



Study of individual and group affective processes in the crew of a simulated mission to Mars: Positive affectivity as a valuable indicator of changes in the crew affectivity



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ABSTRACT

The success of a long-duration space mission depends on various technical demands as well as on the psychological (cognitive, affective, and motivational) adaptation of crewmembers and the quality of interactions within the crew. We examined the ways crewmembers of a 520-day simulated spaceflight to Mars (held in the Institute for Biomedical Problems, in Moscow) experienced and regulated their moods and emotions. Results show that crewmembers experienced predominantly positive emotions throughout their 520-day isolation and the changes in mood of the crewmembers were asynchronous and balanced. The study suggests that during the simulation, crewmembers experienced and regulated their emotions differently than they usually do in their everyday life. In isolation, crewmembers preferred to suppress and neutralize their negative emotions and express overtly only emotions with positive valence. Although the affective processes were almost invariable throughout the simulation, two periods of time when the level of positive emotions declined were identified. Regarding the findings, the paper suggests that changes in positive affectivity could be a more valuable indicator of human experience in demanding but professional environments than changes in negative affectivity. Finally, the paper discusses the phenomenology of emotions during a real space mission.

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1. Introduction

The international study Mars-500 investigated the effect of long-duration isolation on psychological adaptation, behavior, performance and overall health of the crewmembers of a simulated spaceflight. Moreover, Mars-500 simulated many factors that can prove to be important during long spaceflights (e.g. communication

delay, limited sources of food and materials, working routine and monotony, multicultural factors, the crew autonomy, etc.). The project was started in 2007 and, in the final stage of the experiment, the selected six men underwent a 520-day simulation of a spaceflight to Mars that lasted from 3 June 2010 to 4 November 2011.

The present paper deals with affective psychological adaptation – moods, emotions and emotion regulation of the Mars-500 crewmembers during the simulated mission to Mars. At the beginning of our study, we considered that crewmembers would express (and experience) their emotions differently than in everyday life, particularly due to the specific context of long isolation and confinement.

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The affective tone in the crew (enthusiasm, humor, conflicts, etc.) affects, inevitably, every single member of the crew – considering the number of interactions within a small group, it is impossible not to be involved. The crewmembers should consider (consciously or unconsciously) that even though an atypical affective atmosphere arises, they have to remain and live in communication and professional cooperation with the others.

The role of affective processes in isolation and confinement evoke many implications from various theories. Emotions are a strong social phenomenon and in social interactions take specific forms. However, emotions are extremely difficult to measure. They are influenced by the display rules that form towards whom, when and under what circumstances people express their emotions see e.g. [1,2] and feeling rules that define what we should feel in specific situations [1,3]. Emotional display rules at work are different from more general display rules [4] and when we think about isolation, display rules acquire an atypical expression.

From the theory, we can extrapolate that the isolated group would be less tolerant of negative phenomena see e.g. [5]. At the same time the control of negative emotions for people living in isolation would be extremely difficult, not only due to their interdependence and a great number of their interactions and exposures [6,7], but also because of the lack of conventional behavioral and social coping strategies that are unavailable under conditions of social isolation (e.g. the opportunity to talk to someone, go golfing, shopping or fishing, have some chocolate, avoid difficult people, etc.). Positive affective outcomes such as group cohesiveness, solidarity, togetherness, social support and empathy could be strongly preferred motifs for emotion regulation in isolation and confinement.

Following another theory – the theory of *groupthink* [8], we can expect that the desire for cohesiveness or effectiveness could become a more important value (though not always reflected or conscious) and a stronger modus operandi than the focus on individual goals. Although Sandal et al. [9] did not find evidence of “groupthink” in a confinement study lasting for 105 days (the 105 days simulation preceded 520 days long simulation) we cannot dismiss to refuse the development of groupthink in the context of the high autonomy, isolation, or inescapable time schedule. Work with emotion and emotion regulation in isolation can also be considered as the process that the crew uses to facilitate and share *positive social identity* [10–12]: to be a member of a crew with socially desirable attributes (conflict-free, harmonic, efficient) would support the positive self-image of its members (as opposed to the membership of a crew that is adversarial, inefficient, split up, or unable to manage experimental situations or tasks, etc.).

In the context of affective group processes, the theory highlights several phenomena such as *emotional contagion*, which is defined as a tendency of interacting persons to synchronize the ways they express and feel their emotions [13]. Emotional contagion is associated with *affective synchronization* that may lead to affect convergence within interacting people. Predominant valence (positivity or negativity) of affective tone can significantly affect team

performance and effectiveness, particularly when team members are faced with complex, new and multi-level tasks [14]. Paradoxically, a uniform and strongly positive affective tone may be dysfunctional for a team, as it exacerbates pre-existing tendencies of teams to develop one shared reality that team members confidently believe to be valid. Alternatively, heterogeneity in member mood states and emotions within teams (i.e. multiple emotions of varying intensity and valence) may lead to the development of multiple-shared realities that reflect the equivocality of the teams’ tasks and circumstances and other functional outcomes (e.g. multiple perspectives and minority dissent) [14].

Among the important affective problems that can interact with the emotion regulation of crewmembers is the often-discussed so-called *displacement* of undesirable emotions outside the group. Displacement occurs particularly in stressful situations when the crewmembers (consciously or unconsciously) do not express their tension towards other crewmembers, but direct their emotions (e.g. anger) overtly to people outside their group [15,16]. This process is also characterized by a “we vs. them” and “our situation vs. their requirements” approach, overvaluing the positives of one’s own group, or perceived misconception or incompetence on the part of the counter-group (cf. out-group/in-group concept) see [10].

The work with emotions and moods seems to be critical especially when we think about performance on one hand and tolerable affective atmosphere within the crew on the other hand. Our study investigated individual and group affective processes during the Mars-500 project (520 days long isolation). We focused on the moods and emotions of crewmembers and the ways in which they were experienced and regulated. We were also interested in examining the extent to which crewmembers synchronized their affectivity over time. We aimed to find out whether (A) crewmembers showed any predominant affective tone (positive or negative) or their moods and emotions were rather heterogeneous; (B) their moods and emotions became synchronized during the simulation; (C) their affective tone changed during the simulation (i.e. whether their affectivity showed any characteristic and observable progress); (D) their moods and emotions during the simulation differed from moods and emotions they showed before and after the experiment; and finally, (E) how crewmembers non/expressed their emotions towards the others (i.e. their fellow crewmembers).

2. Method

2.1. Participants

The purpose of the Mars-500 experimental study was to gather data, knowledge and experience to help prepare for a real mission to Mars. The study comprised six volunteers (three Russian, two Europeans and one Chinese), all men, between 27 and 38 years of age ($M=32.16$; $SD=4.99$ at the beginning of the simulation). The participants gave informed consent prior to their participation. The participants acted as subjects in scientific investigations to assess the effect that isolation has on various

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