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Mars-105 study: Time-courses and relationships between coping, defense mechanisms, emotions and depression

Michel Nicolas [a,*], Gro Mjeldheim Sandal [b], Karine Weiss [c], Anna Yusupova [d]

[a] Laboratory of Socio Psychology and Management of Sport (SPMS, EA 4180), Sport Sciences Faculty of Dijon, University of Burgundy, France
[b] Department of Psychosocial Science, University of Bergen, Norway
[c] Laboratory of Social Psychology (LPS, EA 849), University of Nîmes, France
[d] Laboratory of Social and Cognitive Psychology, Russian Academy of Sciences, Institute of Biomedical Problems, Moscow, Russia

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ABSTRACT

This study investigated the time-courses and the relationships between coping, defense mechanisms, emotions and depression considered as key factors in adaptation to ICE (Isolated and Confined Extreme) environments. During the space simulation, the Mars-105 experiment, positive emotion decreased significantly and significant positive correlations were found between mature defenses and both positive emotions and Task-Oriented Coping (TOC), as well as between Disengagement-Oriented Coping (DOC) and symptoms of depression. These findings show the impact of space simulation on affective states and the relations of defense to both coping and emotion, which underline the role of these psychological constructs involved in psychological adaptation processes. The results of the present study add insights into the effects of space simulation in order to offer the participants a better selection, preparation and follow-up of these psychological components recognized as essential for adaptation to extreme environments.

1. Introduction

It has been clearly recognized that psychological and psychosocial factors significantly modify human behaviors and performance during real space flights (Bishop, 2004; Manzey & Lorenz, 1997). Adaptation mechanisms to such an isolated and confined extreme (ICE) environment have become an issue of major importance (Kanas, 1997). Currently, this issue is also one of the main concerns for long space missions such as the Mars expedition project. The effect of long-term isolation and confinement on healthy volunteers can be addressed via ground-based simulations (Manzey, 2004; Nicolas & Weiss, 2009; Sandal, Leon, & Palinkas, 2006). The Mars-105 experiment is a space simulation study designed to investigate the effects of an ICE environment on most of the individual and social psychological outcomes and to prepare the next 520-day mission. Specifically, this paper focuses on time patterns and relationships between coping strategies, defense mechanisms and mood.

During prolonged space missions, the most important stress factors could include microgravity, monotony and boredom resulting from low workload and hypostimulation, lack of comfort, confinement and isolation involving limited social relationships such as the separation from family and friends (Manzey, 2004; Suedfeld, 2005). The adaptation of crewmembers to these living conditions clearly shows a number of psychological factors including individual experiences, personality, leisure activities, and psychological adaptation mechanisms (e.g., coping strategies, defense mechanisms and emotions) used to deal with such stressors (Palinkas, 2003; Williams & Davis, 2005). Behavioral and affective reactions to these stressors can include a variety of symptoms including an increase in stress level, emotional instability, hypersensitivity or depressive reactions (Grigoriev, Kozerenko, & Myasnikov, 1987; Kanas, 1991). The capacity of astronauts and space flyers to cope effectively with these various stressors is a major part of the success of manned space missions (Kanas & Manzey, 2008).

Because of theoretical advancements, it has been recognized that the two major concepts involved in psychological adaptation to constraining situations are coping strategies and defense mechanisms (Cramer, 1998; Parker & Endler, 1996). DM are considered as being more oriented toward inner conflicts and dispositions and part of the individual's enduring personality. Whereas CS are

* Corresponding author. Faculté des Sciences du Sport, UFR STAPS, Université de Bourgogne, BP 27877, 21078 Dijon Cedex, France. Tel.: +33 3 80 39 90 11; fax: +33 3 80 39 67 02.
E-mail address: michel.nicolas@u-bourgogne.fr (M. Nicolas).

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considered to be positively oriented toward adaptation to reality and determined by situation-specific variables (Nicolas & Jebrane, 2008a; Parker & Endler, 1996). However, recent empirical studies among the general population showed that CS and DM are both involved and contribute to the adjustment process in a complementary way in recovery after surgical interventions (Fulde, Junge, & Ahrens, 1995), in adjustment with adolescents (Erickson, Feldman, & Steiner, 1997), or in marital adjustment (Bouchard & Thériault, 2003). These results were reproduced in high-level sport competition, underlining that the simultaneous investigation of coping strategies and defense mechanisms may improve understanding of the complex and dynamic ways in which people deal with the demands of constraining situations (Nicolas & Jebrane, 2008b). Despite the meaningful value of these studies, very little if any research on DM or on the link between CS and DM in outer space situations or in other extreme situations exists.

Results concerning the variations in CS or emotion in ICE environments show inconsistencies probably due to the specificity of the situations and the participants' characteristics. Previous studies reported that coping strategies are likely to increase as time passes in ICE environments, such as a hyperbaric chamber (Palinkas et al., 1989; Sandal, Bergan, Warnche, Værnes, & Ursin, 1996). This was interpreted as a trend for reducing apprehension of the potential risks (Radloff & Helmreich, 1968; Suedfeld & Steel, 2000). However, in the Antarctic environment, a comparison between the CS used before and at the end of the expedition showed a decrease in seeking social support and in problem-focused coping, indicating, a less frequent use of these coping strategies (Peri, Scarlata, & Barbarito, 2000). The authors suggested that the expedition members probably tended to protect themselves from the frustration and emotional deprivation that often characterizes the situation in Antarctica.

In space flights, a quantitative study based on content analysis reported that astronauts used problem-oriented rather than emotion-oriented coping strategies with a predominance of Seeking Social Support Problems before Planful Solving Problems and Endurance/Obedience/Effort Problems, indicating the importance of mutual reliance and cooperation within space crews, as well as supportive conversations with family members (Suedfeld, Brcic, & Legkaia, 2009). Furthermore, coping strategies indicated changes across space flight stages (Pre-, In- and Post-Flight). Two problem-oriented strategies showed significant changes during the flight. Confrontation and Escape/Avoidance were at their lowest level during the in-flight stage compared to the pre and post-flight stages. These phase-related changes in in-flight were mainly explained by the importance of emotionally calm interactions among the crew of the space capsule, and for the pre and post-flight stages by the fact that physical escape in space is impossible, except for scheduled or emergency EVAs. While one of the emotion-oriented coping strategies (Denial) showed an opposite pattern with a peak during the in-flight phase, this may have been a substitute for other less acceptable strategies during flight such as Confrontation (Suedfeld et al., 2009).

Research on the time-course of emotional states during space flights has shown the absence of time effects that may be related to the support of space psychologists in mission control who use a variety of countermeasures such as communication with family and friends on the ground via audiovisual links or e-mails, and gifts or letters sent up from home during resupply missions (Kanas et al., 2006). These activities may have helped to lower the effects of periods of monotony and homesickness on orbit. However, another study showed the development of negative emotions during the first month of space flight which is accompanied by adaptation to microgravity. After six weeks, boredom, depression, anxiety, irritability and fatigue provoke increases in operators' mistakes (Gushin, 1995). Since the 1960s, the first anecdotal reports in Antarctic mentioned that minor emotional disturbances were very common but pathological cases were extremely rare (Gunderson, 1963). Research conducted among over-winterers for several years suggests that potential candidates for long-duration missions in the Antarctic should demonstrate emotional stability (e.g., Gunderson, 1974; Palinkas, Gunderson, Holland, Miller, & Johnson, 2000; Palinkas & Suedfeld, 2007; Steel, Suedfeld, Peri, & Palinkas, 1997).

ICE environments such as austral winter in Antarctica have long been associated with increases in depression, insomnia, hostility, anxiety, and the use of alcohol (Palinkas & Browner, 1995; Wood, Lugg, Hysong, & Harm, 1999). Among the impaired psychological effects observed during space analog such as head down tilt long-term bed rest, depression was also shown to increase (Ishizaki et al., 1994, 2002; Styf, Hutchinson, Carlsson, & Hargens, 2001). After the midpoint of Russian space missions, symptoms of depression were reported during the second part (Myasnikov & Zalmaletdinov, 1998). Shuttle/Mir and ISS data indicated reports of symptoms of depression during both American and Russian space missions although the level was rarely pathological (Kanas & Manzey, 2008).

However, these results observed during wintering, polar expeditions, space analog environments or orbital space flights should evolve in a different way during long-term interplanetary voyages. These missions have specificities such as the length of the mission (at least two years), communication delays, greater crew autonomy, a severe sense of isolation and separation from the Earth with the so-called "Earth-out-of-view phenomenon", infrequency or impossibility of receiving supplies, the impossibility of evacuation for a medical or psychiatric emergency, the stronger impact of habitability and harsh living conditions in a space habitat with a lack of privacy and personal space that is more likely to become essential in such settings, the restricted range of environmental cues, the specific workload imposed on the astronauts, complex psychosocial issues due to the monotony of social contacts with the same crewmembers, the lengthy separation from the usual social network of family and friends, and other environmental hazards such as microgravity, exposure to high doses of radiation and potential collisions with micrometeorites (Kanas, 2011; Kanas & Manzey, 2008; Manzey, 2004; Palinkas, 2001; Sandal et al., 2006; Suedfeld, 1991).

Thus, more empirical work is needed to define the mechanisms and processes (e.g., coping strategies, defense mechanisms and emotional stability) that promote optimum adaptation to these specifics challenges during long-duration space missions (Kanas, 2011; Palinkas, 2001; Sandal et al., 1996; Suedfeld & Steel, 2000). Given the previous results in the literature, we supposed that a confined and isolated situation of 105 days would involve changes and relationships between coping, defense mechanisms, emotions and depression.

2. Methods

All volunteers underwent a thorough clinical examination, both medical and psychological, and received verbal and written explanations about the study objectives, procedures and potential risks of the experiment before participating in the Mars-105 campaign sponsored by the European (ESA) and Russian Space Agencies (Roscosmos). The participants gave their written informed consent to participate in this experiment. The study was approved by the ethics committee of the European Space Agency and the Institutional Review Board of the Institute for Bio-medical Problems (IBMP).