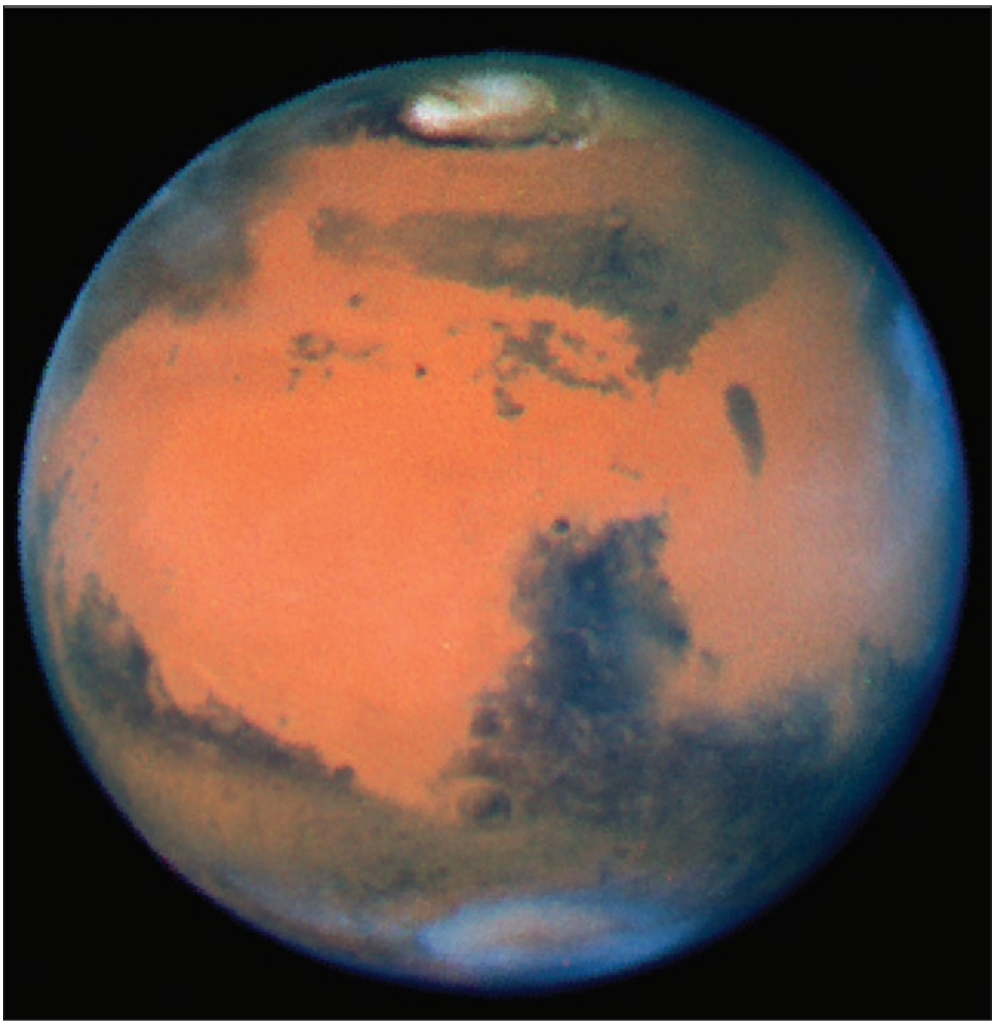

NASA

Mars, the red planet.

BORROWING FROM SECURITY STRATEGY: CAN RED TEAMS HELP ASTRONAUTS PREPARE FOR CREW CONFLICT IN SPACE?

by Robert S. Barrett

Introduction

For highly-trained professionals – military personnel and the like – the notion that we may be susceptible to psychological or psychosocial dysfunction during times of elevated stress or prolonged discomfort is an uninspiring thought. Yet this is exactly the type of concern being expressed by aerospace experts as they consider the prospects of sending a manned space vehicle to Mars. Despite the physical challenges and logistics of conducting such a mission, a major issue remains unanswered: How will people react when they are cocooned in a capsule for three years? The answer is that no one knows for sure.

Life on the Mars capsule, which will likely carry six or seven astronauts, will be one of repetition and proximity, or what space researchers like to call, "...[an] isolated, confined environment" (ICE).[1] Lacking typical hygienic amenities like showers, an abundance of food varieties, privacy, or even personal space, the worry among mission experts and former astronauts, is that even highly-trained individuals may crack. Added to this, the Mars capsule,

Robert Barrett *is a PhD Candidate at the Centre for Military and Strategic Studies, University of Calgary, and holds a Masters in Conflict Analysis and Management from Royal Roads University. Rob's primary research focuses upon the processes of violent inter-group conflict, with particular emphasis upon the forces of volunteerism, recruitment, and indoctrination into deadly groups. Rob is also an active airline pilot and combines his knowledge of contemporary training systems and conflict theory with his research on safety and the performance of teams and crews.*

once it is launched and subsequently fired above Earth's atmosphere, will be propelled along a one-way course with no chance of return until the mission is complete. If an issue were to arise with any of the individuals on board, or with the team dynamic, there would be no available means of intervention.

Most interesting in terms of social science research, is that the future Mars mission, and, to some extent, the International Space Station (ISS) missions, are bringing forth some very thought-provoking questions – questions that, until this point, have been largely avoided due to their delicate nature. Many of these questions cut to the very core of our human 'being,' driving deep into our psychological and social fabric in order to assess, without any political veiling, the various scenarios that might unfold in the capsule. For instance, should crews be comprised of both males and females? Could sexual rivalries tear at the crew dynamic over a three-year mission? What is acceptable behaviour, and how should we define deviance? With Lisa Nowak's well-publicized assault on fellow astronaut Colleen Shipman over Shipman's romantic relationship with a male astronaut, we now have serious evidence that interpersonal relationships can be powerful forces, even for the most highly-trained and tested team member. In this case, Nowak had actually flown on the Shuttle seven months prior to the attack – making it not unrealistic to presume that this scene could have unfolded only a third of the way through a Mars mission.

"Could sexual rivalries tear at the crew dynamic over a three-year mission?"

Even on a less dramatic scale, researchers are asking how seemingly small interpersonal annoyances, such as the way certain people chew their food, could lead to a debilitating conflict condition over time, or whether the normal tolerances and respect for freedom of religious practice will wane with excessive proximity? Are there cultural differences, in styles and modes of communication that might also push crews into conflict? Finally, what is the effect on the human psyche when crew members are acutely aware that they may not survive the mission? Such thoughts they must endure for years – thoughts that surely will intensify as they approach more dangerous or more critical phases of a mission. What can the crew do if an individual crew member becomes detached, depressed, irrational, or violent? Can they restrain that person for a year or more? Under what condition can that crew member be trusted again?

Along with the enormous technical scale associated with a manned mission to Mars, leading aerospace psychologists now believe that it is the human dimension that will be the final frontier for mission development. The questions above, although sensitive in nature, have not escaped the concerns of the world's various space agencies, which now must consider possible countermeasures in the event that their elite teams succumb to onboard conflict when they are months, or even years, away from Earth.

In considering potential ideas, I propose that 'red-teaming' – traditionally used by military and security establishments for testing and improving system readiness – be employed as a 'tool' for introducing psychological and social challenges during crew training. The aim of the red team exercises would be to enhance crew awareness of conflict stressors so that individuals would be able to recognize their own reaction and conflict style, and, in doing so, would be able to develop individualized countermeasure strategies. The need for this self-directed approach is essential when one considers that any potential conflict aboard a Mars mission must be crew-managed.

Challenging Conventional Stigmas

One potential 'down side' to training-intensive environments is the possibility of overconfidence with respect to one's own fallibility. Medical residents push themselves through 48-hour marathon shifts when research indicates that, even after 24 hours, reaction time is equivalent to a person with a blood-alcohol level of 0.1, and airline pilots, until quite recently, felt that absorbing excessive workload made them better-skilled pilots, rather than the less accident-prone course of action, the designating and sharing of tasks and information.[2] I propose that we consider three common reasons for this apparent hesitation to admit professional and personal fallibility. The first is the belief that, because highly-trained individuals actually prepare for adversity, they will also

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Astronaut Lisa M. Nowak, mission specialist, 7 March 2005.

have, by virtue of their training, the emotional intelligence to override mental stressors that might otherwise cripple non-trained individuals. It is an illusionary correlation between mastering one's profession and mastering one's physiology and psychology. Arguably, to some extent, we can train ourselves to increase our tolerance to stress, but that only means that we once again risk overconfidence in assessing our own fallibility. A second argument tends to be that dysfunction, while being a recognized issue, is so rare among crews that the training focus should be upon how the 'system' can compensate for interpersonal issues through 'catch and correct' mechanisms at the team level. For example, how standard operating procedures (SOPs), if followed precisely, can mitigate the problem of human emotional state. Finally, a third form of resistance is the conventional apathetic response to all-things psychological, which is, of course, not so much an argument as it is a silent statement on the subject. This latter view simply ignores the problem of psychological or social dysfunction because it is not deemed applicable to truly 'high performers.'

"To date, much of the methodology for 'capturing' individual and crew reactions to team challenges has been passive in nature..."

'Deviance', however one defines it, is not a term that space agencies like to use or talk about. As researcher Marilyn Dudley-Rowley points out: "In dealing with pilots and astronauts, the social and behavioral [sic] scientist soon realizes that in the eyes of the former and their administrators 'no pilot or astronaut is deviant.' Image is important, for no one wants to suggest that crew members do anything other than perform optimally."[3] Astronauts and other high-performance practitioners know that, in many cases, their very careers ride on their ability to exhibit eternal and unwavering competence, and, in the case of peer-evaluations, to present themselves as a valuable team player. While such attitudes may do well during short duration missions, space agencies are wondering if these same individuals are suited for the type of conflict that may unfold in deep space. Indeed, the difference between shorter and longer missions and the maintenance of crew suitability may have to do with the type and scale of conflict being faced.

Conflict theorists normally consider conflict to be an endemic phenomenon – that is to say, we are never entirely free of it. In its simplest form, conflict can be thought of as existing at two levels: 'latent' (underlying) and 'manifest' (overt). In shorter missions, even though individuals may be aware of a latent conflict condition, it is much easier (and perhaps preferred) simply to ignore the conflict condition in order to complete the mission. This tactic may be particularly popular with high performers who are trained to maintain a 'steely' composure in the face of adversity. In the short run, these types of individuals might be better at maintaining crew harmony, however superficial, in order to focus on getting the job done. However, in a very long exploration-type mission, latent conflict may fester until a point at which a 'trigger event' causes the conflict to manifest into open hostility. In such a case, attempts simply to maintain harmony at all costs would likely fail, exposing the unacknowledged underlying conflict dynamic. Most certainly, preemptively identifying and dealing with a latent conflict in a longer mission – as opposed to looking past the conflict in a short mission – may be among the desired skill-sets for a Mars astronaut. While leading space agencies have begun to openly acknowledge the fallibility factor for exploration-class crews, and have also begun to think about new selection criteria, future work will likely consider the issue of how to train elite teams to recognize and ameliorate latent conflict conditions before they become critical.

To be sure, astronauts are among the most highly-trained professionals in the world – many of whom bring with them the discipline and deportment acquired during years of military training and service. In addition, initial astronaut selection and routine medical evaluations are designed to 'select out' any individuals with less desirable characteristics.[4] Even so, and as the rather unfortunate and dramatic story of NASA astronaut Lisa Nowak proves, despite exceptional selection procedures and training, astronauts are not immune to life's most challenging social stressors. While an argument exists that Nowak's case be considered a minor deviation in an otherwise impeccable team (crew) history, the fact that NASA's *Bioastronautics Roadmap* has identified 'psychosocial dysfunction' to be a significant risk in extended spaceflights, provides further evidence of the growing concern regarding crew conflict and countermeasure development.[5] In fact, the *Roadmap* acknowledges this problem by stating: "...[that] human performance failure due to poor psychosocial adaptation" remains a "Priority 1" risk for the International Space Station and Mars missions, in which "Priority 1" is defined as "...[a] risk of serious adverse health or performance consequences, and there is no mitigation strategy that has been validated in space or demonstrated on Earth."[6] In justifying this high priority, the *Bioastronautics Roadmap* provides the following testimony:

> The failure of flight crews to cooperate and work effectively with each other or with flight controllers has been a periodic problem in both US and Russian space flight programs. Interpersonal distrust, dislike, misunderstanding and poor communication have led to potentially dangerous situations, such as crewmembers refusing to speak to one another during critical operations, or withdrawing from voice communications with ground controllers. Such problems of group cohesiveness have a high likelihood of occurrence in prolonged space flight and if not mitigated through prevention or intervention, they will pose grave risks to the mission.[7]

Given this unacceptable state of readiness, space agencies have placed renewed emphasis upon forming strategies for conflict in space, but, as the *Roadmap* explains, the greater the distance from Earth, the fewer intervention strategies we possess. This begs the question, can astronauts be trained to self-monitor and self-correct their own conflict behaviours in order to prevent conflicts from intensifying into performance-degrading or even life-threatening scenarios? If yes, where should this training occur, who should it include, and how should it be done?

Existing Countermeasures

To date, much of the methodology for 'capturing' individual and crew reactions to team challenges has been passive in nature, with observers watching teams operate in analogue (simulated) environments. The 'top shelf' version of these analogue simulations is done at *Aquarius,* the undersea 'base' off the coast of Key Largo, Florida. *Aquarius* is part of the NASA Extreme Environment Mission Exploration (NEEMO) program, and it is designed to train, observe, and test mission crews carrying out their duties as if they were on the moon's surface, or in the space station. Additionally, and in a less contextually-specific environment, astronaut teams can learn about their leadership styles under stress by participating in the National Outdoor Leadership School (NOLS). These are just two examples of well-known, short-duration earth analogues in which astronauts can participate directly.

However, given the length of the proposed Mars mission, there are also many varieties of long-duration Earth analogues in existence. These analogues can run for months, or years, and, as a general rule, they tend not to use astronauts-in-training. Rather, research-team employees or volunteers are used as participants. Indeed, Canada has taken a lead role in researching physical-environment issues that deal with how to provide life support, grow vegetables, and manage energy on Mars. Analogues such as the *Haughton-Mars Project* on Devon Island are using Canada's remote locales and temperatures to mimic the physical experiences of Mars.[8] To be sure, existing analogues where astronauts are participants are of benefit to their training and to the analysis of crew conflict. Yet, in terms of conflict research, there may be a problem with these analogues in their current form. Analogue training with astronauts, which may take a few weeks on an *Aquarius* mission, may not be long enough to induce the types of social pressures that can cause crew breakdown, as these types of social dynamics are more generally associated with very long missions being conducted for months or years.

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On STS-115 mission, Flight Engineer Jeff Williams and Canadian Mission Specialist Steve MacLean are at the Robotic Work Station inside the International Space Station.

Alternatively, and in addition to these shorter training environments, researchers have also been conducting elaborate analogue simulations in remote locations such as the Antarctic, although most of these analogues tend to use volunteers rather than astronauts, which, in itself, may be problematic. While these analogue environments do offer valuable insight into crew dynamics in remote and isolated conditions, there may be room for improvement. Due to the nature of passive observation, the best we can hope for in these types of analogues is that over 'sufficient' time, the subjects will 'do something' that will lend insight into what could happen in space. Of course, this 'something' may or may not happen, and, as such, we are obliged to consider some of the flaws with this path of inquiry, summarized in the following points:

1. Passive observation is observation 'by chance.' One cannot be assured that the analogue simulation has had sufficient time or adversity to highlight all potential risks, meaning that some high-risk scenarios may go undiscovered. Conversely, in 'active' simulation, as is the case with flight simulators, the inducing of faults covers many conceivable scenarios that the crew may encounter, thereby allowing the crew to experience both the fault and the countermeasures.

2. Due to time constraints, it is not altogether practical for astronauts-in-training to participate in lengthy analogue simulations. As such, the surrogate subjects in these analogues may or may not share key personality characteristics with astronauts who will be flying the mission in question. Would a person who volunteers for two years of isolation and confinement in the Antarctic share the same traits as a Mars astronaut? Do these individuals present viable models for behavioural research? These are complex questions, but important ones nonetheless.

3. In nearly all cases, training for any task is best achieved in the first person. While there is some opportunity for astronauts to reflect upon their actions in simulated environments, I argue that astronaut-candidates should be given the opportunity to build individualized countermeasure skills by being exposed early and consistently to formalized red-team techniques. In addition, the inducing of certain group dynamics allows astronaut-candidates the ability to 'experience' in the first person. This important concept is similar to hypoxia training in an altitude chamber, where first-hand knowledge of one's unique hypoxic reaction (presenting symptoms) is invaluable when compared to symptomatic explanations in a text book.

"The unit label that has come into fashion for this type of system-testing or 'mock attack' is known as the Red Team."

Captain (N) Marc Garneau, Canada's first astronaut.

The Use of Red Teams

These problems make clear the need to revisit the way in which elite teams, and, in this case, exploration-class astronaut crews, prepare for the risk of psychosocial anomalies and crew conflict in space. In rectifying the three aforementioned shortcomings, researchers could a) make analogue simulations longer, more numerous, and inclusive of astronaut-candidates, or b) find more tools to analyze astronauts during the course of their selection and training. I propose the latter, and I do so with the recommendation that we consider the 'borrowing of practice' from another dynamic industry that has also found passive observation to be an inadequate method of preparation, namely, the security industry.

Security strategists have discovered that without challenging the system through in-house trial, it merely defaults to a reactionary (stimulus-response) condition, in which new security protocols are implemented only when problems have been identified through real or attempted attacks. Logically, this is not the most effective way to provide security. As such, strategic wisdom

would suggest that it is logical to predict the types of situations we will face and prepare for them in advance using past experiences, models, and formulae as our guiding principles. Arguably, the accuracy of our predictions depends heavily upon how well our own minds can think like a potential aggressor. If we cannot do this, or if we cannot do this well, we run the risk of being unprepared for their strategies and tactics.

Alternatively, strategists can employ national, cultural, ethnic, religious, group, or subject-matter experts that can predict and decipher novel situations, providing unique insights that might not have been readily apparent to the strategist. The unit label that has come into fashion for this type of system-testing or 'mock attack' is known as the Red Team. At its most basic form, red teaming (as the action is called) is akin to wargaming, yet more recent applications have explored how red teams can be used as partners in defensive efforts, particularly in theatres where conventional wisdom or cultural biases may unwittingly hinder creative thinking. In this sense, red teams have progressed from a unit that merely exposes defensive vulnerabilities to an integrated body that works alongside leaders to provide tactical and strategic solutions when encountering unfamiliar territory. While red teams have received little 'official' status, this is changing. At the University of Foreign Military and Cultural Studies at Fort Leavenworth, Kansas, three new courses were introduced in 2006: a four-month long red team leader course, a six-week red team member course, and a two-week red team practitioner course.[9]

"There are three major ways in which red teams could be used."

Red teams have received mixed reviews, often because they have been a little too successful at breaching security systems in the past, and, in doing so, they have also tended to embarrass those charged with the system's defences. This has been a significant problem for red teams, so much so, that in many instances, security professionals have discouraged their use, or, worse, they have ignored the red team findings altogether. According to a *United States Defense Science Board Task Force Report* on red teaming, this often boils down to organizational culture. In organizations that value criticism and change as a path to improvement, red teams will be readily accepted. In organizations that tend to frown upon internal criticism, red teaming will not survive.[10] In the case of the latter, if a red team finds fault with 'your' system, it is deemed to be indirectly finding fault with 'you.' While this may sound juvenile, one of the more interesting cases of this was raised in 2003 by Bogdan Dzakovic, in his testimony to the *National Commission on Terrorist Attacks upon the United States.* Dzakovic, a red team leader in charge of exposing faults in airport security, explained: "If you are going to hijack an aircraft why not bring a firearm? I knew from working in the Red Team how easy it is to do. Several years earlier the FAA had canceled testing with firearms, after a national Red Team study found over two thirds made it past security."[10] Dzakovic goes further to highlight the 'success dilemma' associated with red teams:

> We were extraordinarily successful in destroying U.S. Flag commercial aircraft and killing large numbers of innocent people in these simulated attacks. This occurred with such regularity and ease as to present a frightening picture of the sorry state of aviation security on a worldwide basis, including our domestic airports. This was all prior to 9-11. Immediately after our Red Team warnings were vindicated, however, we were grounded. Later, I was removed from my position as a Red Team Leader with no explanation and placed in a career limbo.[11]

In order to get around this problem of embarrassing managers and security professionals with red team effectiveness, the majority of red teaming has moved away from an 'adversarial' role toward that of a more collaborative and partnering role. In their new pseudo-consultative relationship with the host organization, red teams no longer run the risk of being 'too effective,' and, as such, they are perceived as partners who seek to cooperatively improve the system to which they are assigned. This is the current state of the art for most red team use.

The newer integrative approach to red teaming has also taken on life in some of Canada's leading institutions. During April 2007, the Department of National Defence released its first-ever *Science and Technology Strategy.* In an interview, Defence Research and Development Canada (DRDC) CEO Robert Walker laid out an ambitious plan to develop and hone Canada's contribution to defence technology, which includes the use of red teams.[12] In the interview, Walker states:

> One can imagine any number of decision aids that might help soldiers and commanders in the field with advice on how they might react under certain circumstances. For one, we want to get better at "red teaming" – anticipating what courses of action an adversary may take based on conditions on the ground and lessons coming out of theatre.[13]

Due to the newer and more progressive (consultative) approach of red teams, their use is gaining popularity. Today, red teams are being used in many other professional sectors, including the business world. It has been discovered that red teams are particularly useful when conducting operations in unfamiliar territory, or where new operational variables and challenges do not fit neatly into existing models. Given the relative success of red teams and their wide scope of application, I propose that red teams be considered as a potential tool for astronaut

training, particularly in the preparation of conflict countermeasures for exploration-class missions. The use of red teams in astronaut training would be based upon the following principal assumptions regarding the type of conflict situation that could emerge onboard a Mars capsule. First is that disputes amongst crew members will undoubtedly occur, yet if left unmanaged over a long period of time, (or if managed poorly), could contribute to the development of more complex and more personal conflicts. Second, 'conflicts,' as opposed to 'disputes,' are far more innocuous and difficult to resolve because they tend to be based upon underlying (latent) conditions that emerge (manifest) in times of stress.[14] Third, once stressors form, it is likely that they would intensify in an isolated, confined environment, not decrease, and, as such, knowledge of how to recognize and mitigate underlying (latent) conflict *before* it magnifies would be essential for optimal crew function. Fourth, astronauts will have to be prepared to identify, diagnose, intervene, and manage crew conflict in the absence of external intervention. Therefore, an ideal training program would assist astronauts in becoming more self-aware in terms of their own individual communication and conflict management styles.

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Canadian astronaut Colonel Chris Hadfield on a mission STS-100 spacewalk.

Using these principal assumptions, and, with particular reference to the last, we might conclude that simply relying on, for example, an instruction module on 'conflict resolution,' would be insufficient in yielding the type of self-learning required to truly appreciate one's own capacity to contribute to, and to manage, crew conflict. Alternatively, astronauts should be exposed to an ongoing program that affords them the opportunity to reflect upon their own fallibility and conflict management style, in concert with that of their peers.' This type of progressive learning could also help an astronaut selection committee 'select in' good candidates as opposed to the current 'select out' strategy. Indeed, observing the development of a candidate's intra-crew conflict management skills over time could help in identifying 'desired' traits, as opposed to identifying 'undesired' traits only. Red teams could be an essential component of this program.

Red Teams in Astronaut Training Environments

The ideal composition for red teams within the context of astronaut training would be former astronauts and existing training and medical staff, along with various subject matter experts in conflict management. How exactly would red teams do their job is the next question.

There are three major ways in which red teams could be used. The first would be to conduct group discussions on the types of conflicts that may be experienced after several months (or years) in space in order to generate team-derived countermeasure plans. The second method would be to monitor existing simulator sessions and provide feedback on group dynamics. And the third method would be to actually induce or simulate a conflict condition within an existing simulator session, which could also include the re-creation of a previously experienced simulator conflict. In most cases, the first and second strategies would be most easily accomplished within the existing training environment. The introduction of a 'conflict challenge' in a simulator session would be slightly more complicated, and, perhaps, could be viewed as a subsequent stage in the evolution of red team practices.

In speaking with Canadian Space Agency training staff, it was explained that many existing simulator sessions are already designed to push astronauts to absorb and manage excessive workload.[15] In these instances, the red team would ask astronauts to log any observations and experiences on the issue of cooperation and conflict, touching upon personal roles and actions in the simulator. Reflection on self and team improvement would offer reinforcement of conflict management strategies. Red teams would act as challengers to existing assumptions and norms regarding astronaut conflict behaviour, with particular emphasis being placed upon understanding personal fallibilities. Moreover, the astronauts would gradually gain a sense of the crew dynamic, and of their own role in that dynamic, through trends in their journal entries. These trends would go far in providing the red team, existing medical staff, and the selection committee further evidence in support of social aptitude and readiness for flight.

In situations where the workload of the simulator session is not as high, red teams may actually elect to simulate a crew conflict condition in the same way that incapacitation is currently simulated, in which one or more individuals is tasked with acting unresponsive. There are two issues associated with this. The first is that 'playing' conflict is not as easy as feigning incapacitation, and the second is that astronauts are often asked to evaluate their peers in terms of whether they would feel comfortable flying with that particular individual in space, which makes it ethically complicated to purposely instigate intra-crew conflict, even if it is simulated. Of these potential problems, the latter might actually be most solvable, with simple agreements amongst crew that conflict simulations are immune to intra-crew evaluations. On the issue of conflict role-playing, such simulations could be as straightforward as reading short cue card scripts that would describe the conflict dynamic and behavioural ramifications to be overcome. For example, a cue card script might describe the depressive state of a crew member and the associated symptoms and consequences of that crew member's onboard work habits. The crew would have to manage the new social situation while meeting the challenges of the physical simulator session. The simulator debriefing would highlight the initial symptoms, the depressive condition or state of the individual, the possible effects upon team performance, and any potential countermeasures. With respect to these types of scenarios, the employment of former astronauts for red team use would be an obvious asset, considering that they may be able to use their own experiences for, and within, the various case studies. As is the case in many industries, simulations that are based upon real events tend to be more interesting and credible among trainees.[16]

"Understanding the social and psychological forces at play begins with an admission of fallibility."

As for the less organizationally challenging red team activity in which red teams provide an open forum for astronauts to discuss potential problems and form countermeasure plans, the function of the red team would take on a more passive 'counseling' and 'facilitative' role. While less dramatic and intrusive, this type of activity could prove highly useful in the personal development of an astronaut's conflict management strategy. In this forum, red team leaders and medical staff could assist astronauts in identifying signals and indications of a potentially harmful latent conflict condition, and to help them understand how their own individual actions either contribute to or ameliorate such a condition. Working through various types of examples, particularly if they were experienced first-hand by the astronaut candidates, could offer valuable lessons for understanding how conflicts can escalate into potentially debilitating dynamics, and this would go far in detailing the risks associated with simply ignoring potential conflict and personal fallibility.

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Canadian Space Agency Astronaut Julie Payette poses with Kent Rominger in the hatchway of the two modules of the International Space Station during STS96.

Conclusion

Recently, the European Science Foundation Standing Committee for the Humanities made public their demand for more research and discussion into the social and psychological effects of exploration-class missions.[17] As an expression of this commitment, in 2007 the Committee hosted two separate international events: a workshop, and a large conference aimed at discussing *humanities* research as it applies to future Mars, lunar, and ISS missions. A dominant theme was to provide a nexus for conventional space-science and non-conventional space-science research disciplines. The general consensus of these debates is that a manned mission to Mars, with its unprecedented isolation and confinement, will be one of the most challenging exploration missions in history, and, as such, it *will,* and it *should,* continue to attract the research attention of both physical and humanistic scholars alike.

Understanding the social and psychological forces at play begins with an admission of fallibility. From this, we must construct various means of understanding the type of conflict that can degrade crew performance at an individual and group level – a task that will surely touch upon various sensitivities in terms of both personal admission and of the basic human experience. Many of these new ideas and discussions will depend heavily upon what emerges from experimentation and earth analogues, and while these methods of inquiry are good, there is certainly room for improvement.

As it is impractical to have astronaut-candidates experience lengthy analogue simulations with all possible colleague combinations, it becomes important that we either develop a way for astronauts to learn from others who may not share their psychological traits, in analogue, or that we develop a way for them to develop conflict management strategies, based upon their own experiences. In short, we need to accelerate experiential learning.

Security strategists know that this sort of accelerating system learning is best accomplished through active challenges against the system – with red teams being one of the best current strategies. Red teams are also particularly useful in importing new ideas and frames of reference from experts who can see the problem from varying angles, which is why red teams have become so popular in preparing counter-insurgency strategies in foreign theatres. With a more facilitative role, red teams have become more widely accepted as a means for achieving rapid situational and system readiness.

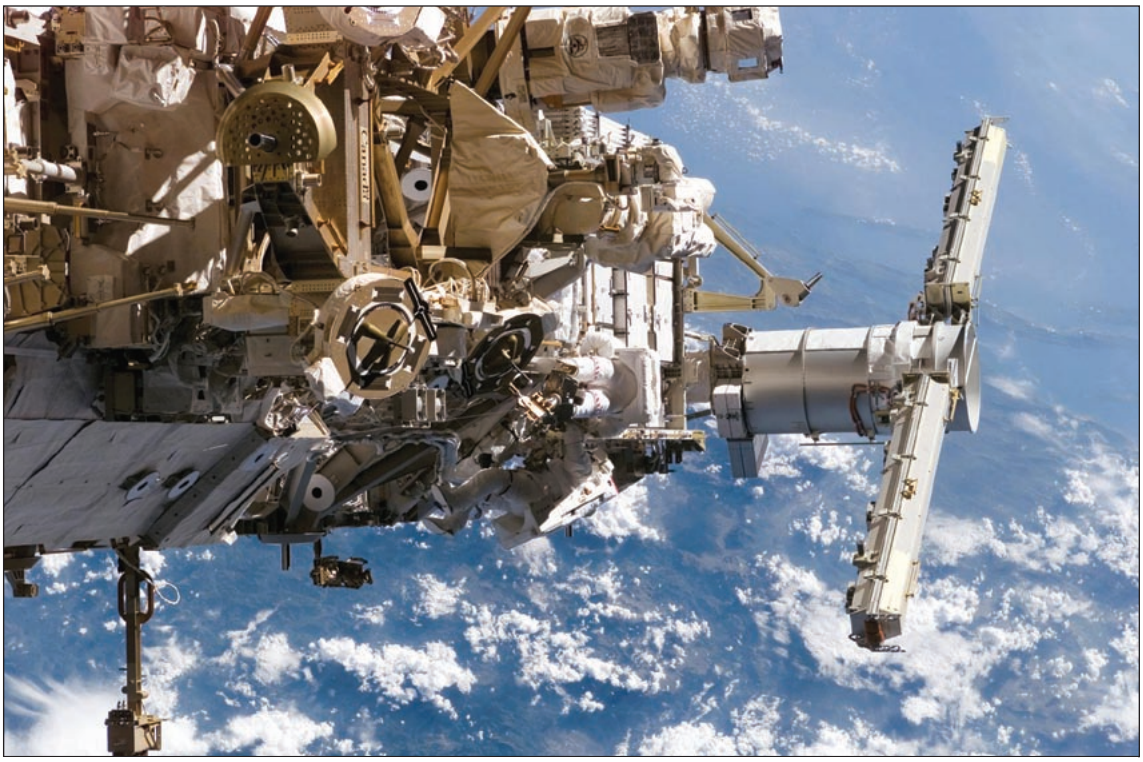
While the use of red teams in astronaut training demands further attention and discussion, the use of red teams seems to satisfy many concerns regarding countermeasure development. Providing a multidisciplinary team that can help astronauts experience, reflect, understand, and prepare for crew conflict, while at the same time providing additional inventory for 'select-in' processes, is certainly an effort worth investigating.

Canadian Space Agency photo

Eyes on the stars. Canadian Space Agency president Steve MacLean announces Canada's two most recent astronaut selectees, Dr. David St. Jacques (left), and Captain Jeremy Hansen (centre), accompanied by Industry Minister Tony Clement, in Ottawa, 13 May 2009.

NOTES

1. For more on isolation research and Mars missions, see Dietrich Manzey, 2005, "Human missions to Mars: new psychological challenges and research issues," in *Acta Astronautica,* Vol. 55:3-9, pp. 781-790. See also: Sam Lee Pool and Jeffrey R. Davis, 2007, "Space Medicine Roots: A Historical Perspective for the Current Direction," in *Aviation, Space, and Environmental Medicine,* Vol.78:1, pp. A3-A4(1). See also: Peter Suedfeld and G. Daniel Steel, 2000, "The Environmental Psychology of Capsule Habitats," in *Annual Review of Psychology,* Vol. 51, pp. 227-253.
2. A person with a blood alcohol count (BAC) of 0.1 would be considered 'legally impaired' according to the Criminal Code of Canada. The Code sets the limit at 0.08 (80 milligrams of alcohol per 100 millilitres of blood.). See the *Canada Safety Council,* URL: <http://www.safety-council.org/info/traffic/impaired/BAC-update-06.html>. Accessed 27 October 2007. Reference to aircrew derives from my personal experience working as an airline pilot.
3. See report by Marilyn Dudley-Rowley, 1999, Dysfunctional Behavior and Performance of Team Personnel in Space and Analog Polar Environments: Implications for Mars Missions. URL: <http://pweb.jps.net/~gangale/opsa/mars/Dudley3.pdf>. Accessed 22 October 2007.
4. 'Select-out' versus 'select-in' comments were made by Canadian Space Agency astronaut selection committee members, on a May 2007 conference call concerning a red-teaming proposal.
5. *Bioastronautics Roadmap* (2005), National Aeronautics and Space Administration. URL: <http://bioastroroadmap.nasa.gov>. Last updated 9 February 2005. Accessed 1 March 2007.
6. *Ibid.*
7. *Ibid.* "Risk 24: Human Performance Failure Due to Poor Psychosocial Adaptation" URL: <http://bioastroroadmap.nasa.gov/User/risk.jsp>. Accessed 5 March 2007.
8. The *Haughton-Mars Project* is an international research station and project on Devon Island in Canada's High Arctic. For more information on the project, see URL: <www.marsonearth.org>. Accessed 26 October 2007. Also, see information on *The Mars Institute,* URL: <www.marsinstitute.info>. Accessed 26 October 2007.
9. See "Army approves plan to create school for Red Teaming," in *U.S. Army Training and Doctrine Command, Office of the Chief of Public Affairs.* URL: <http://www.tradoc.army.mil/pao/tnsarchives/July05/070205.htm>. Accessed 21 October 2007.
10. See "The Role and Status of DoD Red Teaming Activities" *Defense Science Board Task Force Report,* Office of the Under Secretary of Defense For Acquisition, Technology, and Logistics, Washington, DC, September 2003.
11. Statement of Bogdan Dzakovic to the *National Commission on Terrorist Attacks Upon the United States,* 22 May 2003. URL: <http://www.9-11commission.gov/hearings/hearing2/witness_dzakovic.htm>. Accessed 21 October 2007.
12. See interview by Chris Thatcher, "From theory to policy: The strategic engagement of S&T," in Vanguard (online edition). URL: <http://www.vanguardcanada.com/TheoryToPolicyWalker>. Accessed 21 October 2007.
13. *Ibid.*
14. In conflict theory, 'disputes' are often thought of as those issues that can be diagnosed and resolved through negotiation. 'Conflicts,' on the other hand, tend to be deeper and more personal, and tend to be based upon issues that are not negotiable. In many cases, conflicts can grow from disputes.
15. Canadian Space Agency executive were consulted in a conference call, held during May 2007. Discussions included the use of red teaming in astronaut selection processes.
16. This claim is made through observation *of,* and participation in, aircrew simulation sessions.
17. For full text versions of the Genoa Workshop and program information on the Vienna Conference, See "Inter-disciplinary activities in ESF: humans in space," in *European Science Foundation,* URL: <http://www.esf.org/research-areas/space/activities/inif-activities.html>.



NASA

First space walk for Canadian astronaut Steve MacLean on Day 5 of Mission STS-115, when he and fellow astronaut Dave Burbank work on the body of the International Space Station.