
 - o Quality of learning
 - o Retention of information
- Drives
- Motivation and performance
 - o Concepts of motivation (physiological, psychological or social needs)
 - o Model of Human needs – Maslow
 - o The influence of Human needs on flight safety
 - o Basic model showing two independent sources of motivation – Herzberg:
 - a. The perceived value of a reward
 - b. The probability of its attainment
 - o Motivation and job satisfaction
 - o Increasing job satisfaction:
 - a. Job enrichment
 - b. Job enlargement



- Herzberg's two factor theory of motivation:
 - a. Hygiene theory
 - The company's policies and administration
 - Supervision
 - Working conditions and inter-personal relations
 - Salary, status and security
 - b. Motivation (satisfiers)
 - Achievement
 - Recognition for achievement
 - Responsibility for an enlarged task
 - Advancement to higher levels of tasks

Reliability of Human Behaviour

- Definition of Human Reliability
- Factors affecting Human reliability:
 - a) Length of time of exposure to risk
 - b) Degree of risk
 - c) Mental and physical health
 - d) Innate psychological characteristics
 - e) Innate physiological characteristics
 - f) Personality deficiencies
 - g) Stress factors
 - h) Experience
 - i) Motivation
 - j) Skill level

Hypotheses on reality

- Similarity, frequency
- Completion causality

Theory and model of Human Error

- Rasmussen - three levels of behaviour (SRK):
 1. Skill-based behaviour
 2. Rule-based behaviour
 3. Knowledge-based behaviour
- The Reason model of Unsafe Acts
 1. Unintended actions (attentional slips and memory lapses)
 2. Intended actions (mistakes and violations)
- The Reason Failure model
 1. Active failures / errors
 2. Latent failures / errors
- System tolerance to errors



Error generation

- Internal factors (cognitive styles)
 - o Mistaken perception
 - o Misinterpretation of information
 - o Preconceived assumptions
 - o Experimentation
 - o Faulty memory
 - o Fatigue
 - o Lack of practice – deterioration effect
- External factors
 - o Stressors
 - o Ergonomics (e.g. bad design or layout of instruments)
 - o Economics (e.g. company or organisational pressures)
 - o Social environment (e.g. cultural misunderstandings)

Decision making concepts

- Structure (phases)
 1. Diagnosis and definition of the objective
 2. Collect information
 3. Assess risk
 4. Develop options
 5. Evaluate options
 6. Decide
 7. Assign task
 8. Implement decision
 9. Consequences
 10. Review and feedback
- Errors
 - Confirmation bias
 - Probability
 - Salience
 - Over-confidence
 - Fatigue / overload
- Limits
 - Attention
 - Stress
 - Lack of experience
- Risk assessment
- Practical application:
 - o Two main ways of making decisions in the aviation system:
 1. Standard operating Procedures – SOPs
 2. “DODAR” system (British Airways):
 - Diagnosis
 - Options
 - Decide
 - Assign
 - Review



Safety Awareness

- Risk area awareness
- Identification of error proneness (oneself)
- Identification of error sources (others)
- Situational awareness:
 - o Definition
 - o Factors which might interfere with Situational awareness:
 - a. Stress
 - b. Interruptions to the thought process
 - c. Fatigue
 - d. Hopes, wishes and desires
 - e. Poor communications
 - f. Boredom
 - o Loss of Situational Awareness
 - a. Confusion
 - b. Fixed concentration on a single item or factor
 - c. Hurried speech or actions
 - d. Rushing checks or procedures
 - e. Straying from approved procedures
 - f. Taking short-cuts
 - g. Abnormal impatience or mood-swings
 - h. Sudden decline in flying skills
 - i. Tendency to ask leading questions of other members of the crew
 - o Good Situational Awareness
 - a. Gather as much information as possible from every possible source before making up your mind
 - b. Take as much time as practicable to make up your mind
 - c. Consider all possible interpretations of the data
 - d. Once started on a course of action, stop occasionally to take stock
 - e. Check your hypothesis still fits the data as events progress
 - f. Consider ways to test your actions to check the accuracy of your theory
 - g. If incoming data does not fit in your thoughts, do not just disregard it but take time to reconsider the situation, if necessary going back to the first symptoms of the problem
 - h. Try to ensure that you interpret the world as it is, not as you would like it to be

Personality and attitudes

- Defining personality
- Personality, attitude and behaviour
- Development
- Environmental influences
- Assessing personality
- Personality questionnaires and interviewing techniques
- Dimensions of personality: introversion versus extroversion; anxiety versus stable



Individual differences in personality

- Self-concepts (e.g., action vs. state-orientation)

Identification of hazardous attitudes (error proneness)

- 5 dangerous attitudes in flight
 - Anti-authority
 - Impulsive
 - Invulnerable
 - Macho
 - Resigned

Arousal

- The relationship between arousal and performance

Stress

- Definition(s), concept(s), model(s)
 - o Definition of stress and stressors
 - o Categories of stressors:
 - a. Physiological
 - b. Cognitive
 - c. Non-professional
 - d. Imaginary stress
 - e. Organisational stress
 - o Reasonable stress level
- Anxiety and stress
- Effects of stress:
 - o Responses to high stress level :
 - a. Sweating
 - b. Dry mouth
 - c. Difficult in breathing
 - d. Increased heart rate
 - e. Anxiety / apprehension
 - f. Fatigue
 - g. Fear
- Stress reaction and the general adaptation syndrome (GAS)
 - o The phases of GAS:
 - a. Alarm reaction
 - b. Resistance
 - c. Exhaustion
 - o A general model of stress and coping
 - o Strategies to cope with stress:
 - a. Action coping
 - b. Cognitive coping
 - c. Symptom directed coping
 - o Coping with stress on the flight deck
 - o Stress management away from the flight deck



Fatigue

- Types, causes, symptoms
 - o Types of fatigue:
 - a. Short - term fatigue
 - b. Long - term fatigue
 - o Causes of fatigue:
 - a. A lack of restful sleep
 - b. A lack of physical or mental fitness
 - c. Excessive physical or mental stress and anxiety
 - d. Desynchronisation of the body cycles (jet lag)
 - o Symptoms of fatigue:
 - a. Lack of awareness
 - b. Diminished motor skills
 - c. Obvious tiredness
 - d. Diminished vision
 - e. Increased reaction time
 - f. Short-term memory problems
 - g. Channelled concentration
 - h. Easily distracted
 - i. Poor instrument flying
 - j. Increased mistakes
 - k. Irritability and / or abnormal mood swings
 - l. Reduced scan
 - m. Reversion to “old” habits
 - n. Decrease in communication
- Effects of fatigue: practical examples of aircraft accidents due to crew fatigue

Body rhythm and sleep

- Circadian rhythms:
 - a. Body temperature
 - b. Blood pressure
 - c. Heart rate
 - d. Sensory acuity
 - e. Adrenal gland output
 - f. Brain neuro-transmission levels
- Measurement and phases of sleep:
 - Stage 1
 - Stage 2
 - Stage 3
 - Stage 4
 - REM sleep
- Sleep profile for a typical night's sleep
- Age and sleep
- Naps and microsleeps



- Shift work
- Rhythm disturbances
 - Time zone crossing
 - Circadian disrhythmia
 - Recovery
- Symptoms, effects, management
 - Sleep disorders:
 - a. Narcolepsy
 - b. Apnoea
 - c. Sleepwalking (Somnambulism)
 - d. Insomnia (critical or situational)
 - Sleep planning
 - Sleep hygiene
 - Sleep and alcohol
 - Drug and sleep management (e.g. use of melatonin)

Fatigue and stress management

- Coping strategies
- Management techniques
 - o Health and fitness programmes
 - o Relaxation techniques
 - o Religious practices
 - o Counselling techniques

Some basic concepts of automation:

- Protection automation
- Support system
- Glass cockpit

Advantages of automation:

- Crew input decreased
- Technical reliability
- Cost saving
- Decreased size of the cockpits
- Improved situational awareness
- Decreased crew workload
- A smoother and more accurate control of the aircraft
- Greater choice of options for the display of information
- Increased safety



Disadvantages (criticalities) of automation:

- Boredom leading to a loss of Situational Awareness
- Greater delays between the performance of the crew and its ultimate effect
- Automation complacency
- Blinkered concentration
- Confusion
- Pilot remains unaware of important information when solving an unusual and unexpected problem
- Pilots fails to use his traditional skills at basic instrument flying
- Mistrust of older pilots of the new computers
- Complex systems
- Mode error
- Manual control
- Difficulties with crew co-ordination and communication
- Difficulty in changing plans

Automation complacency

- Examples of aircraft accidents due to automation complacency