Title
Positive psychological effects of space missions

Journal
Acta Astronautica, 57

Author
Boyd (formerly Ritsher), Jennifer E

Publication Date
2005-05-01

Peer reviewed

IAC-04-G.5.a.03

POSITIVE PSYCHOLOGICAL EFFECTS OF SPACE MISSIONS

Jennifer Boyd Ritsher, PhD
University of California, San Francisco, and Department of Veterans Affairs Medical Center, San Francisco, USA
ritsher@itsa.ucsf.edu

Eva C. Ihle, MD, PhD
University of California, San Francisco, USA
ca1girl@itsa.ucsf.edu

Nick Kanas, MD
University of California, San Francisco, and Department of Veterans Affairs Medical Center, San Francisco, USA
nick21@itsa.ucsf.edu

ABSTRACT

Being in space is a powerful experience that can have an enduring, positive impact on the psychological well-being of astronauts and cosmonauts. We sought to examine the frequency, intensity and distribution of such salutogenic experiences among persons who have flown in space, using a questionnaire we developed based on the scientific literature and first person accounts. All participants reported positive effects of being in space, but the degree of change varied widely, and some experiences were particularly common. Three of our five predicted attitude-behavior relationships were supported by the data. Response patterns did not vary according to demographics or time in space. Cluster analysis yielded two groups of participants. One group was generally more reactive and also placed a higher priority on perceptions of space than did the other group. We conclude that positive experiences are common among space travelers and seem to cluster into meaningful patterns that may be consequential for Mars missions. We consider the possible selection, training, and monitoring issues raised by our findings.

INTRODUCTION

The experience of being in space is a powerful one that is likely to have an enduring, positive impact on the psychological well-being of astronauts and cosmonauts. Very little research has been done in this area to date.

In a previous survey, a group of 54 astronauts and cosmonauts who had flown in space rated the excitement of space flight as one of the strongest factors enhancing communication between crewmembers and mission control support personnel on the Earth[1].

Only one scientific study that we are aware of has focused in detail on the positive effects of spaceflight, and this was a recent analysis of the published memoirs of four pioneering American astronauts [2]. It found that achievement was a core value orientation for all of them, but it tended to drop during spaceflight, while other enjoyment-related values such as hedonism and stimulation rose. After the flight, the pre-launch balance of values was typically restored. The one individual for whom this pattern was most pronounced reportedly had the most difficult post-flight adjustment period. More information is needed about the patterning of such experiences and the implications of these patterns for adjustment and mental health.

Our study sought to contribute to this newly emerging area of research by surveying astronauts and cosmonauts about their experiences.

Based on anecdotal reports from astronauts and cosmonauts, as well as the scientific literature on the salutogenic (health-promoting) effects of stressful experiences, we developed a questionnaire measuring the positive effects of the space experience. Previously,[3] we presented the psychometric properties of our questionnaire, item-level and subscale-level descriptive statistics, and the modal responses from an initial subject sample.

Here we will review the main findings pertinent to the whole sample and then focus in more detail on the search for patterns in responses across subgroups of respondents.

METHODS

Participants. The sample included thirty-nine anonymous respondents recruited from the Association of Space Explorers (ASE) and the NASA Astronaut Office. Every respondent had flown in space at least once. As we described in more detail elsewhere[3], the ASE participants were recruited via email, and the NASA participants were recruited by mail, with the distribution being carried out by these organizations rather than our study team, to help preserve anonymity.

Instrument. Participants completed the 36-item Positive Effects of Being in Space (PEBS) questionnaire, which has been described in detail elsewhere[3]. The PEBS is based on the 21-item Post-Traumatic Growth Inventory (PTGI) developed by Tedeschi and Calhoun[4] and included additional items more specifically relating to experiences from space. The PEBS has the following subscales: New Possibilities, Appreciation of Life, Personal Strength, Relating to Others, Spiritual Change, Perceptions of Earth, Perceptions of Space, and Changes in Daily Life. Each of the 36 items was rated on a Likert scale ranging from 0, "I did not experience this change as a result of my being in space" to 5, "I experienced this change to a very great degree as a result of my being in space". There were two additional qualitative items. One asked respondents to list any other change not already addressed and rate it on the same scale. Another asked respondents to select and describe their most powerful positive experience.

RESULTS

All participants reported positive effects of being in space, and the most widely reported changes involved Perceptions of Earth (F=24.2, p<.001, df=7). For example, 97% of the final sample said that they "gained a stronger appreciation of the Earth's beauty." By contrast, Spiritual Change was the least common, with each type of change reported by 33% of the sample.

Changes regarding attitudes were equally common as changes regarding behaviors, and 3 of our 5 a priori hypotheses about specific attitude-behavior changes were upheld. Respondents who changed regarding (1) treasuring the Earth or (2) appreciating its fragility or (3) beauty were more likely to report increasing their involvement in environmental causes (r=.58, r=.66, r=.38, p<.05). However, those who became more aware of the unity of humankind were not significantly more likely to report a stronger (4) involvement in politics or (5) relationship with their family.

Next, we tested whether responses varied across types of respondents. Contrary to our expectations, none of the levels of reported changes varied by gender, age group, number of missions, type of mission (short or long duration), or total number of days in space. This includes the full scale, subscale, and item scores.

Next we used a more data-driven approach to search for groups of subjects with different response profiles. A cluster analysis calculated the standardized Euclidian distances between persons in multidimensional space, using 13 dimensions corresponding to the responses on the space-specific items. This analysis generated the dendrogram shown in Figure 1. The left column of Figure 1 shows the subject code number, and the pattern on the right represents the distance in multidimensional space between each subject and all the other subjects. For example, the two subjects at the top are very similar to one another but somewhat different from the third subject, who in turn was very similar to the fourth one. The branching pattern shows two clusters of respondents (There was originally one outlier forming a third group containing only that individual, but the figure shows the pattern with the outlier removed). Cluster 1 at the top contains 23 subjects, and Cluster 2 at the bottom contains 15 subjects.

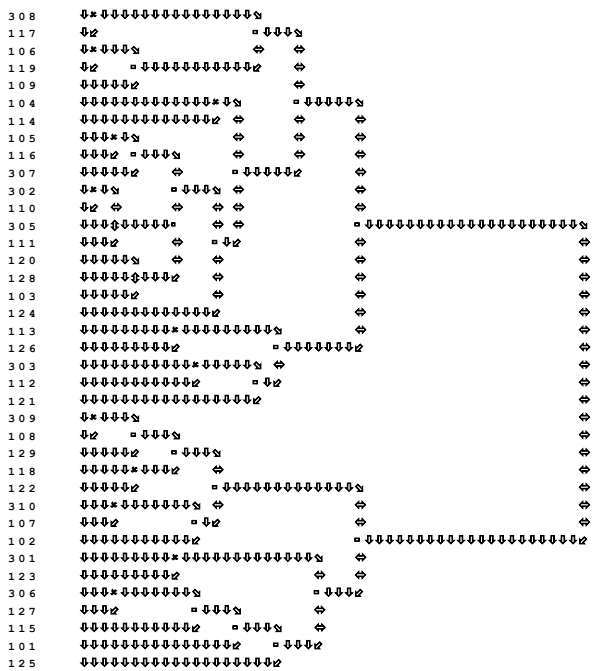

Figure 1. Dendrogram showing two main clusters of respondents

We examined the characteristics of these two clusters of subjects. Cluster 1 did not differ from Cluster 2 on any of the available demographic or

mission characteristics, nor on the content of the open-ended items.

There appeared to be two main features that distinguished the two clusters. First, they differed in their reactivity to the questionnaire items. Cluster 2 reported a significantly greater degree of change on the total score, on all eight subscales, and on most of the individual items (*t*-tests, each at $p<.05$). For example, the overall mean was 1.1 (*SD*=.6) for Cluster 1 and 2.6 (*SD*=.8) for Cluster 2. These findings were confirmed qualitatively by visual inspection of histograms of these variables, which showed evidence of bimodal distributions.

Second, the two clusters appeared to have different profiles in terms of the relative intensity of different types of changes. After the Perceptions of Earth subscale, which was the highest in both groups, the remaining subscales were ranked differently. For Cluster 2, the highly reactive cluster, Perceptions of Space was the next most important type of change (mean 3.5, *SD*=.9), whereas it was only in fifth place for Cluster 1 (mean 0.9, *SD*=.7).

DISCUSSION

As we reported earlier for the initial sample, all participants reported positive effects of being in space, and the most widely reported changes involved Perceptions of Earth[3]. These perceptions were often so profoundly experienced that they led to behavioral change in terms of increased involvement in environmental causes.

Spiritual changes were the least commonly reported type of change. In their page-by-page analysis of astronaut memoirs, Suedfeld and Weiszbeck[2] also were surprised by spirituality scores that were lower than expected based on the strength of some anecdotal reports[5].

Perhaps the group of astronauts studied by us and by Suedfeld and Weiszbeck had a different style of reacting to their experience, compared to those who had reported life-changing religious experiences. This raises the question of whether different types of people have different types of reactions. Therefore, we looked for evidence of patterns across subgroups of respondents.

Our findings showed evidence for two clusters of respondents. These two groups can be distinguished by their reactivity to their experience in space as well as the relative importance of different types of experiences to them. We did not find differences based on demographics or mission duration, which means that these experiences appear to be available to everyone no matter how brief their time in space. Rather, the differences appear to be based on reactivity or expressivity, which may be characteristic styles or personality traits.

Limitations of the study include the small sample size and our inability to test the degree to which it is representative of the population. In the absence of other data points on these individuals, we are unable to externally validate the nature of the two clusters or reaction styles found in these data.

Future research should investigate these two reaction styles, including their relationship to personality traits and to behavior and performance indicators. If supported by future work, these two styles may have implications for selection, training, monitoring, and supportive countermeasures. For example, if one style is more adaptive or if each style corresponds to different performance patterns, these should be taken into account when composing, training, and supporting crews. Encouraging crewmembers to review the personal significance of their positive experiences in space might enhance in-flight stress tolerance and post-flight adjustment.

People who have stronger positive reactions to being in space may be more resilient to stress during extremely long duration missions such as the planned missions to Mars. The view of Earth that seems to be so central to the experience of everyone surveyed will not be available during most of such a mission, so it will be important for crewmembers to gain emotional sustenance from other aspects of their experience.

REFERENCES

1. Kelly AD, Kanas N. 1993. Communication between space crews and ground personnel - a survey of astronauts and cosmonauts. *Aviat Space Environ Med, 64*(9):795-800.
2. Suedfeld P, Weiszbeck T. 2004. The impact of outer space on inner space. *Aviat Space Environ Med, 75*(7 Suppl):C6-9.
3. Ihle E, Kanas N, Ritsher JB, Weiss DS, Marmar C. 2003. Exploring the positive effects of being in space. *Paper #IAC-03-G.4.07.* 54th International Astronautical Congress. Bremen, Germany.
4. Tedeschi RG, Calhoun LG. 1996. The Posttraumatic Growth Inventory: measuring the positive legacy of trauma. *J Trauma Stress, 9*(3):455-71.
5. Kanas N, Manzey D. 2003. *Space psychology and psychiatry.* Dordrecht, The Netherlands: Kluwer Academic Publishers.