Acta Astronautica 113 (2015) 1–7

Contents lists available at ScienceDirect

Acta Astronautica

journal homepage: www.elsevier.com/locate/actaastro

Psychosocial interaction during a 105-day isolated mission in Lunar Palace 1 ☆

Ruilin Wu *, Ya Wang

Institute of Psychology and Behaviour, Beihang University, Beijing 100191, China

ARTICLE INFO

Article history:
Received 24 December 2014
Received in revised form
25 February 2015
Accepted 27 March 2015
Available online 6 April 2015

Keywords:
Psychosocial interaction
3rd quarter phenomenon
Individual difference
Crew structure
Lunar Palace 1

ABSTRACT

As they are the most important and critical group in space missions, the crewmembers' emotions and interpersonal interactions have gained attention. The crewmembers are confined in an isolated environment, have limited communication with the outside world, and often undergo unpredictable risks, which may lead to the aggravation and acceleration of depression, displacement, and even interpersonal conflicts. These psychological factors could deteriorate the astronauts' effectiveness and safety. Therefore, the aim of the study is to identify the possible patterns over time regarding changes in the emotional states, cohesion and other group dynamics during a 105-day isolation period. The experiment was conducted in an analogue space station at Beihang University, referred to as Lunar Palace 1, which is the first crew made up of all Chinese members. In the experiment, all the crewmembers completed a profile of mood states (POMS) questionnaire every week, along with the group's environment scale (GES) and work environment scale (WES) every two weeks. Following the experiment's isolation period, semi-structured interviews were also conducted as qualitative data. As a result, the following observations were determined: 1) there was no 3rd quarter phenomenon observed during 80 days isolated experiment for Group 3; and the average positive emotions and cohesion of crew were gradually increased with the process. 2) Significant individual differences were identified; and crewmembers possessed different change patterns on psychological state. 3) Crew structure with 1 male and 2 female, less pre-mission team building, and collectivist culture might influence the psychosocial interaction of crew. In summary, the results from Lunar Palace 1 demonstrated that the emotions and climate of Group 3 was in a good state for a successful mission.

1. Introduction

As they are the most important and critical groups in space missions, the crewmembers' emotions and interpersonal interactions have gained attention [1–4]. Several psychosocial issues have been identified by previous research studies. These issues have resulted due to the increase in mission durations. The astronauts may experience negative influences to their moods and group interactions over time [5–7]. Also, effects due to individual and gender differences have also been found in the space missions and simulated experiments. These various psychosocial issues have been related to the mission duration, with many problems being noticed after the halfway point, referred to as the "3rd quarter phenomenon" [8,9].

It has been determined from previous studies [3,7,10] that confined isolated environments, limited communication with the outside world and unpredictable risks, may lead to the

☆ Parts of this paper were presented during the 65th IAC in Toronto.

* Correspondence to: School of Humanities and Social Science, Beihang University, No. 37 Xueyuan Road, Beijing 100191, China. Tel.: +86 10 8233 9992.
E-mail address: wuruilin@buaa.edu.cn (R. Wu).

http://dx.doi.org/10.1016/j.actaastro.2015.03.032
0094-5765/

aggravation and acceleration of depression, displacement and interpersonal conflicts. It is imperative to conduct related research in order to identify how these factors influence human mental health and performance in space, and also to find possible counter-measures for these psychosocial issues. The 105-day isolated mission in Lunar Palace 1 at China offers us a precious opportunity to study the interaction and related psychological change of crew.

1.1. Literature review

It is necessary for astronauts to be in a good psychological quality state in order to successfully perform space missions. Several previous studies focused on this topic, and have reported that long duration space flights could affect the astronauts' emotions, as well as the group dynamics [2,3,11,12].

Human behaviours are closely related to emotions. In a space capsule or station, the environment is isolated, and communication with the outside is limited to telephone or delayed video. Also, the monotonous working schedule can aggravate loneliness and homesickness, which could trigger negative mood reactions, such as depression and anxiety. Therefore, an astronaut's unstable emotional state could be a threat to the safety and performance of the space flight. Results from the International Space Station and Mir Space Station have shown that during a mission transition (first few weeks into space and back to earth), the astronauts' emotional changes become irregular [13]. Similar negative moods have also been found in both polar expeditions and space analogue experiments [1,14,15]. In addition, research teams have been attempting to identify the possible changing pattern which added governing emotions. In 1991, Bechtel and Berning [9] put forward the “3rd Quarter Phenomenon”, which suggests that after the halfway point of a mission's duration, the crewmembers experience some depressed emotions. However, recent studies have shown that no 3rd quarter phenomenon occurred on the ISS or Mir [12,16]. These results suggest that this phenomenon cannot be applied to all long-duration isolation missions.

As previously mentioned, emotions can influence human behaviour. The crewmembers are the main executors of the space missions, and therefore the interactions among the crewmembers should be an issue to focus on. The group's cohesion, formed by communication and mutual acceptance, can unite crewmembers, as well as strengthen teamwork. The group's cohesion is influenced by the mission phase. Ref. [17] found that crewmembers felt increasing cohesion at the beginning of a space mission on Mir, since they were progressively adapting to the environment, and to each other. Such positive changes were also found in the Arctic Expedition [18]. Also, the crew's size and structure was another factor which affected the cohesion. Since the conflicts between two persons were found to be more difficult to calm, crews formed by three people seemed a more suitable [3] solution. This formation has been used in multiple space missions, such as the Apollo missions. In addition, the gender effect could also affect cohesion. In a simulated space mission (simulation of the flight of the international crew on Space Station, SFICSS-99), one male crewmember intended to kiss a female crewmember, which triggered serious conflicts [11,19]. However, in other studies, there have been reports that the involvement of female crewmembers could strengthen the group's cohesion and fulfil the task [3]. Therefore, there have been no consistent results regarding the gender effect on space missions.

The group dynamics of the space crew also included leadership, along with the perceived support from the outside. Within the mission group, one crewmember was designated as the leader. Efficient leadership can facilitate a space mission [20]. The support and control of the leader are important factors in leadership. Previous studies have suggested that in different mission stages, crewmembers may need different types of leadership [7]. Studies about ISS and MIR also found that the support of the leader was positively related to the group's dynamics [16,21]. However, some studies have shown that individual differences existed in regards to perception of group interactions [5], which might cause that they misunderstand their leaders. Along with the support of the leader within the mission crew, the perceived support from the outside by the crewmembers was also important. These results may indicate that we should offer different types and degrees of outside support for each crewmember. Currently, there have been no related studies in this regard.

So far, there is not publicly report about medium-long duration analogue of space mission crew, which was consisting of all Chinese members. In general, East Asian culture including China is more interdependent, or collectivist, western culture is more individualistic. Whether the conclusion draws from crew comprised of American or Russian will be emerged in Chinese crew is a very important and should be investigated here. It should be the first time that studying on psychosocial interaction of all Chinese crewmembers and control personal.

1.2. Simulated circumstance

The simulated experiment study was conducted in an analogue space station at Beihang University, referred to as Lunar Palace 1, which is an integration test-bed for bio-regenerative life support systems. The facility consisted of one comprehensive cabin with 42 m^2, and one plant cabin with 58 m^2. The comprehensive cabin included 4 private bed rooms, a living room, a restroom, and a room for waste disposal and insect culturing. The construction of Lunar Palace 1 has been divided into two phases: first phase included a comprehensive cabin and one plant cabin, which could provide three people with a life-support environment. In next phase, another plant cabin will be built, which will assist in the protection and safety of four people. Our study was conducted using the equipment of Phase 1, and the construction of Phase 2 is currently undergoing.

The bedroom with door for crewmember is very narrow, which just contain a single bed and a small table. There is only private area to crew members, who can connect Internet with their personal laptop or smart phone in it. But they cannot call outside through the cell phone. The signal of mobile service is shielded since the experimental facility made by metal material. The only one wired phone usually communicated with outside control with no delay.

Several biological experiments and psychological research studies were conducted in Lunar Palace 1. Seven candidates