Space Psychology

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"Lady Killer" (1933). Credit Warner Bros.
Lecture Outline

• **Group interaction** in isolated, confined environment. Comparison between spaceflight and analogs (polar bases, submarines, closed chambers) data

• Individual and crew **selection** criteria

• Importance of crew psychological **training**
  – Interpersonal communication
  – Multicultural sensitivity
  – Group dynamic and group problem-solving

• Provision of psychological **support** for long-duration space missions
  – Pre- and in-flight counseling
  – Communications
  – Post-flight debriefing

*Thomas Reiter on board Mir.*
*Photo ESA*
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Human Space Flight Experience

Mars missions may last up to 30 months.

Most long-duration flights are 4-6 months long.
### Reported Problems

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<th>Mir</th>
<th>Shuttle</th>
<th>Submarines</th>
<th>Antarctic stations</th>
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<tr>
<td>Interpersonal conflicts</td>
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<td>Anxiety, depression</td>
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<td>Sleep disturbances</td>
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<td>Boredom, restless</td>
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<td>Performance decrement</td>
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<td>Decline in group compatibility</td>
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<td>Alcohol/substance abuse</td>
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**X** = documented reports  
**?** = anecdotal reports
Adaptation to Isolation

• The lack of external stimulation, monotony, and increasing fatigue can cause apathy, depression, sleep disorders, psycho-somatic disorders, decrease in motivation, boredom, and anxiety

• Adaptation generally takes place in 4 phases, independently of isolation duration:
  – 1st quarter: acute adaptation to the unusual environment (hyper-excitation)
  – 2nd quarter: stable adaptation (with fluctuation of the psychological state)
  – 3rd quarter: unstable adaptation (accompanied by accumulation of fatigue, narrowing of the interests sphere, decrease of activity, irritability, aggressivity)
  – 4th quarter: “final effort” period (euphoria, lack of self-control)

• Following end of isolation: depressional state
Communication Patterns among the Crewmembers of an Isolation Study

Day 2

Day 14

Day 26

A-F: crewmembers
C: commander

The thickness of the arrows indicates the frequency of communication

From G. Sandal et al. (1995) Results from ESA’s ISEMSI experiment
Events during 7 NASA-Mir missions

- Crew change at L-8 weeks
- Mission extended by 6 weeks
- Minimal control over in-flight work schedule
- Work overload / underload
- Social withdrawal
- Death of family member
- Dangerous atmosphere (ethylene glycol and contaminant leaks)
- Fire; decompression (loss of module); loss of power (free drift); communication system failures
- Anger with ground control / management (“us vs. them” syndrome)
- Crew friction

Mir Station seen from the Space Shuttle. Photo NASA
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Characteristics of Effective Crews

- Best leaders let crews do work with minimal interference, but recognize when group activity is needed and arrange that activity

- Open communication and feedback channels

- Clearly defined contingencies for achieving goals

- Groups of more than 2 have boundary role persons who act to interpret interests and concerns of all sides to allow activity to progress smoothly

Borman and Levell after Gemini-7 mission. Photo NASA

The 8 crewmembers leaving Biosphere-2 after 2 years spent inside. Photo Taber MacCallum (ISU'91)
“Select-out” criteria are medical criteria specifying those psychiatric disorders which would be disqualifying:
– e.g. schizophrenia, major depression, etc.

Psychometric tests (like MMPI) allow to objectively evaluate if applicant is a “risk to flying safety”
– questions with answers “yes” or “no”, such as: “Have you ever been depressed?”

Structured psychiatric interview to counteract the tendency of applicants to minimize psychological symptoms (“staying clean”) 
– questions such as: “Tell me about the time when you have been most sad in your life”
“Select-in” or psychological selection criteria identify desirable personality traits or characteristics linked to a specific mission (“best person for the job”)

Criteria used for Mercury/Gemini/Apollo missions:

– Aptitude for job
  • Appropriate skills
  • Intelligence
  • Leadership / Followship (“team player”)  
  • Ability to tolerate stress
  • Trainability, flexibility

– Motivation

– Sensitivity to self and others
  • Emotional stability, maturity
  • Ability to form stable quality interpersonal relationship

White and McDivitt after Gemini-4 4-day mission. Photo NASA
• **Mercury**

  – 30 hours for psychological evaluation
  – 2 psychiatric interviews
  – 25 psychometric tests (IQ, performance, Rorschach, etc.)
  – 5 stress tests (heat, cold, low barometric pressure, acceleration, isolation)
  – “Select-in” evaluation based on projected mission requirements

*Scott Carpenter during stress test in heat chamber. Photo NASA*
• Gemini, Apollo, and early Shuttle
  – 10 hours for psychological evaluation
  – 2 psychiatric interviews
  – 10 psychometric tests for Gemini/Apollo; 3 tests for Shuttle
  – “Select-in” criteria for Gemini/Apollo; none for Shuttle
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History of NASA Psy Evaluation

• Shuttle since 1988
  – 3 hours for psychological evaluation
  – Psychiatric evaluation is part of medical operations
    • Psychiatric interview and psychometric testing (MMPI, MCMI-II, FSSCT) are clinical: only look for pathology
  – Psychological evaluation:
    • Research only — requires voluntary consent
    • Goal is to identify those psychological traits which predict performance as an astronaut, and to validate them

President and Mrs. Reagan, and astronauts Crippen and Engle watching STS-4 landing.
Photo NASA
• L — a validity scale; high values indicate evasiveness (e.g. different responses to about the same questions)

• F — a validity scale; measuring the tendency to present one’s self on an overly favorable light (low score = more favorable)

• K — a validity scale; measures defensiveness (e.g. underreport, not completely honest in answering personal questions) (high score = more defensive)

• Hs — Hysteria
• D — Depression
• Hy — Hypochondriasis
• Pd — Psychopathic Deviation
• Mf — Masculinity/Feminity*

• Pa — Paranoia
• Pt — Psychasthenia
• Sc — Schizophrenia
• Ma — Mania
• Si — Social Introversion

* not considered of any significance in defining sexual orientation: high scoring are described as sensitive, aesthetic, passive low scoring are described as aggressive, rebellious, and unrealistic
• Minnesota Multiphasic Personality Inventory (MMPI): consists of 566 items for which a subject is asked to respond true or false

Adapted From P. Santy (1994)
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MMPI of Male Shuttle Candidates versus U.S. Male Norms

Adapted From P. Santy (1994)
MMPI of Female Shuttle Candidates versus U.S. Female Norms

Adapted From P. Santy (1994)
MMPI of Japanese Payload Specialist Applicants versus U.S. Shuttle Applicants

Adapted From P. Santy (1994)
MMPI of Soviet Cosmonauts

1 — Hypochondria
2 — Depression
3 — Emotional lability
4 — Impulsivity
5 — Masculinity/Courage
6 — Rigidity
7 — Anxiety
8 — Nonconformity/Individualism
9 — Activity/Optimism
10 — Introversion

Adapted From P. Santy (1994)
Astronaut Performance

• Assessment of astronaut performance is required to validate “select-in” criteria

• Today, performance evaluated on a voluntary basis only:
  – Cognitive and psychomotor tests:
    • Test of individual tasks to measure vigilance, reaction time, tracking, coordination, and perceptual speed
  – Evaluation from peers:
    • Technical skills (job performance)
    • Ability to live and work with others (leadership, teamwork, group living, personality, communication skills)

• Russian controllers on ground monitor the number of errors performed during crew activities
Socio-Cultural Factors

STS-51G official crew photo. Photo NASA
Greater distances are required for **personal space**:

- in small rooms versus large rooms
- in rectangular rooms versus square rooms
- inside locations versus outside locations
- high anxiety settings versus low anxiety settings
- with people whom you expect to be interacting with over a long period of time versus a short interaction
Multi-Gender Issues

• Women tend to perceive small, **crowded** places as friendly and sociable, while men tend to respond to such environments as irritating and uncomfortable.

• Men are more likely to feel their personal space violated in crowded places and perceive a continuing challenge to patterns of male dominance. Thus, men respond to crowded conditions with greater **irritation and hostility** than women.

• **Mixed-gender** groups respond to crowded circumstances nearly as well as groups of women only.

• Studies suggest that the presence of women exerts a **positive** influence (boundary person) and discourages certain behaviors (e.g. drinking and fighting) that could lead to injury or group conflict.
Sexuality in Space

- There is nothing specifically or formally written down about sex in space.
- All books written on this subject have been vigorously denied by space agencies.
- Russians scientists have studied the impact of weightlessness on animals’ sex drives in space. However, romance and sex for procreation hasn't figured prominently in their work.
- One published study showed spaceflight causes a reduction in testosterone levels in male astronauts (Strollo 1998, ASEM).
- “It would be desirable to have a normal sexual life in long-term spaceflights.” —V. Polyakov.
- “People who are professionally very motivated and goal-oriented do not need sex as an emotional release. A person who might experience such problem in flight will most likely be a passenger on a spacecraft -- a journalist, a politician or just a tourist.”
Multi-Cultural Issues

• **Interpersonal distances:**
  – Latin American, French and Arab interact at closer distances than U.S., English, Swedish or German individuals
  – Use of eye contact not only varies by gender, but also by social and cultural norms
  – Facial expression is a way to communicate: swollen face in 0-g creates problem

• **Issues of personal hygiene and housekeeping** alone account for about 40% of incidents during space missions with unicultural (i.e. U.S. only) crews

• Most of this research has been done in western nations

*Dinner in the Skylab kitchen. Photo NASA*
Microgravity Issues

- **Hygiene** routines are time consuming and laborious (no gravity!)
- **Food** does not taste the same and spices must be added for flavor
- **Countermeasures** may require effortful and time-consuming activity
- **Motivation** to do the required countermeasures becomes increasingly hard
- **Physiological adaptations** to microgravity challenge and stress individuals, and impact interpersonal interaction, concentration, ability to perform group and individual work

Exercising onboard Skylab. Photo NASA
Crew Selection Issues

• **Crew size**
  – As group size increases, its members become more organized and efficient
  – Potential for conflict increases with crew size (>7)
  – Small crew can lead to minority isolation
  – Odd / Even number of crewmembers
  – Command structure (autocratic or democratic)
  – All-male, all-female, or mixed-gender groups

• **Differences in Education / Culture**
  – Age; Experience
  – Values; Career motivation
  – Interpersonal Compatibility
    • e.g., scientists: tend to not interact, and not to work well in a hierarchical command structure; prefer autonomy
    • pilots-astronauts: have military backgrounds, which lead them to prefer a more ordered command structure
Crew Selection Issues (cont'd)

- **Work (professional) role:** e.g., for a human Mars mission:
  - pilot(s)
  - flight engineer/mission specialist
  - life support system engineer
  - scientist (field of expertise?)
  - medical doctor (?)
  - psychologist/psychiatrist (?)
  - other (journalist, artist ?)

- **Cross-trained individuals:** e.g., Crew Medical Officer

- **Group dynamics:**
  - Crew-oriented sensitivity training: issues of adaptation to isolation and confinement, stress management skills, communication skills, cross-cultural training
  - Some training should involve both crewmembers and mission control personnel ("bull sessions")
  - Team building and group problem-solving techniques should be dealt with prior to the mission (field exercises)
Factors for Successful Groups

- Factors that impact group fusion
  - Emergencies: forced to work together for common survival
  - Arrival of outsiders (e.g., replacements, new personnel)
  - Resentment towards outsiders (e.g., mission control, authorities)
  - Leadership: promotes performance and minimizes conflicts
  - Social events (e.g., parties, holidays)
  - Group rituals and habits
Factors for UnSuccessful Groups

- Factors that impact group fission
  - Power and status (e.g., leader / followers)
  - Differences in work demands (e.g., crew shifts)
  - Differences in responsibility (e.g., pilot / non-pilot)
  - Differences in motivation
  - Differences in personal values
  - Leadership (e.g., authoritarian / participative)
• **Leadership** is the process of social influence in which one person can enlist the aid and support of others in the accomplishment of a common task

• Leadership Styles
  – **Autocratic or Authoritarian** – all decision-making powers are centralized in the leader. Leader does not entertain any suggestions or initiatives from subordinates. One person decides for the whole group and keeps each decision to himself until he feels it is needed to be shared with the rest of the group
  – **Participative or Democratic** – favors decision-making by the group. Leader gives instruction after consulting the group. Leader can win the cooperation of their group and can motivate them effectively and positively
  – **Laissez-Faire or Free Rein** – Leader does not lead, but allows maximum freedom to subordinates, i.e., they are given a free hand in deciding their own policies and methods
• **Soviet/Russian space program** uses extensive pre- and in-flight psycho-social support activities and psychological monitoring to facilitate group fusion and cohesiveness
  
  – Survival training
  – Parachute training
  – Provide constant reminders of Earth via music, video, books
  – Personal items in re-supply ships
  – Surprises and holidays
  – Frequent contact with family, friends, artists, media
  – Voice analysis by ground psychologists to detect stress and interpersonal conflicts

*Survival training in Russia. Photo NASA*
ISS Pre-flight Psy Support

• NASA Psychological Services Group started in 1994 (NASA-Mir)

• Support begins when ISS crewmembers deploy for **training** in Star City: advocate for improved conditions and resources; assist with family contacts; off-hours recreation

• Involvement in **issues** that could later affect in-flight psy support:
  – Work and rest schedule
  – Habitability (acoustic, crew quarters)
  – Food variety
  – Language training; culture training

• **Family** involvement in preparation:
  – Informal meetings with immediate family; interest / hobby questionnaire completed for crewmember; personal preference kits for crewmember
  – Family Support Office
ISS In-flight Psy Support

• Monitoring individuals and team
  – Flight surgeon primary link with crews during flight
  – Private conferences with crewmembers, as needed
  – Cognitive assessment (WinSCAT) developed
  – Behavioral and Fatigue assessment tools being considered

• Support activities
  – Personal items re-supply via Progress and Shuttle
  – Transmitting news and event information
  – Private family conferences
  – Amateur radio communication
  – E-mail, personal cell phones

• Family Support Office
  – Regular contact maintained with family
  – Information about mission (especially contingencies)
ISS Post-Flight Psy Support

• **Postflight meetings** with crewmember and family
  – Assess overall psychological health
  – Assess practical value of current psychological preparation and support
  – Follow-up on specific mission events regarding individual, crew and family reactions, and adaptation
  – Obtain recommendations for improving support for following crews

• Support as needed to return as soon as possible to **regular work** and **family life**
Additional Reading