Dutch Entertainment Computing Consortium (DECC)
Roadmap Workshop
Lorentz Center, Leiden

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Dutch Experiment Support Center (DESC)

ACTA - Vrije Universiteit
Amsterdam

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Presentatie :
DECC workshop
12-4-2006

file: 100-PRE-018-000 DECC Roadmap W

Dutch Utilisation Center, DUC (I)

DUC
Dutch Utilisation Center
NIVR SRON

mainly:
- scientific/industrial coordinat.
- funding / politics

DOC
Dutch Operations Center
(NLR-NOP)

mainly:
- operations
- documentation

DESC
Dutch Exp. Support Center
(ACTA-Vrije Univ.)

maily:
- information
- ground research facilities
- science

DUT
Dutch Util. of technol
(All industrial partners)

mainly:
- technology
- hardware developmet

Dutch Utilisation Center (DUC) (II)

- National Support of Scientists, Instruments and Operations
- EDR-FRC in cooperation with ESA, Belgium and others
- National Instruments in cooperation with ESA, NASA, CNES and others
- Support of Erasmus User Center (EUC)

DESC Tasks

- Maintenance of ground based facilities
- Specific support and supervision for ground research
- Support development/testing of experiment hardware
- Support for preparations of flight experiments

- Identify and encourage new users
- Familiarisation of future users
- Development / stimulation of new research proposals
- Information and public relation activities
- Education / internships

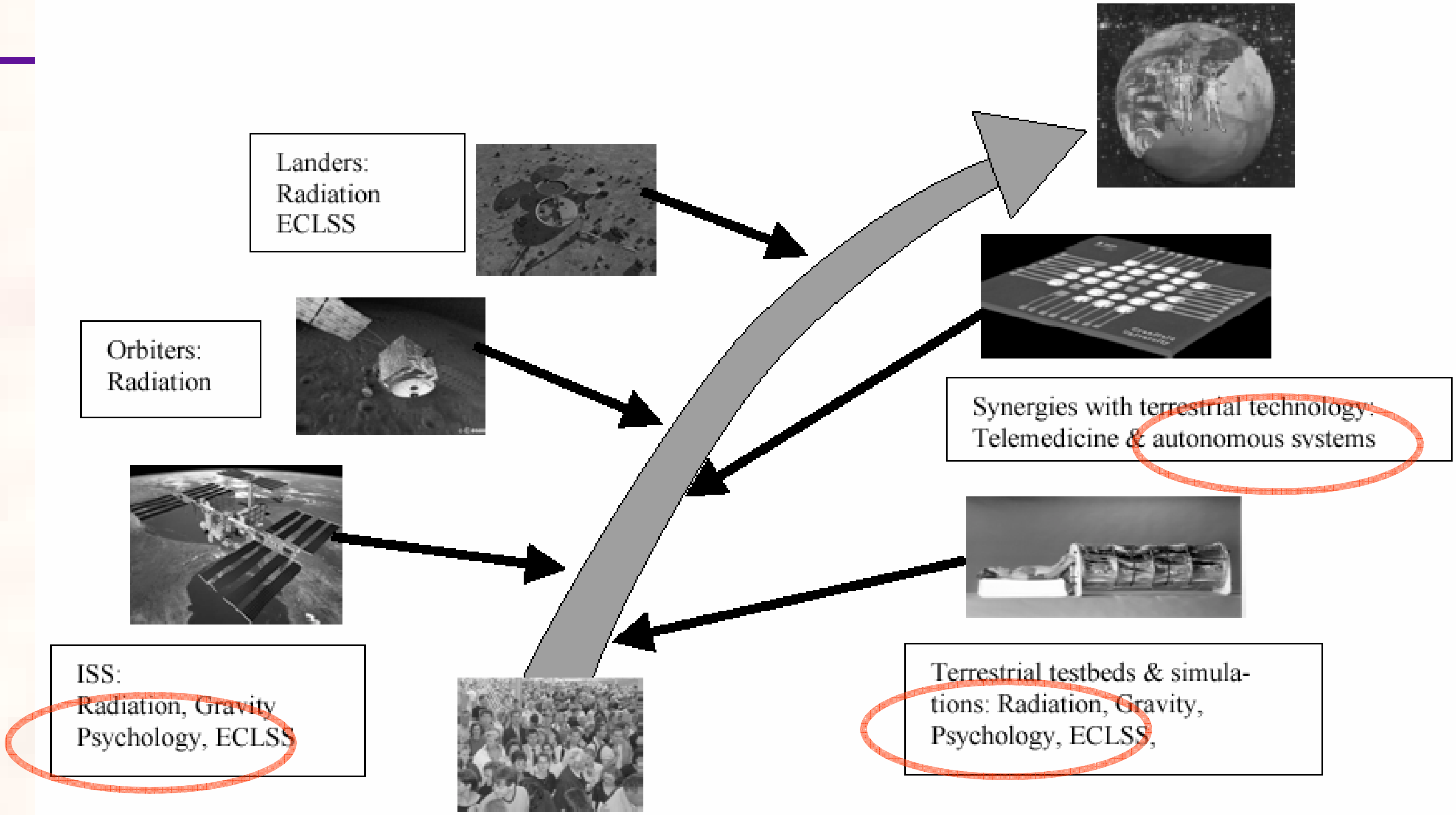


Fig. 5. Roadmap with regard to human health issues for a future Europe strategy towards human exploratory missions.

Gerda Horneck / DLR:
From: http://www.weblab.dlr.de/exo/pdf/Human%20missions-ESA%20SP-021207-fin-fin.pdf

Psychological Risks Relevant to Long-Duration Spaceflight

Mental Performance

- Performance decrements due to hypogravity-effects on brain mechanisms
- Performance decrements due to indirect effects of spaceflight-related stressors on the attentional state

Individual Health and Well-Being

- Disturbances of sleep and circadian rhythm
- Dysfunctional affective reactions and impairments of mood
- Mental and behavioural illness

Interpersonal Interactions

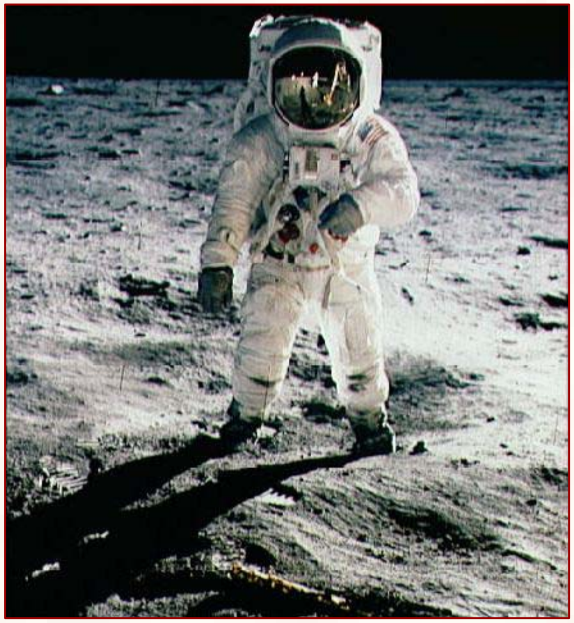
- Intracrew Issues
- Issues of Space-Ground Interactions
- Issues of Multicultural Crews

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

Stressors in Space

Space Environment

Mission Tasks



Space Habitat

Social Situation

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

file: 100-PRE-018-000 DECC Roadmap Workshop input Leiden 12-4-2006.ppt

Currently Applied Psychological Countermeasures

Selection

Training

In-Flight Support

- Ground-based monitoring
- Uplink of news
- E-mail up-/downlink
- Private family conferences
- Psychological conferences
- Crew packages
- Onboard entertainment
- Visiting crews

DECC possibility

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

	Station in LEO (MIR, ISS)	Lunar Mission	Mars Mission
Duration	**4-6 months**	**6 months**	*16-36 months*
Crew Size	**3-6**	**4**	**6 (4/2)**
Isolation/Social Monotony	**moderate**	*high*	*extremely high*
Crew Autonomy	**low**	**medium**	*extremely high*
Evacuation Opportunities	**yes**	**yes**	*no*
In-Flight Support Measures			
• ground-based monitoring	**yes**	**yes**	*very restricted*
• audio/video transmission	**yes**	**yes**	*very restricted*
• e-mail up-/downlink	**yes**	**yes**	**yes**
• internet access	**yes**	**yes**	*no*
• onboard entertainment	**yes**	**yes**	**yes**
• re-supply flights	**yes**	*no*	*no*
• visiting crews	**yes**	*no*	*no*
Visual Link to Earth	**yes**	**yes**	*no*

DECC possibility

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

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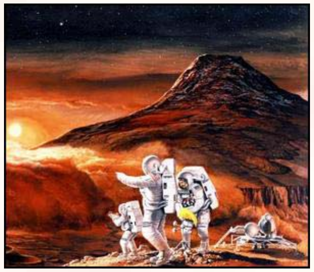


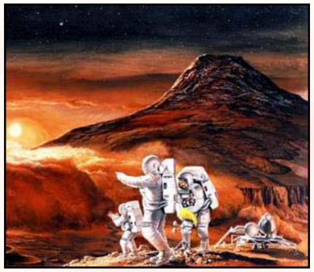
The 500 and 1000-Day Mars Mission Scenarios:

Generalisability of Current Knowledge from Orbital Flight and Analogue Environments

- Missions to Mars will not be comparable to any other undertaking humans have ever attempted given the distance of travel, the duration of life under constant dependence on life-support systems in isolation and confinement, and the lack of short-term rescue possibilities
- Currently applied countermeasures to maintain individual performance, health and well-being, as well as crew morale via audio-/video contacts can only be provided to a very limited degree

➡ **Most of the possible risks arising from psychological issues will be LARGELY INCREASED. In addition new psychological risks will arise which, in principle, cannot be assessed in advance.**

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg



Psychological Key Issues Related to *Behavioural Health*, *Well-Being*, and *Interpersonal Interactions* Shared by Both Reference Missions

- **disturbances of circadian rhythm and sleep** during transfer phases
- extremely long periods of **low workload**, **monotony,** and **boredom** during transfer phases
- **long-term dependence on autonomous life-support systems**
- extreme level of **social monotony**
- extreme high degree of **crew autonomy**
  - issues of autonomous management of external and internal crises
  - issues of “group-think”
- increased risk of **mental and behavioural illness** (WP 2200)
- high risk of **motivational decline** during transfer back
- **post-flight adaptation problems**

DECC possibility

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

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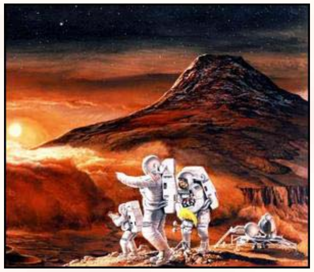


Specific Psychological Key Issues of the 1000-Day Mission Arising from Leaving 2 CM's in Orbit

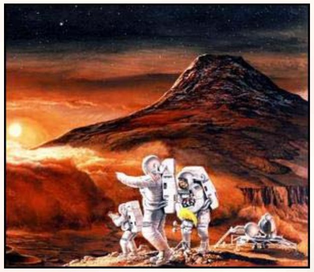
- The orbiting crew members will be exposed to *excessive* levels of
  - **monotony and boredom** (due to low variety of task demands)
  - **social monotony** (only partially balanced by intercom contacts to surface crew)
  - **sensory deprivation** (due to stay in the same spaceship for 1000 days)

- **Issues of maintaining motivation of orbiting crew**

- **Break-down of crew cohesiveness**
  - interpersonal and "inter-subcrew" conflicts after re-union during transfer back
  - leadership issues

→ **Whenever possible this feature of the 1000-day reference mission should be avoided**

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg



Indeterminable and Uncontrollable Risks of Mars Missions

Earth-Out-Of-View Phenomenon

Human responses to loosing the visual link to their home planet are unknown. Conceivable responses include:

- **maladaptive affective reactions** (e.g. feeling of anxiety, sadness)
- **development of mental illness** (e.g. anxiety disorder, depression)
- **partial or complete loss of commitment to expected system of values and behavioural norms**

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

Levels of Possible Countermeasures

Accomodation of living and working conditions during the mission to human needs and capabilities

- Design of habitat (e.g. private crew quarters, interior decor)
- Design of autonomous systems (e.g. concepts of ajustable autonomy)
- Work-Rest Scheduling

DECC possibility

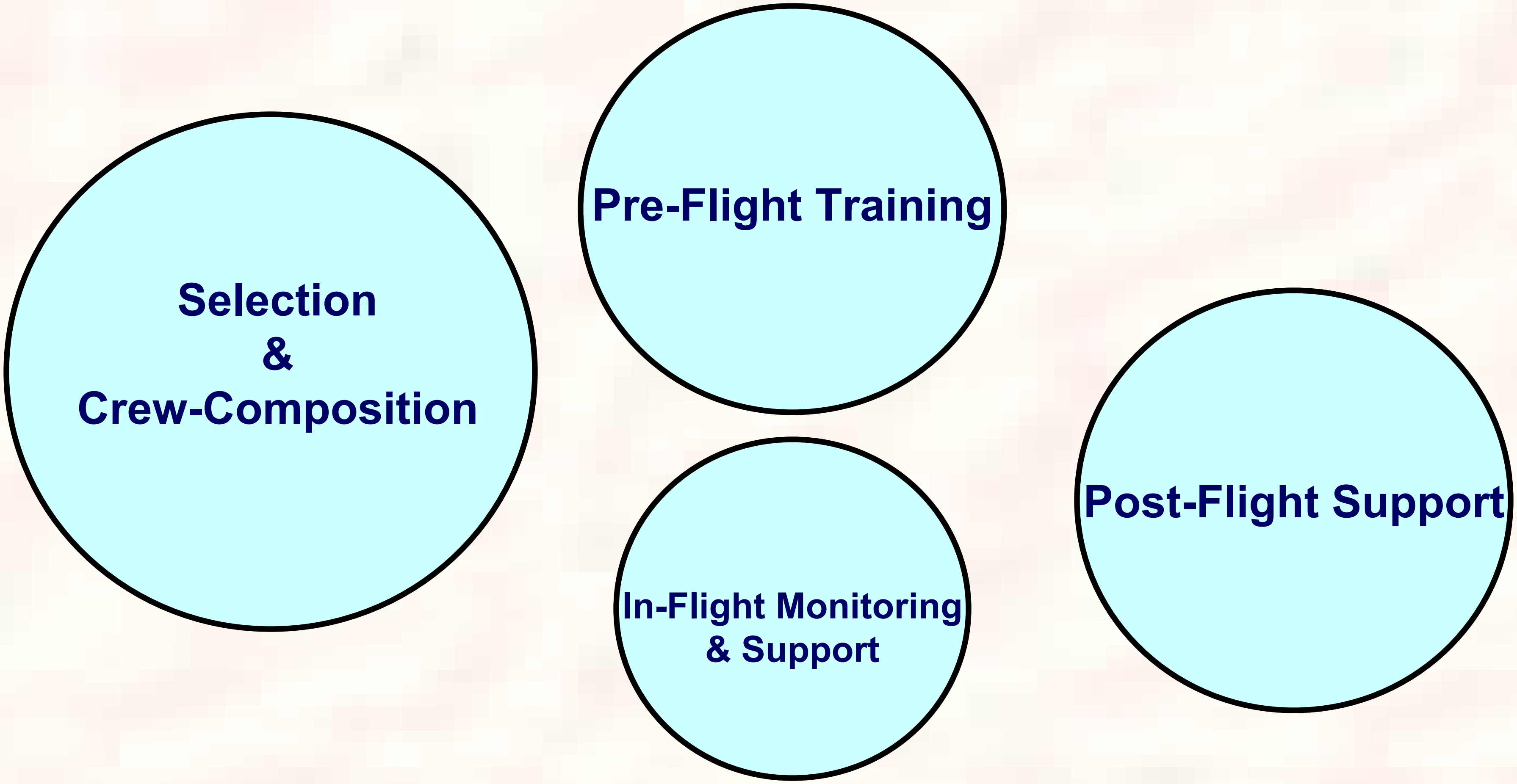
↑

Adaptation of humans to the extreme living and working conditions during the mission

- Selection
- Training
- In-flight support
- Post-flight support

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

Relative Significance of Psychological Countermeasures for Mars Missions



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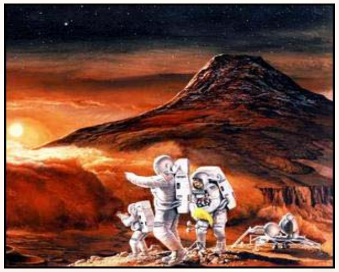


Proposed Coutermeasures: Selection and Crew-Composition

Selection

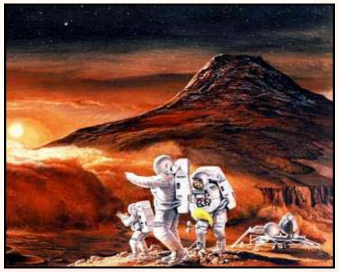
Psychiatric screening (select-out)

- Review of biographical and family history

Psychological selection (select-in)

- Task motivation
- Cognitive and psychomotor performance capabilites
- Personality traits related to interpersonal behaviour
- Personality traits related to performance under stress
- Interpersonal needs, attitudes, skills

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg



Proposed Countermeasures: Selection and Crew-Composition

Crew-Composition

Crew Size: 4-6 CMs represent minimum size, 6-8 would be better

Age: homogeneous crews are to be preferred

Gender:
- lack of systematic research/inconsistent experiences
- mixed gender crews involve specific issue of contraception
- sending married couples is unrealistic and does not solve the problem
- minimum of 2 CMs of each sex recommended in mixed gender crews
- more open discussion needed

Culture: Crew should consist of individuals who
- are as homogeneous as possible (e.g. have lived in common culture)
- have experiences with other national/organisational cultures
- possess flexibility to adapt to other cultures

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

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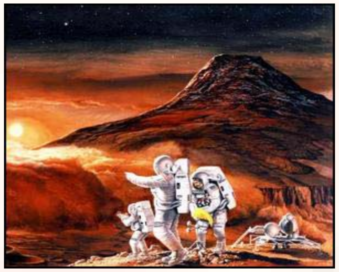


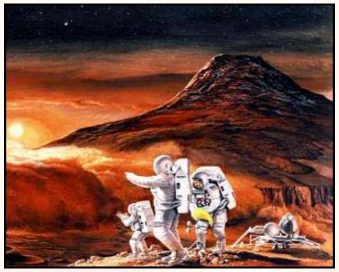
Proposed Countermeasures: Selection and Crew-Composition

Crew-Composition

Key Challenge: Compatibility of Individual Characteristics

- **Homogeneous personality traits** (e.g. agreeableness, conscientiousness)
- **Complementary needs** instead of need competition (e.g. dominance)
- **Congruent needs** that can be mutually satified (e.g. need for social contact)
- **Complementary skills and cognitive abilities**
- **Shared system of values and behavioural norms**
- **Positive emotional attitude towards each other**

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg



Proposed Countermeasures: Pre-Flight Training

Individual training

- Individual self-care strategies and stress-management skills
- Interpersonal skills

Crew-training

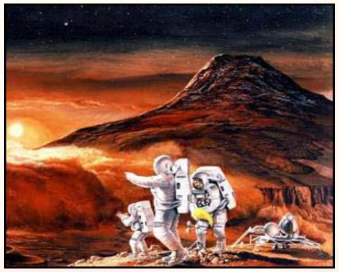
- Support of team-building process
- Anticipatory problem-solving
- Development of crew-supporting skills
- Self-experience and coaching under simulated conditions

DECC possibility

Specific training for selected crew members

- Commander: leadership skills
- Physician(s): diagnosis and treatment of psychiatric disorders

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg



Proposed Countermeasures: In-Flight Monitoring and Support

In-Flight Monitoring

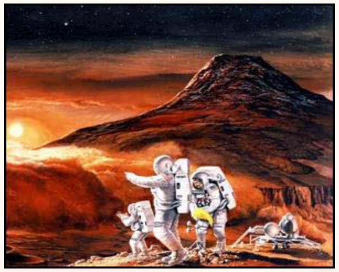
DECC possibility

- **Mental performance**
- **Circadian rhythm and sleep**
- **Emotional state and behavioural health**
- **Interpersonal relationships**

Technological developments needed which take the operational constraints of Mars missions into account (e.g. evaluation of mood based on analysis of e-mail communication)

Issues of self-assessment needs to be explored

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg



Proposed Countermeasures: In-Flight Monitoring and Support

In-Flight Support

- **On-board support for maintaining critical skills**
  - identify level of fidelity needed
  - exploring suitable advanced technology (virtual reality)
- **Sensory stimulation**
  - Earth-bound views and sounds (based on advanced technology)
- **Recreational opportunities**
  - variable exercise equipment for realease of stress
  - library of paperback and electronic books
  - personal entertainment supplies (e.g. DVD, computer games)
  - support of recreational crew activities
  - support of constructive leisure activities (e.g. academic studies, hobbies)

DECC possibility

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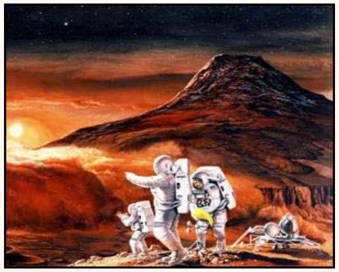


Proposed Countermeasures: In-Flight Monitoring and Support

In-Flight Support (cont'd)

- **News from Earth**
  - innovative concepts needed (e.g. simulation of 'internet' on on-board server
  - technological developments to increase transmission capacity needed
- **Social contacts to family and friends**
  - on Mars only possible via e-mail and one-way audio/video transmissions
- **Psychological counselling and guidance**
  - on Mars only possible via e-mail or one-way audio/video transmissions
- **Tools for treatment of psychiatric disorders**
  - restraint system and identified list of psychoactive drugs
- **Family-support during the mission**

DECC possibility (digital buddy)

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

Conclusion: 34 R & D Needs Identified

Fundamental Research (15)

- **Cognitive performance and perceptual-motor skills**
- **Maladaptive individual reactions**
  - Sleep and circadian rhythms
  - mood, behavioural health and coping
- **Interpersonal interactions**

Applied Research and Development (19)

- **Habitability and Autonomous Systems**
- **Selection & Composition**
- **Training**
- **Monitoring**
- **In-flight support**

DECC possibility

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

Conclusion: 34 R & D Needs Identified

Strategical Considerations

- **Research on ISS**
  - only required for questions addressing effects of space specific factors
  - cognitive performance, perceptual-motor skills, sleep, circadian rhythm
- **Research in analogue natural environments (e.g. Antartica, deserts)**
- **Secondary analyses of existing data bases from analogue environments**
- **Ground-based simulations**

➡ Compared to the past a much more coherent long-term research program is needed which assures both, a systematic investigation of individual, environmental and organisational issues critical for Moon/Mars missions, as well as a comparability of different studies

From ESA-Humex study (2001) by D. Manzey, DLR, Hamburg

NASA Bioastronautics Roadmap

Bioastronautics Roadmap

Home Comments/Feedback ?

Fin

Missions | CC Areas | Disciplines | Risks | R & T Questions | Tasks | Deliverables | Processes | Search | Links | He

Current Selection Filters

Crosscutting Area(s)

23 Medical Skill Training and Maintenance

24 Human Performance Failure Due to Poor Psychosocial Adaptation

25 Human Performance Failure Due to Neurobehavioral Problems

Clear All Filters

Get All Risks In PDF

45 Risks found.

21 Rehabilitation on Mars

22 Medical Informatics

Risk 24: Human Performance Failure Due to Poor Psychosocial Adaptation

Print Risk Data Sheet (All Missions) | Print Risk Data Sheet (Selected Mission)

Crosscutting Area : Behavioral Health and Performance

Discipline : Behavioral Health & Performance and Space Human Factors (Cognitive)

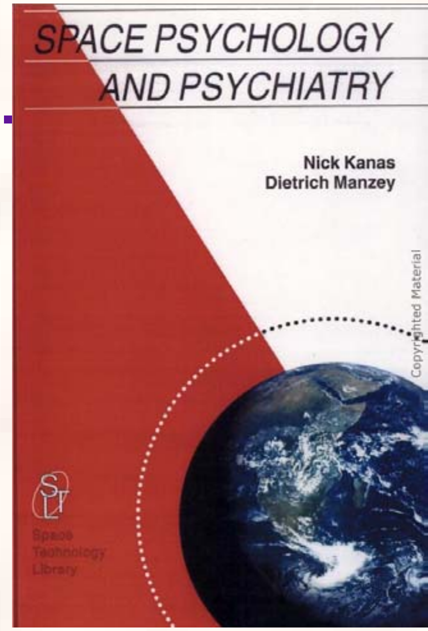
Description : Human performance failure may occur due to problems associated with adapting to the space environment, interpersonal relationships, group dynamics, team cohesiveness, and pre-mission preparation.

Context / Risk Factors : The isolated and confined nature of space flight, along with its potential hazards, pose human performance related challenges. This risk may be influenced by boredom with available food, crew autonomy and increased reliance on each other, crowding, distance from family and friends, duration of flight, incompatible crewmembers, interpersonal tensions, mechanical breakdowns, poor communications, scheduling constraints and requirements, sleep disturbances, or social isolation.

Justification / Rationale : Moderate likelihood/high consequence risk with low risk mitigation status. Serious interpersonal conflicts have occurred in space flight. The failure

A typical image of the F-MARS station

- test in ground research : “Mars stations”, Antarctic Stations, military systems (submarines etc.)
- In flight : ISS studies
- Moon-base studies
- Finally : Mars scenarios



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(Underlined sections emphasize empirical work conducted in space)

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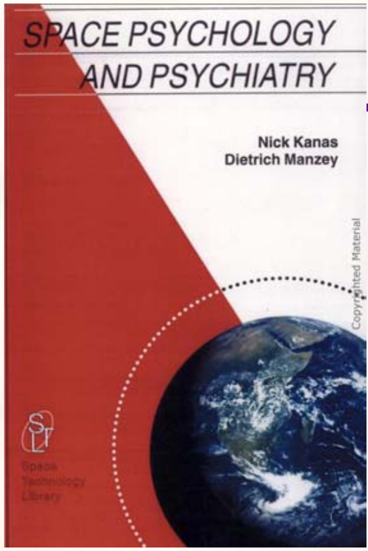
SPACE PSYCHOLOGY
AND PSYCHIATRY
Nick Kanas
Dietrich Manzey

"Unprecedented periods of confinements, people being away for three years or more, the period of isolation, the lack of capability to rescue people-- all these things become intensified in the case of Mars," Harrison notes. uit: Hariis, Univ. Davis, USA

http://www.org.id.tue.nl/DECC/Mental%20Preparation%20for%20Mars.pdf

2001 Aviation, *Space and Environmental Medicine* (Vol. 72,No. 5)

Kosslyn and his NSBRI- funded team have worked since 2000 to develop a Palm Pilot- based program called MiniCog, which measures astronauts' cognitive abilities during space flight, comparing them with the astronauts' usual Earth- based scores or to population norms. For example, before going to work on a difficult task-- perhaps repairing malfunctioning equipment on the spacecraft's hull-- an astronaut might use MiniCog to see whether his or her spatial relations are up to snuff. If an astronaut performs poorly at mentally rotating three dimensional objects-- a task adapted from the 1970s work of Stanford psychologists Roger Shepard, PhD, and Jacqueline Metzler, PhD-- a nap or a cup of coffee might be in order, Kosslyn notes. In addition to tests of spatial ability, MiniCog can evaluate an astronaut's level of attention, motor control, working memory and problem- solving, say its developers.

So, a group of NSBRI- funded researchers headed by James Carter, PhD, a clinical psycholo gist at Harvard Medical School, and including former astronaut Jay Buckey, MD, of Dartmouth Medical School, is developing a computer program to assist astronauts dealing with depression or interpersonal conflicts-- the two most likely problems to appear during extended space travel, say the scientists.

Thank You