Available online at www.sciencedirect.com
ScienceDirect
PERGAMON
Acta Astronautica 64 (2009) 1304–1313
ACTA ASTRONAUTICA
www.elsevier.com/locate/actaastro

Transcultural group performance in extreme environment: Issues, concepts and emerging theory

Judith Lapierre[a,*], Stéphane Bouchard[b], Thibault Martin[c], Michel Perreault[d]

[a]*Université du Québec en Outaouais, Directrice du GIRESSS, chercheuse au CRISES, 283, boulevard Alexandre Taché, Case postale 1250, succursale Hull, Gatineau, Québec, Canada J8X 3X7*
[b]*Université du Québec en Outaouais, Directeur du laboratoire en Cyberpsychologie, Canada*
[c]*Département du travail social et des sciences sociales, Université du Québec en Outaouais, Canada*
[d]*Professeur honoraire, Université de Montréal, Professeur invité, Université fédérale de Rio de Janeiro*

Received 23 February 2007; accepted 8 January 2009
Available online 18 February 2009

Abstract

A simulation for flight of international crew on space station took place in Moscow from July 1999 to April 2000 (SFINCS) at the State Biomedical Institute of Russia (IBMP) isolation chambers. Objectives of this study were to identify concepts of psychosocial adaptation and of social interactions to develop an explanation of the transcultural group performance. Method: constructivist epistemology with grounded theory research and fourth generation evaluation were used. Data on processes and interactions were gathered during 110 days of confinement as a subject and extended to 240 days as an outside scientist. Results indicate that coping is influenced by usual coping strategies and coping behaviors inside. Several stresses and human factor issues were identified altering well being and performance inside the chambers. Enabling and limiting forces are discussed. A theory on transcultural group performance is proposed. Issues are raised that appear critical to selection, training and group performance.

Keywords: Space simulation; Group processes; Psychosocial factors; Performance; Gender issues; Grounded theory

1. Introduction

US space agency NASA has released its plans for returning humans to the moon and set 2018 as the earliest launch date. A long term interplanetary mission to Mars is also being designed. Technology may be currently developed but what are the psychosocial requirements for such missions and are we ready? Space [1,2] and polar scientists [3,4] have long anticipated that human factors will pose greater barriers to our quests. Human factors such as interpersonal relations and psychological health have frequently been recognized as variables related to mission success and failure [5,6]. Mental stresses of exploration have been said to be surpassed by far by the stresses imposed by the complexity of relationships. It is specifically the challenges of living and working on the high frontier that bring group cooperation and cohesion to the forefront of our future movement into interstellar space. Considerable psychophysiological stress is associated with space travel and that stress can be lethal [7]. As goals of the different space programs evolve to those long interplanetary, international

* Corresponding author. Tel.: +1 819 595 3900x2275; fax: +1 819 595 2384.
E-mail addresses: Judith.lapierre@uqo.ca (J. Lapierre), Stephane.bouchard@uqo.ca (S. Bouchard), Thibault.martin@uqo.ca (T. Martin), Michel.perreault@umontreal.ca (M. Perreault).

0094-5765/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.actaastro.2009.01.002

and interdisciplinary missions, health and well-being of our astronauts will depend partly on those human factors. In general, both the European and American scientific community acknowledge that extreme isolation and confinement increase the risks to both physical and mental health. Some authors [8] believe that interpersonal problems could affect the ability of the crew to act in a cohesive manner, resulting in psychological problems and reduced well-being, therefore affecting performance. One of the stated objectives of NASA's research program in the psychological aspects of manned space flight is to develop preventive and remedial countermeasures for breakdown in psychological health leading to performance decrement. Space agencies current programmatic level of effort is insufficient to produce the data needed to satisfy the program objectives. What is needed is a comprehensive psychosocio physiological research program. Such a program should try to clarify the interrelationships between psychological and physical fitness, between group dynamics and work performance, and finally, should aim at developing and assessing the impact of a global psychological program including selection, training, support in-flight and post-flight for astronauts. The current state of knowledge in these areas is quite limited, particularly in the area of psychological countermeasures for both the European and American space programs. The prime goal of this study was to contribute to group processes knowledge development by developing an explanatory model of transcultural group performance in confined environments. Concepts of psychosocial adaptation to a variety of stress factors related to isolation and concepts of social interactions served to elaborate the foundational basis of what constitute an exchange context, processes and outcomes in extreme environments.

2. Method

Grounded theory [9] and the fourth generation evaluation research methodology [10] were used. QSR NUD∗IST was the software used to analyze the data. Data collection process included: questionnaires, interviews, participant observation during 110 days, focus groups, crew-3 commander's reports, weekly diaries, written documents related to the confinement experiment and communications/press release. Interactions involving two eastern countries crews of four males each (Russian crew: 240 days: identified as crew 1/Eastern country crew: 110 days: identified as crew 2) and one international crew of four including one female (110 days, replacing crew 2-identified as crew 3) staying in isolation from 110 to 240 days were studied. Glaser and Strauss grounded theory methodology includes several analysis steps: category development and saturation, concept development, category reduction, negative instances, linking categories, core variables emergence and finally concept modification and integration. The constructivist fourth generation evaluation process is based on hermeneutic dialectic approach with different stakeholders searching for consensual and conflictive views. That approach was used with interviews and focus groups. QSR Nud∗Ist software analysis was used to categorize all transcriptions of verbatim.

3. Experiment and daily operational issues

3.1. Isolation chambers

Two main isolation chambers were used, a 100 m^3 for the crew 1 and a 200 m^3 one for both crew 2 and crew 3, the international crew. Several areas of chambers showed microorganism growth. Dust accumulation kept for biochemical analyses in showed excessive air debris and cement accumulation. Mid-way through the experiment, head lice outbreak occurred and affected crews. A report on this issue was published already [11], aimed at identifying ways to prevent such transmission during missions.

3.2. Hygiene and food

A shower facility was installed in the international chamber. Crew 1 had access to that shower while crew 2 and crew 3 spent their respective 110 days. Hot water was available during the last 3 weeks of crew 3 stay. Diet was Russian and consisted of meals that repeated itself every 3–4 days, including canned kasha, corn and instant soup. Unlimited prepared cheese and canned fish were also available. Once a month, fresh vegetables and canned ham for three meals were provided along with 24–250 cc's of fruit juices for crewmembers. Special resupply included Japanese preparation and Italian pasta. Crews 1, 2 and 3 reported on the lack of variety and boredom of the food. Snacks that were bought and chosen by crewmembers before the confinement were not relayed to the crew at any time. Calorie intake seldom reached the recommended daily intake of 3000 kcal for the international crew. During SFINCSS the pleasure associated with meals was unrelated to the food but to the social aspect of this activity.