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CREATIVE PROCESS TO IMPROVE ASTRONAUT RELIABILITY.

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ABSTRACT

It is commonly believed that creativity is used by artists to communicate personal interior states and by engineers to find solutions to problems. However, we can use imagination and creativity also to improve every day life in Space. In training for long-duration Space missions (LDM), like Earth orbit, and Moon or Mars missions, the creative process is a fundamental contribution to mission success. As mentioned by Martius (2008) creativity stimulates the learning process and self-awareness in relation to the environment. Creative expression may extensively contribute to psychological stability and to astronaut safety. Music, poetry and painting are art mediums that in Space can be used for self-expression or expression of ideas, adding as well a new dimension to knowledge. As the psychologist Csikszentmihalyi (1996) explains "creativity ...leaves an outcome that adds to the richness and complexity of the future."

This paper presents the beliefs, investigations and opinions of authorities on the importance of creative and artistic expression for long-duration Space missions.

INTRODUCTION

The effects of astronauts' confinement have been researched in places like an Antarctic laboratory, caves, submarines, detention centres, and isolation chambers. Loss of motivation, depression, and insomnia are only a few of the effects that can negatively influence reasoning ability.

Art media like music, painting, and poetry have great potential for the welfare of people living in discomfort and in isolated conditions. Fantasy, creativity and imagination can break any barrier; as a prisoner said: "If we want to be free we have to think about art" (Sardo, 2000).

All human beings are creative; creativity is what gives us the skill of adaptation, the possibility to live in different contexts and to find solutions to new problems in unexpected situations like during Space missions. Training astronauts in the creative process can increase adaptation skills and mental stability.

Creative expression is what we use to elaborate and communicate in various ways our feelings, knowledge and experiences.

As Josef Beuys states, "Every man is an artist."

Everyone has creativity and everyone can activate the creative process to bring forth artistic expression.

The artistic and creative areas live a free status, the human being place. Artistic expression and creativity are places of experience and knowledge.

Following a holistic approach (*holos* = complete) towards human factors, we should take in to account both body and mind needs. The astronauts' needs are not only technical but also human needs, like life moment experience, remembering, feeling, and their expression.

The artistic expression responds to one's need to be presents to oneself. However, creative knowledge is also a fundamental factor for the resolution of technical problems like making a "round peg fit into a square hole", as on Apollo 13.

1. PSYCHOLOGICAL SUPPORT

Creative self-expression will improve astronaut creative skills, life quality, and mental stability. It focuses on private, subjective feelings in contrast to the obligations and limited relationships that characterize isolated situations.

A creative moment must be free: it cannot be planned, is is a leisure activity. According to the Space psychologists Kanas and Manzey (2003, p.130) "leisure time activities in Space are very important, they help to counter boredom and monotony."

Creative processes are focused on problem solving or self-expression. The subject achieved the best result, when he activates this process freely, by "personal needs" instead of commissioned work in a constricted time frame. Quoting the research of Teresa Amabile (1983) "Intrinsic motivation is conducive to creativity, but extrinsic motivation is detrimental (p. 15)."

In an isolated environment the creative process is necessary to survive monotony, stimulus deprivation and boredom. It is essential to wellbeing, to psychological survival, and to avoiding acting like a machine. Sailors isolated on the sea for long journeys employ their spare time to make artistic expressions like batons and miniature ship models out of whalebones. Like sailors, astronauts may create a new form of art if we give them the opportunity.

1.1 Sensorial stimulation and self-awareness

Lack of solar light, wind and seasonal changes, are characteristic of the artificial habitat in Space. During long duration missions this sensorial deprivation affects astronauts.

The variation of stimuli such as seasonal changes are natural conditions and sensorial stimulations that ensure archetypal brain activity by helping to avoid mental drowsiness and to maintain alertness (Mahnke, 1996).

“As a countermeasure to heavy workloads or monotony, astronauts have drawn on leisure activities imported from earth or invented in situ” (Häuplik-Meusburger, et al. 2008). Creative entertainment like social games “can maintain and enhance manual dexterity, mental alertness and social interaction amongst crew” (Häuplik-Meusburger, et al. 2008).

A group of architects and designers has presented to the International Space Conference in 2008 a game designed for microgravity environments and aimed to stimulate creativity and positive socialization during Space missions. The “Space game” is designed “to make the most of the kinetic and sensorial potential of reduced gravity conditions” (Häuplik-Meusburger, et al. 2008).

Applied to social play, to the expression of personal state, or as a problem solving strategy, in all cases creativity stimulates the learning process and self-awareness in relation to the environment (Martius, 2008). Self-awareness acts against the mental drowsiness generated by stimulus deprivation in a monotonous, artificial, and isolated Space dwelling.

1.2 Sublimation process

Astronauts in isolation must constantly keep their self-control, without the freedom to express personal instincts or emotions.

During long-term missions, conflict among crew members might arise, and astronauts will not be free to leave the mission early or to change crew members; moreover it will not be possible to take a break or to have a few days of holiday. Astronauts must constantly control their feelings repressing instincts like aggressiveness or sexual impulse.

In this context, a psychological support can be helpful through creative expression.

Yamanaka (2003) stated that artistic expression “touches, encourages, and provides a way to express emotions.”

By means of the sublimation concept, energy derived from a sexual or emotional impulse is channelled from its original purpose into a positive social activity such as intellectual investigation or an artistic endeavour - in short, into a creative activity.

Playing, painting, music, sculpture, or daydreaming can activate this process.

According to Malchiodi’s theory (2006), the creative process is a means of imaginative, authentic, and spontaneous self-expression. It is an experience that, over time, can lead to personal fulfillment, emotional equilibrium, and self-development.

Since prehistory, art has always been an element used by humans to communicate with the external world (Rubano, 2005).

Creative expression is a psychological countermeasure to isolation, which “includes all actions and measures that alleviate the effects of the extreme living and working conditions of Space flight on crew performance and behaviour” (page 131, Kanas, N.; 2003).

Creative expression will become essential in extreme isolation, as in a Mars mission during which astronauts will have remote psychological support.

1.3 Art as therapy

In Space habitats, facing social isolation, discomfort, and emotional repression, art can be used as therapy. This is what happens in hospitals, prisons, and mental health institutions with “art therapy.”

Art Therapy was born thanks to the contribution of psychoanalyst like Winnicott and Melanie Klein and from Dubuffet’s Art Brut (art made by mentally ill people).

It develops from the theory that “artistic creation is a focused and organised activity like children’s play, it is based on the transformation, through symbolic activity, of emotion in expressed cognitive elements” (Caterina, 1998, p. 54).

In art therapy, artistic expression is a way to balance emotions and to contribute to well being (Caterina, 1998, p.51). This principle also supports the “sublimation theory”.

As a matter of fact, putting inner emotion into the external artistic “vase” helps to release tensions.

However, visualizing feelings as an external thing has another important effect: it brings more knowledge of our personal emotional experience (Rubano, 2005).

Francesca Rubano, a specialist of Art Brut, Art therapy and Relational Art, points out that Art Therapy is a key solution for mental stability in isolation, as a countermeasure to limited communication and limited social relations (personal communication, September, 2009).

2. CREATIVITY FOR THE UNEXPECTED

Is creativity a fundamental necessity in Space missions?

Replying to this question, astronaut Prof. Dr. Ernest Messerschmid emphasized in a personal communication (courtesy, Stuttgart, July 2009) the importance of creativity, particularly in finding solutions to unexpected and unknown problems: "Creativity is important in manned exploration missions. It distinguishes astronauts from robots as humans are prepared for the unexpected."

Messerschmid was a D1-Spacelab Astronaut 1985 with a flight on Challenger, and Head of the ESA Astronaut Centre from 2000 to 2004 at the European Space Agency (ESA). He explains that in Space exploration astronauts are there also to represent the entire human species. This is why it is so important to send humans and not only machines; this is why astronauts must be able to bring along with them human culture like artistic expression or historic knowledge.

Moreover, quoting Csikszentmihalyi (1996, p.1), in order to represent humans astronauts need to be creative, given that "creativity is the central source of meaning in our lives". "We share the 98 % of our genetic makeup with chimpanzees. What make us different are our language, values, artistic expression, scientific understanding and technology. (...) Without creativity, it would be difficult indeed to distinguish humans from apes".

As mentioned by M. Masali (courtesy communication, 2009), "creativity is part of our biological characters developed by natural selection as an *exaptation*¹, an archetype of human adaptation. It is what helps us to adapt in the Space environment."

2.1 Problem Solving

Space Architect Barbara Imhof in a personal communication (June 2009) explains that "creativity is an expression of discovery and can lead to invention and this is happening in all professional areas", not only in the artistic one.

¹ EXAPTATION (Gould & Vrba, 1982) is the use of biological characters developed by natural selection as a consequence of their usefulness in a specific role

Creativity can effectively find solutions when a human is dealing with Space missions to investigate the "unknown."

"Houston, we've got a problem." These famous words, spoken by astronaut Jim Lovell from Space in April 1970, prompted a public demonstration of creative solution-finding aptitude. "The Apollo 13 mission in 1970 is an example of a complex mission where unpredicted events nearly caused a disaster. Earthbound engineers' creativity (and adhesive tape) saved the lives of the astronauts including devising an hour long assembly sequence to mate a square CO₂ scrubber canister with a round hole" (Jones, 1995).

"What fuelled that process was reverse vision"² (King, 1996).

2.2 Lateral Thinking

In problem solving, reverse vision or lateral thinking are the central parts of the creative process.

Creativity "... is sometimes a reactive force, triggered when all else fails. It's a response to a new order of things. We experience our highest creativity not in doing business as usual, but when there is the most at stake and failure is a possibility but not an option. When our fixed assumptions about how things operate won't do, a new mission must be launched". "Forget the flight plan," was ordered in the Apollo 13 mission. "From this moment on we are improvising a new mission. How do we get our men home?" (King, 1996).

2.3 Today creativity is an astronaut's requisite

Today, creative skills are a pre-requisite for astronauts of the Canadian Space Agency (CSA, 2009): "They have also been tested for their creativity, teamwork skills and physical fitness." NASA also requires the astronaut candidates to have "creativity, ambition, teamwork, a sense of daring, and a probing mind" (NASA, 2008).

Creativity is a skill that helps in every day life and must be part of the astronaut's selection and training.

For example, "visual art can be useful both to visualize and communicate creative invention and also to express personal situations. Art media like musical instruments or visual art, through a focused training, can be used to activate the creative process" (personal communication, Villani, 2009).

Darlene Lin, from NASA, led an astronaut training experiment at Pavilion Lake Research Project that included an artist-in-residence program. Lin on "Learning by doing: A Hitchhikers' Guide to the Scientific Training of Moon and Mars Bound Astronauts" (2009) states: "Humans are set to return to

² Refer to "2.2 Lateral Thinking" creative process.

the Moon. Astronauts will be chosen from a variety of backgrounds. As we train them for their missions, we also want to put the heart and soul of humanity back in Space exploration.”

The Association for the Advancement of Artificial Intelligence (AAAI) published a paper that underlines how in astronaut training creativity acquires a crucial role for Moon or Mars missions: “Whereas the repair of Apollo 13 heavily involved ground engineers telling astronauts what to do, this type of help won’t work for Lunar and Martian habitation. In the Apollo case, the engineers had a good understanding of the problems, because they had very good models of the situation -- exact duplicates of equipment.

On Mars or Moon, problems are likely to occur which involve terrain interaction that cannot be duplicated exactly. This is something that a person on site will be best able to analyze (feel, see, etc.). The communication lag from Mars may also prevent effective contingency solutions. The astronauts themselves will be the best ones to solve unexpected time-critical events” (Yim, 2006).

3. ARTISTIC EXPRESSION IN SPACE

Creative expression is the result of the creative process used to solve a concrete problem. It can be artistic expression when finalized to self-expression through the use of artistic media such as music, poetry and painting. In summary artistic expression is the objective expression of subjective impressions (Maksim Gor’kij in Munari, 1966).

In this paper, although many different opinions are reported, artistic expressions is not considered by the authors as art, but it can be conducive to art³.

3.1 What brings Artistic expression into Space missions?

Replying to this question in a courtesy personal communication (Potsdam, September 2009) Dr. Bernard Foing, ESA chief director and poly-instrument performer and composer, says: “Art in Space will give a new dimension to the artistic production expanding human culture. Through artistic production the international crew of Space missions - bringing their original local culture - will be interacting with the new

³ The focus of this paper is not to discuss the problem of art or not art but to bring different argumentations on the importance of creative process in Space. As Bruno Munari (2003), a famous Italian artist and designer, was not to distinguish between art and not art but between the process: fantasy is unrealisable, invention is practical, and creativity is essential. Fantasy, invention and creativity thinks and imagination sees.

heritage of the universe.”

Foing underlines the importance of Space as a place for cultural application. He points out that the crew is international, each member brings the culture of his homeland, that will be expressed in a new dimension: the Universe.

3.2 Culture

“Of course culture!” Rogier Malina said replying to the same question. He is an astrophysicist, Space art expert, editor and Director of “Leonardo Journal of Art, Science and Technology”, and he expressed his opinion in a courtesy personal communication (e-mail, 16 September 2009). “After more than fifty years of Space exploration we have failed as a society to build a “Space culture.” Space professionals need to admit that they are not experts by the side of developing Culture; they must work in collaboration with professionals in the arts and humanities if we wish to continue human expansion and exploration of Space.

Just as the Chinese emperor burned his fleet of ships to focus on the internal affairs of his empire, so we on earth must find ways to build a sustainable society on the planet. If Space culture is to be part of the solution, we have urgent work to do with professionals in the arts and humanities to make sure that it is not five hundred years before humans again step on another celestial body.

We must explore all possible ways of involving professionals from the arts and humanities in all aspects of Space activities.”

3.3 Happiness

Artistic expression is a way to bring inner emotions outside. This process helps to feel, understand, learn and control our inner experience. It is a challenge to expand us.

“People who learn to control inner experience, will be able to determinate the quality of their life, which is as close as any of us can come to being happy” (Csikszentmihalyi, 1990, p.2). Optimal experience is when people report a feeling of concentration and deep enjoyment, it “depends on the ability to consciously control what happens moment by moment, each person has to achieve it on the basis of his own individual effort and creativity” (Csikszentmihalyi, 1990, p.5).

The creative process is part of what Csikszentmihalyi, (1990) defines as flow; it is a moment of concentration to pursue a goal, where the person momentarily forgets everything else. “The periods of struggling to overcome challenges are what people find to be the most enjoyable times of their life” (p.6): “it’s fun, a

great fun, to come upon something new” (Csikszentmihalyi, 1996, p.4)

To get and idea of the joy, risk and hardship involved in the creative endeavours: when we are involved in creativity we feel that we are more satisfied than the rest of our life. The excitement of the artist at the easel or the scientist at the lab is close to the ideal fulfillment that we all hope to get from life, and so rarely do. Perhaps only sex, sports, music, and religious ecstasy – even when these experiences are satisfied and leave no traces – provide an equally profound a sense of being part of entity greater than ourselves. But creativity also leaves an outcome that adds richness and complexity to the future (Csikszentmihalyi, 1996, p.2).

Prof. Mihaly Csikszentmihalyi is a positive psychologist, former chairman of the department of psychology at the University of Chicago. Famous for his research on flow state and creativity, he supports Aristotle’s theory that “more than anything else man and woman seek happiness” (Csikszentmihalyi, 1990, p.1).

CONCLUSION

Space dwellings are artificial high-tech environments where monotony, boredom and repression of instincts (like sexual or emotional ones) can “enhance stress with effect on the immune system” and as a consequence impair astronauts’ health (Le Scienze, 1998).

The creative process improves astronauts’ well-being and safety in three ways. First, it activates the lateral thinking mechanism, which astronauts need in order to face unanticipated problems. Secondly, it supports artistic expression in order to guarantee psychological stability in isolation (e.g., it sublimates repressed impulses via creative expression.) Thirdly, art such as music, painting, poetry, or even imagination are stimuli against the sensory deprivation in an artificial habitat.

In the creative expression, emotions, feelings, instincts, and memories, come out - through the sublimating⁴ process - in the artistic product, as real and concrete proof of our existence and our experience (Rubano, 2005).

Creative expression is a medium of communication between the artist and the world. The artistic communication of astronauts’ experience will attract public interest.

Moreover, Space is a place for us to apply our cultural heritage, adding a new dimension to human

⁴ Refer to: 1.2 Sublimation process.

knowledge. Quoting Csikszentmihalyi (1996), “Creativity leaves an outcome that adds to the complexity of the future.”

As Malina states in the definition of Space Art “The creation of contemporary art is inextricably tied to the process of creating human civilization. Within this perspective, art making will occur as a part of Space exploration, and in fact art making must be encouraged in Space as one of the ways without which, in the long run, human use of Space will be incomplete and unsuccessful” (Malina, 1989 in Woods, 2001).

In conclusion, in the context of outer Space, the capacity to implement the creative process is a psychological countermeasure. It can effectively support a mission’s success as a complete human experience. Quoting Buzzoni (2007): “Let me express a wish: may a new place of cultural synergy come into being...”

DEFINITIONS

Space Art: “Contemporary art which relies on Space activity for its implementation” (Malina, R., 2002. In Woods 2001), and is able to interact with the feelings and moods of the habitants, thereby increasing their wellbeing. The roles of Space art are:

1. Encouraging scientific exploration
2. Recording historical evolution and planetary exploration
3. Promoting international cooperation
4. Synthesizing information to stimulate new ideas about the universe and our relationship to it.

(William K. Hartmann, 1990. In Woods, 2001)

APPENDICES

In the following part of this paper, possible utilization of Art instruments in Space are presented as appendices.

Music and Painting instruments have been selected as key examples. The goal is to show the feasibility and the benefits of using these artistic mediums on the Space crew and also within the Space industries.

APPENDIX 1. MUSIC

Creating artistic expression in Space seems a complex task. However, music is one of the most appreciated activities for astronauts.

In the International Space Station many artistic media are used: musical instruments, pencils, paper on which to write poetry or personal thoughts are available; well coloured pencils were brought by the Korean astronaut Yi So-yeon (Yi So-yeon, personal courtesy communication, Glasgow, October 2008).

“In long duration” says the American astronaut Ellen Ochoa, a classical musician; “you want to prepare yourself to be away for long time, one thing that you like to do is to carry on with activities that are important for you on the ground. A lot of those, you can’t. But whenever you can - and playing a musical instrument is an example - people sure like to do that”. In short duration music is also important. In a Shuttle mission it is “more of a sentimental thing, a memento for people who have had music as a serious hobby” (Miller, 2003). Ochoa played her flute on shuttle mission STS-53 in April 1993 (Lindsey, 2009).

“People that spend their time in an activity that they like may experience happiness, increasing the quality of life” (Csikszentmihalyi, 1990, p.4).

Music in Space is a new form of creative expression already used by astronauts.

A 1.1 Music in Space Missions

“The strangest thing about playing music in Space,” says the astronaut and musician Carl Walz, “is that it’s not strange. In most homes, there’s a musical instrument or two. And I think it’s fitting that in a home in Space you have musical instruments as well. It’s natural.” “Music makes it seem less like a Space ship, and more like a home.” (Miller, 2003)

Carl Walz is the singer (Vis, 1998) in an astronaut band called Max-Q (named after the moment of maximum aerodynamic pressure during a launch). Susan Helms is also a member of the band, and during her mission STS-54 she had the opportunity to play her keyboard floating (Lindsey, 2009).

Music in NASA missions was started with Gemini 6 where the first experiment was done with harmonica and bells.

From Gemini 7 (1975), music played a role of welcome relaxation to relieve the stress inherent in Space missions and to enhance the much needed team spirit between the astronauts and the ground crews (as conflicts between Space and ground crews has happened before).

In Apollo 17 (1972) and Skylab (1973-9) music as a morning alarm had a function of warming up the feeling.

In the (February, 1984) shuttle mission Ron McNair brought his saxophone and recorded his playing. The recording was later accidentally lost.

In the Russian Mir mission, guitars were on board and played by the crew. The first member was Aleksandr Laveikin with an acoustic guitar in 1987, then followed by Gennady Strekalov, Talgat Musabayev, Thomas

Reiter and Sergei Vasilievich during Euro-Mir 1995. The French cosmonaut Jena-Loup Chretien in November 1998 brought also a keyboard onboard the Mir station (Lindsey, 2009; Vis, 1998).

As mentioned by NASA, “a lot of astronauts play instruments. And a surprising variety of musical instruments have found their way into Space: in addition to the keyboard, there’s been a flute, a guitar, a saxophone, and the Australian aboriginal didgeridoo” (Miller, 2003).

“Yuri Romanenko a Russian Cosmonaut during a 326 day stay on Mir (2.5.1987-12.29.1988), wrote 20 songs” (Lindsey, 2009).

Before he went up in 2001, the astronaut Carl Walz recalls, the psychological support people asked him what kind of things he’d be interested in taking along. He said: “Well, a keyboard would be nice.” And they said: “We’ll look into that” (Miller, 2003).



Image: Ed Lu, nicknamed Piano Man, follows a music score whilst European Pedro Duque (right) turns the pages. © NASA (2009).

A 1.2 Safety and Music Instruments

The major problems of musical expression are cost and safety. Mike Pedley (NASA Space station manager for Materials and Processes) is in charge of equipment safety. In his opinion an “electronic keyboard, for instance, might be a source of electromagnetic radiation capable of interfering with the operation of the shuttle or station. Such items can usually be modified, explains Pedley. The type of casing makes a difference: something in a metal case generally doesn’t

emit much radiation; in a plastic case, it emits more. Usually, he says, it's possible to change one or two components in a way that reduces the radiation without affecting the function. Wooden instruments like guitars raise another concern: they are flammable. Such equipment is allowed to go up only if astronauts agree to handle them with care and stow them while not in use" (Miller, 2003).

A 1.3 Difficulties of music in Space

Playing an instrument in Space will be an extraordinary experience, however it is a common belief that playing music in Space will be too complex.

The Space environment has no effect on sound transmission inside the pressurized dwelling, and outside there is no sound at all, as there is no air. The difference in gravity does affect the player, how the instrument will be handled, or how it will produce sound. Ayako Ono, one of the authors, playing a kind of maracas during the microgravity periods of parabolic flight, observed that the metals and wooden balls inside the instrument were moved in a different way producing different sound.



Credit: ESA & Ayako Ono

Image: "Resonance Aroma", playing with the sound and fragrance of wood in microgravity. © ESA & Ayako Ono, 2006.

"When I played the flute in Space," says the astronaut Ochoa, "I had my feet in foot loops." In microgravity, even the small force of the air blowing out of the flute would be enough to move her around the shuttle cabin. In fact, even with her feet were hooked into the loops, she could feel that force pushing her back and forth, "just a little bit" as she played (Miller, 2003).

As for guitar, says Walz, "you don't need a guitar strap up there, but what was funny was, I'd be playing and then all of a sudden the pick would go out of my hands. Instead of falling, it would float away, and I'd have to catch it before it got lost" (Miller, 2003).

And when he played the keyboard, Walz, too, had to use foot restraints to hold himself in place. In microgravity, he says, every time you hit a note, you push the keyboard away. "You have to sort of get used to that." Walz managed by strapping the keyboard to his legs with a bungee cord. "That constrained it a little bit more," but he never did figure out how to use the foot pedal without moving out of position" (Miller, 2003).

A 1.4 Music as Mission Advertising

Art is a cultural heritage often used as advertising because it attracts public interest.

Music has been sent in Space starting from Voyager mission, where sounds (from Birds, Fire, Speech, Bus, Volcanoes) were sent with authors music⁵. Bach, Mozart, Stravinsky, Beethoven, Armstrong, and music from Japan, New Guinea, Peru, Bulgaria, China, Senegal, Mexico, Australia etc. have been sent to "the outermost edge of the Sun's domain and beyond" (NASA Voyager, 2009).

But Voyager was not the only one. Also in the Cassini mission music was sent to Saturn's moon Titan. With the "Music2Titan" mission, ESA (European Space Agency) was "aiming to leave a trace of our humanity in the unknown and to build awareness about this adventure, especially among young people" (ESA, 2009).

All music that has been composed or played in Space is commercially available on a CD by Ron Goodwin called "Music in Orbit."

APPENDIX 2. PAINTING

Visual art as painting will be soon part of Space missions.

In 2003 ESA sponsored "Space Print", student parabolic flight campaign projects that study techniques to paint in microgravity.

"The primary goal of this experiment is to set up an artistic technique that exploits microgravity. This technique could be used during future manned Space flights or commercial microgravity flights onboard planes. The Microgravity environment will shape free-floating paint thrown toward a canvas, hence the title of the experiment" (Agnolon, 2003).

A 2.1 Color as a Need

As Liuccia Buzzoni elucidates, art and especially the use of colors in a world deprived of them can greatly

⁵ Listening on line at:
<http://voyager.jpl.nasa.gov/Spacecraft/sounds.html>

contribute to astronauts' well-being. This is because color is reassuring and it also acts as a psychological compensation and an encouragement to creativity.

The study of the effect of colors upon people in microgravity is the basis of a project that is being carried out by Liuccia Buzzoni for ASI (Italian Space Agency) as part of their research program in collaboration with the Turin-based company ALTEC.

During the International Space Exploration conference in Berlin (2007), Buzzoni was invited by ESA to present the "Colors in Space" project. "Each color has its own vibratory frequency, and colors, with their positive or negative characteristics, have an effect upon our whole being. Depriving a person of colors has the effect of making it more difficult for him/her to believe in himself/herself, as a powerful source of energy is taken away. Colors in Space can be a source of emotions and can arouse a person's deepest sense of life. Colors can support the astronauts' body which otherwise could tend to let itself go, thus affecting whatever activities the astronauts are carrying out."

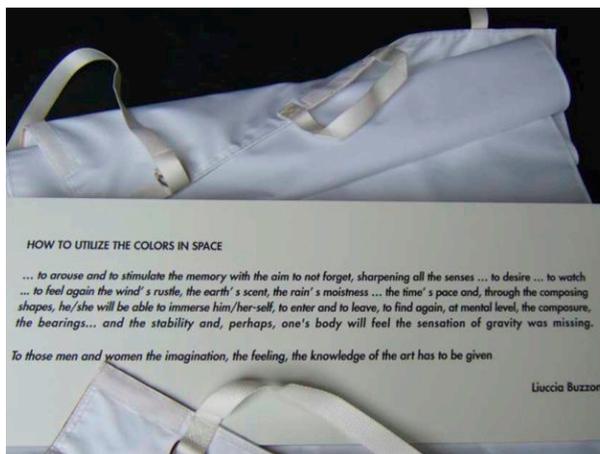


Image: "Color in Space", facility to paint in Space © Liuccia Buzzoni, 2007.

"Art with its colors is a way to awaken primeval feelings⁶, such as the instinct of survival that everybody houses in himself/herself. It is also a way to make people aware of their feelings and fit for communicating and expressing them. Art with its colors can help stimulate memory and senses. At a physical and psychological level it can make it easier for astronauts to find balance, orientation, stability, and a sense of gravity" (Buzzoni, 2007). Bearing in mind the importance of creative use of color on board of Space stations, Roberto Vittori carried out an experiment on "Color in Space," to establish painting techniques in Space. The experiment was recorded on video.

A 2.2 How do you paint in Space?

⁶ Primeval instinct is an aspect of behavioural science. The use of safety colored light is based on this discipline.

In the "Color in Space" project, pre-painted transparent plastic plates were superimposed so as to obtain polychrome effects and personal creations. As Buzzoni (2007) explains, "I have painted the plates in different nuances of the seven primary colors, bearing in mind the sensations they evoke and transmit in common experience on earth. Brush-strokes freely laid...fit for being interpreted...Natural colours, saturated and bold."



Image: "Color in Space", facility to paint in Space © Liuccia Buzzoni, 2007.

Thanks to the colored plates, astronauts can manipulate colours without dispersing them around. They can also have the feeling of actually painting and creating. The differently colored plates will be arranged according to the astronaut "artist's" best judgement on a panel inside a special sliding bag. The bag, made of a fabric called "Nomex," is also used to carry the plates.

The goal of this Space research is to measure, record, and evaluate the individuals' reactions to colors when exposed to microgravity and isolation for a long time. We know that on board an orbiting station space is restricted. Moreover, astronauts have to do with scientific modules. But the real aim of the research is "to make it possible to escape routine and to live as creatively as possible in conditions of microgravity" (Buzzoni, 2007).

A 2.3 Visual Art claims public interest

Public interest is a key element for industry because it

brings support and sponsors.

The public is attracted to things that everyone can do, like painting or playing, facts of everyday life, experience and emotions, and things that can be easily learned as visual arts.

Space art expert Rogier Malina points out that the work of some of the most important illustrators⁷ not only “anticipated some of the results of Space exploration, but in some senses made Space exploration possible by generating public interest and support as well as helping scientists to plan and illustrate their experiments” (Woods, 2001).

To gain public interest, astronauts must be able to communicate their personal experiences to the population.

As shown by Rubano (refer to 1.3 Art as therapy) visual representation has been used since prehistory to communicate man’s experience.

Visualizing personal experience through artistic expression provides astronauts with knowledge of their own emotional dimension and at the same time helps them communicate it to the vast public (Rubano, 2005).

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