

Making media work in space: an interdisciplinary perspective on media and communication requirements for current and future space communities*

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Abstract: As humans expand into space communities will form. These have already begun to form in small ways, such as long-duration missions on the International Space Station and the space shuttle, and small-scale tourist excursions into space. Social, behavioural and communications data emerging from such existing communities in space suggest that the physically-bounded, work-oriented and traditionally male-dominated nature of these extremely remote groups present specific problems for the resident astronauts, groups of them viewed as ‘communities’, and their associated groups who remain on Earth, including mission controllers, management and astronauts’ families. Notionally feminine group attributes such as adaptive competence, social adaptation skills and social sensitivity will be crucial to the viability of space communities and in the absence of gender equity, ‘staying in touch’ by means of ‘news from home’ becomes more important than ever. A template of news and media forms and technologies is suggested to service those needs and enhance the social viability of future terraforming activities.

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Introduction

The potential for space colonization took a major step forward in 2004 with the emergence of the British aviation spin-off, Virgin Galactic, and its business plan to make space tourism a viable reality by 2008 (Foust 2005). This mainstream commercial model, taken in conjunction with competition between the four power blocks – the United States, Russia, China and Europe – indicates pressures towards what some would see as a new ‘space race’. The fact that it is a *race* has been made evident by the financial and political support for space endeavours across those power blocks, notwithstanding some impressions that NASA’s funding has been reduced at certain times (Reichhardt 2001). That it may turn into a *race for colonization* was made evident by the United States’ proclamation that the year 1992 was an ‘international space year’: McKay *et al.* (1992) notes 1992 was the 500th anniversary of Columbus’ landing in the Americas, and hence ‘might prove a suitable focus for ... citizen participation in our country’s space program’. The history of the

United States is one of colonial settlement behind an expanding frontier. Space is effectively the new frontier in this expansionist rubric. McKay *et al.* (1992) indicate that NASA hoped for collaboration with the private sector in this colonization. McKay *et al.* see this new challenge as one that can energize and transform the US.

‘In the long run, human migration into space will not only alter our own human culture on Earth but also result in the creation of a new culture adapted to the realities of space living’ (McKay *et al.* 1992).

The same authors (McKay *et al.* 1992) note that aspects of such a new culture mean that ‘new living themes and patterns will change our sense of self, communication, dress, food, time, relationships, values, beliefs, mental processes and work habits’.

‘To prepare for such revolutionary changes in the human condition, we need immediate research by cultural anthropologists and cross-cultural psychologists’ (McKay *et al.* 1992).

Cokley *et al.* (2005) opened a particular thread of this research by suggesting that astronaut communities, both present and future, have characteristics that allow them to be

* Documenting the research-in-progress programme ‘Astronauts as audiences’, the first section of which was published as Cokley *et al.* (2005).

considered – and studied – as ‘media audiences’. These characteristics allow existing and ongoing communications research to be brought to bear on communities aloft in an effort to more clearly define the communications patterns that might develop, and should be developed, to allow space communities to thrive.

That first research into ‘astronauts as audiences’ (Cokley *et al.* 2005) suggests that the first space colonies will be primarily composed of highly trained and well-educated astronauts, most likely drawn from an international base, composed mostly of males, and will contain both military and civilians. These colonies will require government commitment, as well as substantial financial resources from private corporations or consortia, to become reality. Initially, colonists will presumably be focused primarily on astrophysics, medicine, astronomy, geology, engineering, biology, military research and ‘mission to planet Earth’ issues. If space settlements are to become a reality they will need to be financially viable, and launch systems will need to be safe, reliable and capable of carrying large numbers of people into space. It has also been suggested that colonies might include settlements for religious groups who wanted to practice their faith, penal establishments, establishments for handicapped people who would benefit from the zero-g environment, settlements for people with different political or social norms, and a place for those who see the need for ‘building new land’ rather than taking from another (Cokley *et al.* 2005).

‘As the population continues to grow at exponential rates, tremendous demands are put on the limited natural resources of our planet. The moon may become a source of energy from the mining of helium-3, a source of energy that could be exploited without the danger of releasing radiation into the atmosphere. Mars may have water deposits and hold potential chemicals that could be used to produce rocket fuels. In the future, Mars could even become a major re-supply colony for ships destined to asteroids and other planets and moons within our Solar system.’

The first colonies – whether orbiting Earth or other planets, or based on firm ground on the Moon, Mars or somewhere else – will presumably resemble human communities on Earth. The United States Centre for Disease Control (CDC 2005) defines a ‘community’ as follows.

‘A specific group of people, often living in a defined geographic area, who share a common culture, values, and norms and who are arranged in a social structure according to relationships the community has developed over a period of time. The term ‘community’ encompasses worksites, schools, and health care sites.’

It is noted that the world of the early 21st century already includes three separate kinds of communities aloft, including humans involved in: (1) private, military and commercial atmospheric flights; (2) the sub-orbital flights developed since 2004 and soon to be implemented by the Virgin Galactic Corporation; and (3) the government/military communities staffing the International Space Station and the various

shuttle missions. NASA also announced in September 2005 that it would be establishing another kind of community aloft by 2018: (4) bases on the Moon and then beyond (NASA 2005).

Among these four kinds of communities, the first is demonstrably the largest and at this point the most influential in any discussion of communities aloft. It is the largest because approximately 10 000 passenger aircraft are aloft at any one time on routes around the world (Crichton 1999), indicating a total population aloft of many more than 1 million human beings, in groups of at least 100 individuals, and usually more. UK Department for Transport estimates (DFT 2004) predict annual airline passenger numbers at UK airports alone will rise from 160 million in 1998 to 229 million in 2005 (this year), 276 million in 2010, 333 million in 2015 and 401 million in 2020. Once aloft, these groups of between 100 and 500 people are enclosed in a relatively confined aircraft space for flights of between 1 and 26 h duration, heading from a single origin to a single destination, governed by legislation which sets out specific rights, powers and duties for every individual or class of individual on board (FAA 2005; CASA 2005). It is the most influential population because – while the number of recorded community disturbances or events of any kind is comparatively small – the management and logistics skills required to manage the communities aloft as well as the supporting infrastructure and associated communities on the ground (passengers awaiting departure or dispersal; relatives, colleagues and friends circulating at airports; airport staff; security staff and ancillary staff such as in-out transport operators) is immense† (Google Answers 2005). It is also suggested that this group’s perception, correct or otherwise, that flight is ‘safe’ is a prime driver of the future viability of the airline transport industry‡ (ASN 2005) and this is likely to apply to the commercial viability of future space tourism flights and, eventually, to communities in space, making this group and its characteristics even more influential. While this influence cannot be understated, and indeed is referred to later as a major commercial driver of communications delivery devices for the in-flight population, characterization of this group is largely outside the scope of this article. Thus current study aims to draw together the first ‘astronauts as audiences’ data, which specifically refers to astronauts, and examine it, as suggested by McKay *et al.* (above), through the lenses of psychology, anthropology, media and communication studies.

Scope

The scope of this article is to theorize about the nature of anticipated space communities and their related groups from anthropological, psychological, media and communications

† The annual passenger throughput of the biggest alone was more than 83 million in 2004 (see Appendix 1).

‡ The Aviation Safety Network (2005 n.p.) notes that ‘Before booking a flight, a lot of people want to know if the airline they are going to fly with is a safe one’.

perspectives, to identify individual and group characteristics that are likely to enhance the space community environment, and to begin to identify likely media products, which might serve those communities.

Method

The method employed involves first a presentation of multi-disciplinary literature reviews derived from readings of the first *Astronauts as Audiences* data (Cokley *et al.* 2005). These are followed by a general discussion of the processes and drivers of colonization, communities and how individuals and groups within them communicate, and some communications channels.

Anthropological studies

From the data available (Cokley *et al.* 2005), the ‘community’ of space travellers up to the present has consisted of highly educated specialists. It is worth considering whether or not this model will survive into the future. Up to the present space travellers might be characterized as a rarefied scientific community, together for the specific purpose of pursuing human endeavour in space. Since more than a third of the astronauts have obtained their degree from US military, naval or air force academies (Cokley *et al.* 2005), it can be presumed that among the community there is a sense of militaristic ideology. The whole focus of the community, in its infancy, is *work*. The people who go into space are likely to, together, make up a decidedly focused and career (mainly science) driven population.

It is pertinent to think about the gender dynamics of the space community. Thus far, a little less than 13 per cent of general astronauts have been women (Cokley *et al.* 2005). That so few astronauts have been women is highly significant to the character of future communities in space. This leads to the question, ‘is space a space that is constructed as masculine space?’ Frontiers have a strongly masculine character. Moreover, space is a context that is contained by space (the shape of the station or vessel) and time (the period spent away from Earth). But it is also contained by the notion of space as a ‘final frontier’ (to quote from *Star Trek*), and as a frontier, a masculine space where women are interlopers (see, for example, Bloom 1993).

In order to think about the gendered nature of these space communities, it has been useful to consider two comparable contexts that have been studied by anthropologists and cultural researchers. One of these is the military and the other Antarctica. The different research stations in Antarctica are significant scientific and technical communities, isolated from wider society and home by distance and extreme conditions. The military, or more specifically (in the example below), the armed forces, represents isolated specialist units who are expected to be cooperative with each other and the common purpose. Both contexts are dominated by males.

According to Burns (2000), Antarctica ‘has been constructed in literature, art and myth as a place for men, and in the eyes of many men, even today, women should not be

there’. It was found that at the US base in Antarctica, which has the highest proportion of women of any of the Antarctic bases, ‘gender imbalance was a salient aspect of the women’s experiences’ (Weinstock in Burns 2000). This imbalance was a distinctive feature of women’s work time while in Antarctica, and Burns found that sexual harassment was ‘directly mentioned, alluded to, or implied’ in many of the stories she collected from women who worked there (Burns 2000).

Things that Burns found were emphasized about Antarctica (see also Edwards & Graham 1994) can similarly be found in the discourse of other military contexts and frontier works. For example, the armed forces, especially high risk and specialist units, are characterized as situations that are singularly and uncompromisingly male (Simons 2001). The nature of the work is dangerous men’s work, and in this context there is the need for ‘unwavering mutual trust’, a trust that men do not have in their female counterparts (Simons 2001).

Perhaps less specialist and more comparable to the situation in space is Burke’s (2004) study on the ‘cult of masculinity’ found in the military, a study based on her years as a lecturer at a naval academy in Maryland. Burke found that there was a complicated range of misogyny at all levels of the military, and the rigid and masculine hierarchy of the military worked strongly against women’s advancement in this area.

In space, the ‘community’ is not only bounded by the vessel, or the built environment, but also by the largely military-controlled context of space research, space flight and so on. A consideration of the ‘rigid masculine hierarchies’ of naval academies that Burke (2004) has reported on is thus significant in any study of the everyday experiences of individuals and of human relations in these projected ‘communities’.

Psychological studies

The psychological implications for astronauts of long term space travel or isolated space communities are only just being unravelled. Some experience is already available from longer-term space station sojourns but has also been imputed from analogues such as isolated science or military communities (e.g. submariners, polar scientists; Stuster 1998; Thomas *et al.* 2003). Largely these observations are related to the inevitable consequences of small groups in minimal space with little recreation opportunity and isolation from friends, family or other social contact. Issues fall into the social, organizational and psychological domains.

The space community, whether short term or longer term, is a *bounded behavioural system* and the implications for astronauts are immense. Interpersonal stress and aspects of communication can be factors that determine the success or failure of a mission. As time spent in space increases, the quality of life of individual astronauts and the group as a whole must also be considered (Bluth in NASA, n.d.).

The nature of ‘work’ in space is also likely to change along with greater divisions of labour and more diverse types of

space personnel, and an Earth bound societal shift to consider space travel and time spent in space as more 'normal' and routine. Consequently, astronauts will not receive the same social endorsement and reinforcement from media coverage that they have in the past (Cheston in NASA, n.d.).

Changes in the way that space programmes operate such as increased numbers of personnel, the inclusion of women, longer duration missions and the potential addition of orbiting space centres will influence the social and behavioural planning for such activities. A focus on social, behavioural, organizational and environmental factors can enhance the quality and quantity of a mission's outcomes and potentially prevent disasters resulting from human error or interpersonal stress (Cheston in NASA, n.d.).

A key question to consider is 'what level of adaptation is needed for humans to travel and live in the cosmos?' (Arnould 2001). Both pilots (i.e. personnel trained to operate space vehicles) and payload specialists (i.e. scientists and technicians responsible for operating on-board equipment) undergo basic medical and psychiatric assessments where the focus is to determine the presence of any clinical or sub-clinical personality disorders, assess the capacity of the individual to function as a productive member of the group in their assigned role and to identify individuals who are likely to perform effectively under high-stress (Cheston in NASA, n.d.). While these are fairly basic selection or exclusion criteria the expansion in demands for longer term or permanent space residence will drive an expansion in minimum personality, motivational and performance requirements for potential space candidates. Whilst all crew are exposed to careful psychological screening, and consideration is given to team composition, these have not proved sufficient countermeasures to address some of the consequences of the space flight environment. More consideration is required of the benefits of psychosocial and team training for long duration flights and missions (Kass & Kass 1999).

The concept of adaptive competence will become more important in the selection and recruitment of space personnel, identifying individuals who have the capacity to respond and adjust to new environments, whilst remaining effective in performance and recognizing the importance of their own psychological growth. Social adaptation skills are an element of adaptive competence and an individual's intrinsic skill may be subject to enhancement through social adaptation training. The focus of social adaptation training is in three areas: social sensitivity, communication skills and group performance. Group performance, which includes individual skills, such as leadership and facilitating compromise, may be more critical for longer-term space residence.

Al Holland, chief of psychology in NASA's Medical Operations Branch, suggests (in Freiberg 1998) that 'we tend to focus too much on the individual level and too little on the organizational level'. There is not enough focus on 'selection for teams' (Dion 2004). Astronauts must interact not just within their own space resident organizational group but also

between themselves and Earth. Holland (in Freiberg 1998) states that 'actions taken by ground control and management affect the mental health and well-being as much as, or more than, the individual's psychological makeup or the space environment'.

However, criteria for crew selection have not solved the problems encountered in space flight, such as cramped conditions, isolation, work stress, fear and incompatibility with other crew members. Incompatibility and interpersonal stress have been detrimental at both the psychological and physiological levels, and have been a threat to the operational success and the safety of missions (Kass *et al.* 1995). This is in contrast to previous perceptions that psychological problems during space missions would be a 'non-issue' if individuals with the 'right-stuff' were selected (Suedfeld 2005). Holland has proposed a novel solution to crew incompatibility, which is to train all selected members of the prime crew and back-up crew together and to allow the combined group to peer select the final prime crew (Freiberg 1998). However, once selected, it would be the responsibility of the crew to monitor and take the actions necessary to maintain the health and well-being of both the individuals and the group without direct assistance from specialists. Such responsibility necessitates the development of tools and measures to assess aspects such as cognitive function and sleep quality during a mission but also the suitability of individuals and teams for long-duration missions and the development of models of adaptation to isolated and confined environments to frame recruitment whilst still on Earth (Eksuzian 1999).

Psychosocial factors that have already been identified as likely to have a negative impact on crew morale and performance include: differences due to gender, culture, work experience and motivation, communication issues due to language and dialect variations and task versus supportive leadership roles. The range of negative consequences highlights the difficulties that astronauts may encounter during long-duration space missions, these include: subgrouping and scapegoating (e.g. due to gender, cultural differences), miscommunication, role confusion and competition (Kanas 1998).

Simulations of longer-term space missions have identified that the crew have fewer problems with isolation but are more concerned with recreational activities, family and work. Individually, reactions to stress included projecting problems on to other crew members (Rosnet *et al.* 1998). A temporal pattern of interpersonal tension has been established in space simulations, suggesting that interpersonal tension increases at the beginning, in the middle and toward the end of a long simulation (i.e. 135 d). However the character of the tension varies over the period, from competition for leadership at the beginning, decreased cohesion and aggression toward mission control in the middle phase and open conflicts towards the end of a confinement. An increase in negative emotional expressions was observed in the latter half of the simulation period, consistent with the increase in conflict (Sandal 2001). There are implications for socio-behavioural planning for real space missions from such analogues.

Indeed these findings have been replicated in in-flight studies conducted during the Shuttle/Mir programme. The study evaluated in-group and out-group displacement of negative emotions, changes in tension, cohesion and leader support over the period of the mission and cultural differences. There was a waterfall effect of the displacement of negative emotions from the crew to mission control to management, which was associated with a difference in levels of tension and dysphoria between crew and mission control. Mission control personnel were more tense than crew members (Kanas *et al.* 2001)!

It would appear that certain personality characteristics immunize individuals from the high stress extreme environment of space travel and long duration missions; these include strong achievement motivation and interpersonal sensitivity. Individuals who possess these characteristics appear to cope and adapt better than others (Sandal 1998). Such characteristics are consistent with the concept of 'emotional intelligence'. There may also be a gender difference in the availability of such interpersonal resources, as one study of Antarctic expedition teams demonstrated the importance of emotional support and help to other team members, which were provided predominantly by the female members of expedition teams. Such support was less evident in all-male groups (Leon & Sandal 2003).

Future research, selection, training and implementation of socio-behavioural programmes for potential astronauts must focus on adaptive social competence and team compatibility to address the issues contingent in the microworld of long duration space travel.

Communications studies

Space communities of the future are likely to follow some of the most basic simple communications rules recognized by theorists (McQuail 2005): that human communication takes place in time and it matters when it occurs and how long it takes; that communication is produced in a given location and reflects features of that context; that power and social relationships are invariable components of communication, and communications are a frequent means of the exercise of power, whether effectively or not; that communications media provide occasions, links, channels, arenas and platforms for information and ideas such as 'social reality' to circulate, and by way of media, meanings are formed and social and cultural forces operate; and that concepts such as 'identity' and 'cultural difference' are formed, maintained and sometimes destroyed by communications media and the messages they relay. Social issues that relate to media communications include relations with politics and the state, cultural issues, social concerns, normative questions such as freedom of speech and expression and the formation and change of public opinion (McQuail 2005). Levinson (2003) argues that walking and talking – communications and transportation – go hand in hand. So it is natural that travelling to space will raise the question: how will human beings communicate from, and within, space? He also raises a

question more pertinent to journalism and news communication.

'If you want something genuinely new, the only way to go is up. And what will we find there? Increases in scientific knowledge, access to vast resources, opportunities for adventure ...' (Levinson 2003).

and on an even higher plane:

'If our deepest need to get beyond this planet is spiritual – to learn a little more about who we are in this Universe – then we would do well to enlist religion as a springboard to space. We have seen, in the terror of September 11 and its aftermath, the awful destruction that religious belief can motivate. Can it help fuel the reverse – the lifting of our species off this planet?' (Levinson 2003).

Some of the media issues raised by Andrejevic (2004) display an analogy with the anticipated characteristics of space communities. He writes principally of reality TV shows and the essentially mundane nature of webcam internet sites such as Jennicam (2004), DotComGuy (2004) and the Cambridge University coffeecam (2004):

Webcams that allow visitors to watch the corn grow in an Iowa cornfield, monitor the exploited life of a hamster in his cage, and follow the lifecycle of an ant colony ... (the) sheer fascination with the ability to peer into the mundane existence of strangers ... it is the very banality of what is being watched that underwrites its reality: the coffee machine is not a contrivance to entice viewers and sell advertising. In all of its triviality, sitting there, slowly filling up, it is palpably, dreadfully 'real'.

Andrejevic (2004) suggests the 'cameras appeal to a drive for transparency: the desire to see, thanks to technology, what would otherwise remain hidden from view'. In the context of the present research, it is further suggested that the experience of watching the 24/7 lives of astronauts, to which Earthbound citizens have become accustomed, shares some essential features of the *Big Brother* house, the cornfield and the hamster in a cage: it is there, so we watch. From the viewpoint of the astronauts who are already actors in this extraterrestrial reality TV show, there is a further aspect that will become important as space colonies expand their populations and available technologies: interactivity. As Andrejevic (2004) notes: interactivity provides an environment 'in which the TV we watch will watch us back, ostensibly for our own good'.

General processes of colonization

Colonization has tended to have one of four drivers: the state, commerce, a (hybrid) state–commercial partnership or refugee groups seeking out new lands away from socio-political contexts that they deemed to be unacceptable.

Examples of the state-driven approach have been:

- France and England's penal colonies in South America, the Pacific and Australia;

- Russia's colonization of Siberia (under both the Tsar and the Soviets);
 - China's (contemporary) colonization of its interior provinces;
 - Indonesia's (contemporary) Javanese colonization of its outer islands;
 - Austrian and Ottoman military colonization of their Balkan frontiers; and
 - Portugal's African colonies.
- Examples of the commercial model have been:
- Holland's establishment of commercial entrepôts in Asia and North America;
 - the early English penetration of the Indian sub-continent;
 - England's (slave-driven) plantation colonies of the Caribbean and southern USA;
 - England's indentured-labour colonies in Fiji, Queensland, Malaysia and Natal (South Africa); and
 - France's colonization of Canada.

Examples of hybrid state-commercial partnerships have been:

- Spain's American empire;
- Britain's 19th century occupation of the Indian sub-continent, Southern Africa and Kenya; and
- France's occupation of Indo-China, Algeria and the Ivory Coast.

Examples of refugee groups seeking out new lands away from the socio-political contexts they deemed to be unacceptable have been:

- the Puritan settlement of New England;
- the Jewish settlement of the Russian Pale;
- the Jewish settlement of Israel;
- the Mormon settlement of Utah;
- the Sotho settlement of Lesotho and western-Zambia;
- the Matabele settlement of western-Zimbabwe; and
- the Afrikaner settlement of South Africa's interior.

The above give us some hints as to the sort of drivers we might expect for space exploration and colonization, although, at present two models seem to be predominating in the arena of space exploration, namely: the state-driven model and the commercial model. These two state-driven models were evident in the Cold War 'space race' when the United States and Soviet Union squared off against each other in a government-driven race to orbit the Earth and eventually land on the Moon. Since the first Earth orbiter, Sputnik, was launched in 1957, those two countries have been joined by China, Japan and the European Space Agency consortium of smaller nations. On the other hand, the commercial model is evident in Richard Branson's 'Virgin Galactic' company, which promises to begin private space flights in 2008 (Virgin Galactic 2005):

'We are now starting to take reservations and deposit commitments for the first year of operations. The ticket price has been set at US\$200000 and the minimum, fully refundable deposit to secure your spaceship seat is US\$20000.'

The state-driven model was validated by means of a promotion of Cold War rhetoric: i.e. (on the US side)

'the Russians are coming', or (on the Soviet side) 'The Americans are coming'. This propaganda approach is once again becoming evident as the US builds competition with Russia, China, North Korea, and to some degree, Japan. The militarization of space has benefited from this process, with public-private partnerships producing spy satellites, rockets capable of carrying and delivering the payloads of large weapons, and anti-missile defence systems. The US propaganda process has also adopted a complementary 'public good' model, reflecting the US culture of the 'Old West' pioneering theme, and the possibility of developing new international partners for ventures such as the International Space Station.

The commercial model validates itself in different ways – namely profit. It is recognized, as Levinson notes (2003) that 'outer space as a sightseeing industry ... would have to start very slowly and carefully. For a long time it would no doubt be a plaything of the very rich'; and again:

'The next stage of the commercial model is likely to be exploitation of minerals on the moon. The analogies to equivalent (mining) successes on Earth in the past are, however, stretched because the Californian, Yukon, Australian and South African gold rushes featured easy access to food and water, and free oxygen everywhere.'

In space the logistics will be more complex and hence more expensive – probably necessitating a mix of state and commercial resources to make such ventures possible.

Communities and communication

One kind of community that might be analogous to the first space communities (based on Cokley *et al.* 2005) is that of the 19th and 20th Century mining town, best known in the remote regions of north America, southern Africa, east Asia and Australia. The image of a mining town also includes more modern oil rigs and remote exploration bases such as those in Antarctica. The link between research on polar explorers and space communities is supported by Harrison *et al.* (1991) and Dudley-Rowley *et al.* (2001), who based their long study on polar and space expeditions. Groups found on island resorts and cruise ships share some of the same characteristics, and Blainey (2003) suggests that this type of remote community has been in existence for more than 150 years:

'The ship (the *Great Britain* in 1862) had called at no port and (encountered) only a couple of vessels but gleaned from them no news. Such a ship was like a modern space capsule, but totally out of touch with outside society. The news of importance came from within the capsule itself – from the whims, friendships and jealousies of the people thrown into each other's company.'

Under these conditions forms of communicative interaction arise. Space travel would also produce communicative interaction in confined pressure-cooker type situations. Work

would need to be done to try and lessen the potential for conflict and dysfunction in these contexts.

Once space colonists reach their destinations new forms of communicative interaction will arise. In these new contexts communication is certain to be institutionalized, and new media will emerge as vehicles for space settler communication. Some examples of immigrant behaviour are relevant to understanding what sort of media is likely to emerge. A three-staged progression is likely to follow if past migration experiences are anything to go by.

Stage one occurs when new settlers occupy a foreign site and crave 'news from home'. This period involves the new settlers concentrating their communications efforts on receiving news and information as quickly and efficiently as possible from their (now remote) homeland. It also involves community members creating and circulating a category of story, or 'news' that acts to justify their decision to move away from home into the newly-settled site, characterized as the 'land of opportunity'. These stories typically focus on settler success stories, with the message that 'moving to the new site was a good idea because: (1) it's better here or (2) it was bad at home'.

Stage two occurs when the first generation of locally-born colonists begins to see itself as rooted in the new place. The need to validate colonization is lessened in this period and community members begin to more deliberately mix local news with news from 'the old country'.

Stage three occurs when community members lose interest in news from 'the old country' because they no longer consider it to be 'home'. At this stage they seek news from their own local context and from other similar settler-communities.

Governments and funding agencies that establish space communities – and these already exist in microcosm on the International Space Station – would be well advised to consider the rationale and aims for these communities, and put in place policies that can demonstrate having learned from the historical models described above.

Some communications media

The first colonists will come from a certain 'type' of community on Earth, and might tend to take characteristics of those communities into space with them: trust/mistrust; religiosity or the absence thereof; openness/closedness; and their various interests (rural, urban, etc.). They might also choose to select, publish and distribute among themselves items of 'news' (perhaps even a 'newspaper') that would reflect all their interests and community backgrounds at any given time. If members of these space communities are sociologically similar to members of previous Antarctic study populations (Cokley 2003), or populations elsewhere, then they would probably prefer a recognizable 'newspaper' to read for relaxation and convenience (in the lavatory, for instance). Bentley (1998) suggests that this has a measurable and positive 'community capacity building' effect, and Maddox (1972) notes that 'the urge to turn back, to

re-read ... and to browse is unlikely to atrophy in anyone now literate ... A good while will pass before people give up the reassurance of print and come to accept an electronically verified facsimile signature to be as reliable as one written in ink'.

Levinson (2003) notes that human assessments of life in space are more meaningful than data relayed by robots. It is suggested that news of discoveries relayed back to Earth will be transmitted by some means of technology that will also transmit information and news back from Earth to the outpost: 'We go into space to see not only what's out there, but back here' (Levinson 2003). He also suggests that 'scientists – and journalists – in space can tell us more about Earth than we can tell from the surface'. The NASA Mission to Planet Earth programme established in the 1990s supports this position.

Location in space or in stratospheric airliners might seem to preclude this but the latest research by staff at the Palo Alto Research Centre, established by the Xerox Corporation in the United States (2004), shows the reverse is true. Researchers there have invented 'Gyricon', which they describe as 'electronic reusable paper', tiny beads embedded between two layers of plastic, thin and flexible, which could be 'bound into a book' (Palo Alto Research Centre 2004). If it can be bound into a book, it can be formed into the shape of a newspaper. Content 'such as text and pictures' (Palo Alto Research Centre 2004) is displayed on this thin plastic material by the application of a voltage, typically using a hand-held wand or something resembling today's fax or scanner: 'With the appropriate electronics stored in the spine of the book, pages could be updated at will to display different content' (Palo Alto 2004). Others are also working towards the commercial development of electronic paper, including researchers at the Massachusetts Institute of Technology (Jacobson 2004) and Kent Displays and Cambridge Display Technology in the UK (ScienCentral 2004).

Commercial airlines have now adopted applications in the Ku microwave band, fed by satellites, which allow passengers paid access to email, live television and in-flight worldwide web browsing (Croft 2001). Boeing's 'Connexion' system, featuring 'electronically steered transmitting and receiving antennas' and a data rate of 1 Mbps, and the rival 'Tenzing' system – using L-band onboard phone and radio systems – were released for public use in 2004 (Dudley 2004). 'Boeing hopes to turn the in-flight internet market into a US\$50 billion-a-year business by 2010,' writes Croft (2001). Mackenzie (2005) notes that 'chatting on a mobile phone, surfing the net from a laptop and watching video-on-demand will soon become part of the standard flying experience'. While the news and media needs of remote audiences are often solved using distributed electronic networks, Caldwell & Taha (1993) remind us that computer-mediated communications systems can benefit members of small groups in increasing the amount of communication and reducing social isolation, but only when the computer-mediation satisfies the needs of the group and involves group processes.

Table 1. *A planning schedule for news and communications media for space communities*

Reason to travel into space	Media needed to motivate this type of person	Media needed in the new colony in the short term	Media needed in the new colony in the longer term
(1) Profit and/or exploiting the resources of distant places.	News and advertisements of opportunities: news of engineering developments.	These people will expect a full range of entertaining and informative media. Initially interested in news and entertainment 'from home'. Likely to lead to a commercial media sector in new colony.	Eventually local news and entertainment will become more important than 'old country' sources; hence a local media will evolve.
(2) Tourism.	Advertisements; editorial reports: 'travel journalism'.	Means for tourists to send accounts of their experiences home: voice and message capacities.	Means for tourists to send accounts of their experiences home: voice and message capacities.
(3) Career (e.g. scientists or military, or employees of the colonizing agency).	Job advertisements.	US armed forces radio- and television-type services (i.e. employing organization run media).	Many careerists will 'return home'. The rest will join settler societies and so use local media.
(4) Explorer/thrill-seeker.	Editorial reports: 'travel journalism'; accounts from adventurers.	Means for explorers to send accounts of their experiences and discoveries home: voice and message capacities.	Means for explorers to send accounts of their experiences and discoveries home: voice and message capacities.
(5) Refugee or ideologically-driven.	In-house media to recruit and mobilize 'in-group' and encourage them to join the 'move' by justifying the reasons for moving.	In-house ideological media to keep in-group motivated and focused on the colonial enterprise and news of the 'old country' (bad situation).	Eventually local news and entertainment will become more important than 'old country' news, and a local media will evolve to service the new community.
(6) Compelled (prisoners or slaves).	No media required for those being compelled. But media probably needed to justify this compulsion to others.	As prisoners they will take what they are given (i.e. probably the media being used by their guards).	They will probably evolve into a normal community with its own local media.

For space travellers, NASA itself maintains a communication network that allows crew members on the International Space Station (ISS) and the Space Shuttle fleet to keep in touch with Earth news using digital means including the internet. Van Twest (personal communication 2002) notes that by 2002, crew on the International Space Station did not have 'internet connectivity but do have email: however it is sent up and down two to three times a day in batches so there are delays'. Van Twest also notes (2002) that full internet capability is one of the items in NASA's operational concept for the space station, using a local area network (LAN) on board 'so that scientists can freely interact and research questions'. Astronauts travelling on the various space shuttles also had email capability by 2002 (Van Twest 2002) but it was limited to individuals whom the crew designated before lift-off: 'it's not used for official communications but for simple "how goes it?" notes, and personal communication with family and friends'. She notes (2002) that there was no real-time web browsing in 2002, astronauts could only view web pages that had been 'up-linked', and these uplink transmissions happened only twice a day and the pages were generally limited to 'PAO (public-affairs office) generated events etc.'. Those in space 'communities' may not have access to a wide range of media sources, nor much of a choice about media content, rather this is likely to be directed

and delimited by the state, the military or the corporation who fund and run the vessel. Nonetheless, with the kinds of technology projected as available in the near future to contemporary airline travellers, and NASA's development of greater capacity of LANs and email, it is possible that individuals will be able to reroute the official media sources, perhaps produce their own media or future versions of the web 'blog'.

Discussion

The 'bounded' nature of the space community environment is one of the most significant aspects to emerge from this research, along with the 'remoteness' – the time and effort required to travel between Earth and 'there'. Together they describe a place (or places) that confines its inhabitants and that is extremely remote from their otherwise 'normal' residence: a confined environment on the frontier of human existence. That frontier environment is not only confined and remote; it is embedded in an extremely hostile wilderness, the vacuum of outer space. This *confined*, *remote* and inherently *dangerous* environment is likely to combine with the *masculine*, *militaristic*, highly *work-focused* and *career-driven* populations identified as forming the first space communities with intense results, since the literature signals

a difference in perceived trust levels between the sexes in comparable social contexts.

However, our research also signals that the precise qualities that are most required for community viability in the confined, remote and dangerous environment of space are, at least notionally, recognizably feminine: adaptive competence, social sensitivity, emotional intelligence and perceptiveness. History informs us that women, most generally, have provided these emotional support ingredients for other remote groups of explorers and are likely to be called upon again in space.

In the absence of a dominant or even effective female presence in space communities, based on the existing data and trends discussed in Cokley *et al.* (2005) our research suggests that the replacement ingredient in the formation of viable communities will be constant, personal and non-operational 'news from home', since for many of those men and women aloft, 'staying in touch' with their partners, families and Earthbound colleagues is likely to alleviate the negative social consequences of this rarefied context. Similarly, the kinds of communication media that we have projected as available to, or developed by the individuals in these future space communities (such as web blogs and inter-space station or vessel community email/other electronic networks) may well be used by men and women to deal with this recognizable (yet novel) environment in novel ways.

Our research further indicates that relatively precise customization of media to reflect the stage of colonization is not only possible, it is highly recommended. Such customization would ideally take the form presented in Table 1 (above), so that the media and communications needs of the various populations, and kinds of populations, would be planned and addressed in advance, rather than in the *ad hoc* manner that history demonstrates.

Conclusions

Policy direction provided by governments and funding providers is crucial to the survival and viability of communities in space and such policy is often, if not always, driven by public opinion. The public's perception of communities aloft is dependent on the mediated communications that reach its members: from space, from space agencies and from Earth-based news media. These public perceptions have an identified feedback loop into the political sphere, where future policy and funding decisions are made. In that sense, policy that recognizes the importance of the proper formation for space communities, and of those communities staying in touch with Earth, is likely to be the most successful in the colonization of space.

The research presented in this article suggests to policy-makers that astronaut selection from now on should concentrate on enhancing the feminine characteristics described in this article, while minimizing the dominant masculine features of existing space communities.

They should also ensure that the managers and space designers who implement their policies physically build into

the space environment and everyday routine a specific capacity for astronauts and their Earthbound associated communities – families, friends, political and commercial institutions, cities and organization – to remain in the close, personal and interactive contact which this research recommends. In short, news and communications channels ought to be established as part of the astronauts' environment, not as last-minute add-ons. A template for that communications capacity is included in this article.

Finally, it is suggested that a communications policy should be developed specifically to enhance the implementation of these policies, to ensure timely and well-communicated actioning of policy initiatives into 'real life'.

Appendix

A 10% selection of the 100 biggest airports in the world ranked by the number of passengers in 2004, prepared by a staffer for Google Answers (<http://answers.google.com/answers/threadview?id=563670>, based on http://www.forbes.com/2005/08/23/air-travel-airports-lifestyle-cx_sb_airportland.html).

- 1 - Hartsfield-Jackson Atlanta International Airport (ATL) ... 83 606 583
- 10 - Denver International Airport (DEN) ... 42 393 766
- 20 - Beijing Capital International Airport (PEK) ... 34 883 190
- 30 - Philadelphia International Airport (PHL) ... 28 507 420
- 40 - Paris Orly Airport (ORY) ... 24 032 000
- 50 - Fort Lauderdale/Hollywood International Airport (FLL) ... 20 819 292
- 60 - Fukuoka Airport (FUK) ... 18 526 000
- 70 - Ronald Reagan Washington National Airport (DCA) ... 15 932 000
- 80 - São Paulo Guarulhos International Airport (GRU) ... 13 728 000
- 90 - Sacramento International Airport (SMF) ... 9 581 000
- 100 - Southwest Florida International Airport (RSW) ... 6 737 000

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