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# The Extraterrestrial Chorus: How and Why Choral Music is Important to Space Exploration and Colonization

(Part I of the Choral Ark)

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by

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# The Extraterrestrial Chorus:

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Colonization

Part I of the Choral Ark

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## **I. Introduction**

As we move into the twenty-first century, it is the universe, not just the world, which has become smaller. Overcoming the technical challenges of space travel, a feat once seemingly impossible, has become a regular occurrence. Similarly, the colonization of other planets, while not yet accomplished, seems to have become a technological possibility. The physical means of space travel has been the focus of scientific inquiry and technological development in the field of space exploration; but now, as a result of our progress, the psychological, societal, and cultural impact of both future travel into space and eventual population of other planets has become a more significant and immediate concern.

Space is a strange and unfamiliar environment for human beings. The longest consecutive period ever spent in space was 438 days; this record was set by Valeri Polyakov from January, 1994, to March, 1995, on the Russian Soyuz TM-18 mission to the Mir space station. Attempts to colonize foreign planets, as well as any undertakings of long-range space flight, will necessitate that astronauts spend periods far longer than this away from Earth. The record for the farthest distance that humans have ever been from the Earth was set in 1970 by the Apollo 13 crew while passing over the far side of the moon, a distance of 400,171 kilometers. By contrast, the distance from Mars to Earth ranges between 55,700,000 kilometers and 401,300,000 kilometers, or some 139 to 1,000 times that distance. The precise effects of such an enormous space voyage are not known, but we know of a host of documented physical and psychological changes experienced by astronauts on both short- and long-term missions, a number of them

negative. Weightlessness and an alien social environment are among primary causes of these adverse effects.

Another question that must be asked is: once we reach a new planet, how will our lives continue there? Will a potential loss of traditions, mores, and norms lead to cultural and societal degradation? Will the longing for home and familiar social structure become so intense as to compromise the space mission? These are just a few of the many problems that may arise.

In this project, we attempt to explain how choral music, and music in general, could be a primary tool towards solving these problems. Historically, singing has been an integral part of culture and community, and its contributions to physical and psychological health are acknowledged by leading health professionals. Choral music, in the form of Gregorian chant, was the first notated music of Western Europe. Strong evidence suggests that choral music promotes a cooperative work ethic, the ability to listen and follow directions, creativity, social interaction, and discipline. Such a valuable asset to our society must not be discarded, and in fact, choral music and the practice of singing may be one of the keys to our mastery of space.

## **II. Space exploration and colonization as an inevitable future**

The concept of space exploration and colonization has been, since its inception, one espoused by great thinkers and scientists. Its place in popular culture has been sown by many years of intense, yet often fanciful, prediction. The body of theory resulting from these musings should be understood as the product of the same energy and methods

which have driven all of man's technological advances. As well, it is clear that it is a temptation of the scientific mind to consider the future with a near religious zeal and certainty, perhaps betraying the foundations of scientific practice in sake of humanitarianism. But the threats fueling this fire of thought are undeniably real.

The primary motivation towards expanding humanity into space is that Earth itself is doomed, and humanity would be wise to unbind its fate with that of Earth. The upper limit on the lifespan of Earth is dictated by the life of the Sun, which will one day become a Red Giant. Earth's sun is expected to become a red giant in about five billion years. It will become sufficiently large to engulf the current orbits of some of the solar system's inner planets, possibly including Earth's. However, the gravitational pull of the sun will have weakened due to its loss of mass, and so it is possible that Earth may escape to a wider orbit. Consequently, the fate of the Earth with regard to the expanding Sun is still hotly debated in the scientific community. Despite the debated chance that Earth could survive this transition, such an event would mark the beginning of the end of Earth's capacity for sustaining life on its surface. However, as this is currently expected to occur billions of years from now, most advocates of immediate space exploration and colonization cite it only as proof of eventual necessity.

John Richard Gott, III, a professor of astrophysics at Princeton University, is well known for developing and advocating cosmological theories for time travel and the Doomsday argument. Gott's Doomsday argument, published in the journal *Nature*, applies the Copernican principle to the lifetime of humanity and determines with 95% confidence that humanity will survive for another 5,100 to 7.1 million years. The Copernican principle states that no special observers should be proposed in scientific

inquiry. Gott's interpretation of this principle into an algorithm, called the Copernican method, allows one to estimate the probability that something will cease to exist in a certain amount of time. For example, when you encounter an object for the first time, provided that you are not a special observer knowing its age, construction, etc., there is a 75% chance that it is in the final 75% of its life. Gott has made a major effort defend his form of the Doomsday argument from a variety of philosophical attacks, but the debate is still ongoing. To popularize the Copernicus method, Gott gave the *New Yorker* magazine a 95% confidence interval for the closing time of forty-four Broadway and off-Broadway productions based only on their opening dates. He was more or less 95% correct. For this reason and others, Gott is a major proponent of space exploration and colonization.

Stephen J. Hawking, renowned physicist, academic celebrity, and Lucasian Professor of Mathematics at Cambridge University, has expressed deep concern at the peril man faces in the current era. He states, "In the long term, I am more worried about biology. Nuclear weapons need large facilities, but genetic engineering can be done in a small lab. You can't regulate every lab in the world. The danger is that either by accident or design, we create a virus that destroys us... I don't think the human race will survive the next thousand years, unless we spread into space. There are too many accidents that can befall life on a single planet. But I'm an optimist. We will reach out to the stars."

<sup>1</sup>Hawking's words add weight to the generalized threat of doomsday, putting forth a plausible cause and timeline. But more importantly, the emerging understanding that mankind might be in a very precarious place that could dictate the need for more immediate action.

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<sup>1</sup> Highfield, Roger: "Colonies in space may be only hope, says Hawking," *The Telegraph* (October 16, 2001). Available online at <http://www.telegraph.co.uk/news/main.jhtml?xml=/news/2001/10/16/nhawk16.xml>

This concept of the 'critical stage' of humanity is a focal point of Sylvia Engdahl's argument for the necessity of space exploration and colonization. Technology has developed to the extent which would permit interplanetary travel and colonization, but has not yet been utilized to do so. The other edge of technology's sword allows an ever smaller portion of the population to destroy the lives and habitat of an ever larger one. Without divine intervention, it seems inevitable that this immense destructive capability would find its way to actualization, through intent or accident. Moreover, the currently uneven global economic distribution is particularly suited to endeavors into space, as disproportionately wealthy nations could set aside the capital required for such a long-term investment as space exploration and colonization. Other resource concerns reinforce the 'critical stage' hypothesis: global population growth would, within a hundred years, need to be halted to maintain sustainability. Avenues opened by human presence in space could lead to reduced energy costs and an excess of valuable materials.

The current running underneath these arguments is the human spirit and drive. Among all these theories is an attempt to put to words an intuitive sense that space exploration and colonization is an (immediate) necessity. Although it would be strange for renowned scientists to rely upon a 'feeling', but it is apparent that such motivations must not be overlooked. Captivating and guiding public interest must be their true goal, as it is the only path to realizing these hopes and aspirations. An operation of this kind of magnitude needs a nation, or perhaps a world, of believers behind it. So, shaping and elaborating upon these reasons that have been put forth will do much to sway the scientific community, but society is unlikely to be moved by cold logic. Along these

lines, there are a number of social theories that see much benefit in space exploration and colonization as an ideal.

Sylvia Engdahl references a few of these theories in her essay *Space and Human Survival*, specifically noting that public admiration for Columbus and Lewis and Clark does not rest on, and perhaps is completely unrelated to, their utilitarian achievements of science. The concept of a 'frontier' is captivating and uniting, as it emphasizes the distinction of the known set apart from the unknown. If this frontier is extraterrestrial, then it serves as a force of global unity, even if the exploring is done by only a handful of nations. This does assume that this initiative remains relatively non-militarized and jointly operated. Arguably, militarization and competition could accelerate certain achievements and fight bloating bureaucratic impediments, but if there is any place for mankind to enter a more peaceful regime, space is it. Furthermore, she points out that Columbus' journey would never had occurred if not for the monarchial system of government and concentration of wealth, as the people would not conclude that money is better spent on sea vessels commissioned to fall off the earth than on food for the hungry, namely, themselves (as even the educated minority would certainly have agreed, despite knowing the voyage was not doomed). The critical understanding is that the benefits of exploration are always to some extent unseen. However, there are many clear benefits of space colonization and exploration; these diverse benefits should serve as a sign of the near limitless potential return for an investment.

At least one of these 'unforeseeable' profits of exploration has, in recent decades, become quite evident: new technologies are consistently being developed by NASA and other space organizations in order to overcome the myriad physical challenges of space



travel. There are countless examples of technologies now essential to modern life, which were originally developed for the purpose of space travel, most distinctively the computer. Satellites now cover the sky, transferring essential information at the speed of light, making possible a wide range of other technologies like the Global Positioning System. Less apparent, but perhaps more critical, are the advances in material science spurred by space travel. The material requirements for space travel are uniquely extreme, facing temperatures far above and below those known on the surface of the earth, demanding near perfect failure rates. The materials that must be developed to overcome these challenges are then as well unique and find essential usefulness in disparate and unrelated fields of science, medicine and industry.

As the aspirations of space travel expand to further exploration and colonization, these challenges grow exponentially, as the goal is always to travel farther and faster for a longer period of time, compounding difficulty. It is a driving force of technological innovation. Success and discovery will not just mark progress towards its own ends, but an expansion of the very fringe of science and what is known to be possible.

### **III. The interplay of music and culture**

Humanity's love affair with music extends back well into the annals of prehistory. French archeologists in the 1950s discovered a 3,400-year-old song, including both melody and harmony, written in Assyrian cuneiform on a clay tablet. Dr. Ivan Turk, a paleontologist at the Slovenian Academy of Sciences, also found an artifact between 40,000 and 80,000 years old which is strongly believed to be a flute made from the bone

of a cave bear by Neanderthal man which has holes spaced to create part of a diatonic scale. Bas-reliefs, paintings, statues, and other artistic relics depicting humans involved in the performance of music or dance also give us indications of musical development among early cultures.

One of the earliest periods in which we have at least a few writings to grant us a more thorough understanding of the state of music in the time is the Greco-Roman era. Ancient Greece in particular has left us with some very interesting knowledge. We know that the Greeks employed a few musical instruments similar to those used in modern times, such as the hydraulis, the predecessor to the organ; the kithara, a type of lyre and an ancestor of the modern guitar; and the aulos, a double-reeded flute. The Greeks made great contributions to music theory, giving us the Greek musical modes which became the basis for European classical and church music. Pythagoras, the famous philosopher and mathematician, also gave us a good deal of our understanding of harmonics and overtones. Choral music, too, was prevalent in Ancient Greece and was ubiquitous in religious ceremonies and celebrations as well as being produced for entertainment. The Greeks took music quite philosophically, and as the philosophers were also the educators, this led to Ancient Greece being the birthplace of music education, with music and music theory being taught to boys as young as six years of age.

Less is known about musical tradition in Ancient Rome, partly due to the fact that much of the traditional music of the time was later banned and destroyed by the Roman Catholic Church. We do know, however, that the Romans borrowed many of the musical practices of the Greeks, including most of their instruments. Rome also employed two simple brass instruments, one similar to a trumpet and another similar to a French horn.

In Rome, music education continued and musical performance was involved in military signaling, funerals, gladiatorial games, and religious ceremonies as well as large concerts and small performances for entertainment. Music competitions were also common and attracted many entrants, including Nero himself.

The history of music after the fall of the Roman Empire in 476 A.D. is much more thoroughly known. We immediately enter the period widely known as “early music,” which includes the Medieval and Renaissance musical periods. The Medieval period includes the earliest notated music of western Europe, and hence our western music tradition: Gregorian Chant. New musical practices were experimented with, notably polyphony, the simultaneous playing or singing of multiple melodic lines. Europe was very religious at this time, and wealthy churches and monasteries were among the few entities that could afford to produce or notate music. As a result, the majority of works that survive from this period are sacred in nature. Secular music found a bit of a niche in the form of wandering minstrels and troubadours, who made their living often with self-accompanied, simpler, poetic music.

The Renaissance period was characterized by the emergence of choral music as the most ubiquitous form of music in the period. Polyphony was more fully explored, and the madrigal form, a form of choral singing based on poetry, was developed. Most of the music of this time remained influenced by the ever-present religious element, with many of the great works being masses, motets, and other sacred music forms. The madrigal was an exception to this trend, with most music in that form being of a secular nature. Much as the Renaissance signaled a “rebirth” of art, literature, and philosophy, so too with music was the Renaissance a rebirth, laying the fundamentals for a much richer

and broader musical palette in terms of music theory as well as more widespread secular music.

Following this is the period of common practice, including many of the famous “classical music” periods including the Baroque, the Classical, and the Romantic periods. The Baroque period signified the implementation of more complex instrumental music, the beginning of operatic and oratorio forms, and the dominance of chords. Both accompanied and a capella choral music continued to flourish in this period, being bolstered by the invention of the cantata form. Music began to be produced with more intricately elaborated, in a style that was synchronous with the architectural and artistic zeitgeist. Emotion and dramatic tension were present in far greater degrees than in Renaissance music.

Choral music was not as prevalent in the Classical period, with many works of the time focusing on the symphony. Music tended to have a single clear melody with an accompaniment, a musical technique called homophony. This technique was the natural manifestation of Classicism, the pervading taste of the time in architecture, literature, and art, which lauded works which were formal but restrained, with a sleekness and elegance. Sonatas, symphonies, and concertos were all popular forms during this period. Similarly, more ordered and hierarchical music was created which embodied some of the scientific structural advancements of the period.

Romantic music carried many of the traditions of the classical period forward, but the music became more expressive, consistent with the simultaneous literary and artistic movements of the time. Instead of the more technical nature of Baroque music or the grand organization of Classical music, Romantic music focused on the depths of human

emotion. The concept of tonality was introduced, and music became more concerned with the texture or feel of sound. Operas became more popular, and choral music was featured prominently in many of these works. Composers also began to experiment with dissonance and chromaticism, creating music that was challenging and unorthodox. A new form of music that was also present in much of the same time period as the Romantic era was African-American spiritual music. This music, which originated with African slaves working on American plantations in the eighteenth and nineteenth centuries, was an expression of cultural identity. Slaves were often stripped of their humanity and culture, being forbidden to speak in their native languages or practice their own religions. One of their main responses to this cruel treatment was to affirm their culture through song, and these spirituals served many purposes to the slaves, offering everything from a soothing influence which helped keep morale up to veiled references to native culture and hints towards the Underground Railroad.

In the twentieth century, music became increasingly diverse, progressive, expressive, and personal. Formal music became yet more experimental, with many movements such as impressionism, minimalism, and atonalism. Technology, in the forms of radio/broadcast, amplification equipment, and recording media, gave rise to an entirely new phenomenon known as pop music. Pop music is music intended for mass consumption, usually simpler in structure and composition than formal musical works, and can be created by anyone, either with or without formal musical training. Pop music itself further diversified into everything from simple early-twentieth-century ballads and folk/world music to blues, jazz, swing, rock, country, heavy metal, and even electronic music. Some forms of music follow in the basic Western musical tradition, others

incorporate elements from many different musical traditions, and some music strives specifically to defy convention. Indeed, modern forms of music sometimes challenge the definition of music itself.

It is clear from the above brief summary of the development of Western musical tradition and its interplay with culture that in fact the two are inextricably linked: music is as vital and integral a part of Western culture as the liver is to the human body. While a survey of other musical traditions is outside the scope of this paper, it seems reasonable to extrapolate a similar relationship with other cultures and musical traditions, especially given the amalgamation of and blurring of divisions between musical traditions that can be found in the twentieth century.

While music does often express the cultural mores and tendencies of the time and place in which it is created, it is not a simple unidirectional relationship. Music has served as a primary means of exposure to art and culture throughout the ages, serving not only as a testament to various phases of the human condition in society, but also as a method by which the culture and attitudes of the era are encapsulated, spread, and passed on to future generations. In this sense, music provides an important link between a people and their culture and provides a channel for the free expression of ideas and emotions.

This valuable connection, however, depends upon the continued adaptation of music along with culture. Thus far in history, the two have seemingly remained in step. However, in order to remain culturally relevant, music depends on continuing participation, in the form of music education, composition, and performance. In the field of performance, singing especially stands out as it is the most natural and therefore

essential of instruments, and one with no additional equipment—the very same faculty that we use to express ourselves verbally also enables us to make music, and our innate skill with our voices compared with our lack of such natural talent with other instruments imbues singing with a greater power of emotional expression. Group singing, as noted above, has been in existence since at latest the Golden Age of Ancient Greece, thousands of years ago. In modern times, choral music is every bit as relevant as it was then, and is the top choice for participation in the performing arts among both adults and children in America.<sup>2</sup> It is vital that we preserve this participatory element that keeps music’s grand cycle of cultural communication, dissemination, blending, and emotional expression functional.

One of the most conclusive demonstrations of this relationship is easily seen by taking another look at history: in the late 1960s and early 1970s, rock’n’roll music was in its heyday. As a new and malleable form of music that could be produced much more quickly than a large classical work, rock’n’roll was incredibly adaptive to the cultural issues of the day. The music addressed a cultural loss of innocence, political ideals, anti-war sentiment, and many other such topics which were on the minds of a large portion of the public at the time. As a result, this music became anthemic and nearly sacrosanct to an entire generation and a subculture known as the “hippies.” Participation was high, with concerts and music festivals being popular. Woodstock is the most well-known example, with an attendance of approximately 450,000 Americans, with another 1.5 million that tried to attend but could not due to traffic congestion.<sup>3</sup> With an estimated

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<sup>2</sup> Chorus America, *America’s Performing Art: A Study of Choruses, Choral Singing, and Their Impact* (February, 2003). Available online at <<http://www.chorusamerica.org/>>

<sup>3</sup> Bennett, Andy: *Remembering Woodstock* (May 1, 2004): xiv.

total national population<sup>4</sup> in 1969 of 202,676,946, the number of people who attempted to or succeeded in attending Woodstock, a single musical event in a rural area of New York, amounts to nearly 1% of the entire national population. As a result, the festival was one of the most culturally influential events of the past century.

Unfortunately, it seems quite likely that we are on the brink of a possible change in this system. While it is too early for a definitive analysis, it is clear that our relationship with music is changing. Historically, involvement with music has meant participation in its creation or, at the least, attending a performance. In the modern day, however, music has become more convenient. Thanks to recording media, music can now be made into an easily acquirable collection: in the United States alone in 2005, retailers ordered approximately 1.3 billion units of music, including full albums, singles, and digital downloads, at an estimated value (based on list price) of over \$12 billion.<sup>5</sup> This figure does not include increasingly popular illegal internet-based music transfers. Whether the recording comes in the form of a compact disc, a DVD, an iPod full of thousands of songs, or assorted recordings on a computer, Americans have become hoarders of music.

Simultaneously, over the course of the past few decades music has increasingly become a commercial commodity, with increasingly consolidated control of broadcasting and recording means, and the emergence of new music and musical groups with sound or content engineered via market research to appeal to the demographics considered most

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<sup>4</sup> Population Estimates Program, Population Division, U.S. Census Bureau: "Historical National Population Estimates: July 1, 1900 to July 1, 1999" (revised June 28, 2000). Available online at <<http://www.census.gov/popest/archives/1990s/popclockest.txt>>

<sup>5</sup> Recording Industry Association of America, *2005 Year-End Statistics: U.S. Manufacturers' Unit Shipments and Retail Dollar Value* (2006). Available online at <<http://www.riaa.com/news/newsletter/pdf/2005yrEndStats.pdf>>



profitable, and extensive publicity campaigns to promote the group and thus increase revenue. There are thus two possible explanations: either our culture has become so fixated with money that this idea is being communicated through these new styles of music, or this trend is not mere coincidence, but evidence of an incipient shift of paradigm: instead of a sort of interactive artistry which promotes human expression, modern American culture may be starting to see music as a passive activity, to be collected and listened to at a later time for superficial “entertainment” value.

In the latter case, the continuation of this trend may lead to a decline in music participation, which due to the bidirectional link between music and culture would inevitably cause bland, irrelevant music and thus a loss of this great asset of expression and cultural development. Failure to keep the participatory element active in moving away from the planet would be even more catastrophic, as astronauts and possible future generations in colonies on other planets would not only lose one of the most important modes of cultural identity at a time when it is most needed due to separation from culture, but further that this exciting and important period in human history would not be fully embodied in music of its time and thus humanity would lose an important subjective record of the emotional and cultural issues that this period will indubitably entail.

#### **IV. Direct benefits of choral music**

The ability for humans to sing, the vocal production of musical tones, predates the development of spoken language. It is presumed to be the first instrument, and there has never been a culture of which singing was not a part. Ancient and universal, singing was

part of primitive culture in a way which was vital to the individual, social group, or religion. “Primitive man [sang] to invoke his gods with prayers and incantations, celebrate his rites of passage with chants and songs, and recount his history and heroics with ballads and epics. There are even cultures that regard singing as such an awesome act that they have creation myths relating that they were sung into existence.

It is likely the earliest singing was individualistic and improvisatory, a simple imitation of the sounds heard in nature. At what point the singing of meaningful, communicative sounds began cannot be established, but it was doubtless an important step in the creation of language. Many anthropologists believe the development of a lowered larynx (important to articulate speech, as it effectively makes the flexible lower tongue the front wall of the pharynx) was a relatively recent aspect of human evolution.”<sup>6</sup>

Despite its long history of importance, and perhaps because of the seemingly obvious nature of its benefits, singing and its effect of human physiology and psychology has only recently begun to be strictly researched. According to two exploratory studies by Clift and Hancox, the perceived benefits of singing fall into six distinct but related categories: benefits for well-being and relaxation, benefits for breathing and posture, social benefits, spiritual benefits, emotional benefits, and benefits for heart and immune system.<sup>7</sup>

Though several studies have sought out information on the perceived benefits of singing and singing within a group, there has been little research into verifiable medical benefits. A study by Kruetz et al. measured levels of cortisol (an indicator of stress) and

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<sup>6</sup> Koopman, Josh: “Antiquity to 1590,” (1999). Available online at <<http://www.lawrence.edu/fast/koopmajo/antiquity.html>>

<sup>7</sup> Clift SM, Hancox G.: “The perceived benefits of singing: findings from preliminary surveys of a university college choral society”, *Journal of the Royal Society of Health* (2001): Volume 121, Number 4, pp248-56.

immunoglobulin A (an endocrine defense against bacterial infection in the upper respiratory tract) before and after music performances and practice. There was a consistently elevated level of immunoglobulin A in both practice and performance groups, but the effects on cortisol were less regular, decreasing during practice sessions but not during performances.<sup>8</sup>

The perceived physical benefits of singing on breathing and posture, fighting muscle tension and even respiratory symptoms, have not been researched. A small study performed by Lucia found that asthmatic children who were wind instrumentalists had improved bronchoconstrictive symptoms, as well as positive changes in mood and decreased fatigue.<sup>9</sup> Similar physical benefits conferred by singing are believed to arise from the 'light gymnastic' nature of the activity, and the training and strengthening of muscle groups associated with breathing (specifically in the diaphragm and throat). Other proposed factors, such as the release of endorphins (that help to block pain) and increased oxygenation of the blood, arise from aerobic exercise.

So it seems that many of the benefits of singing could be gained from any number of other active practices or hobbies. However, the further effects of singing in a group and the particular nature of singing make it a particularly effective and convenient choice.

The issue of accessibility is one that has been addressed, as the most commonplace aversion to singing alone or in a chorus rises from a fear or belief of inadequacy. This phenomenon seems most prevalent in America and Europe, where extreme emphasis is placed on the quality, craftsmanship and professionalism of music

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<sup>8</sup>Kruetz, et al. : "Effects of Choir Singing or Listening on Secretory Immunoglobulin A, Cortisol, and Emotional State," *Journal of Behavioral Medicine* (2004): Vol. 27, No. 6.

<sup>9</sup> Lucia, R.: "Effects of playing a musical wind instrument in asthmatic teenagers," *Journal of Asthma* (1994): Vol. 31, No. 5, 375-85.

performance. These attributes are necessary to be a critic of popular music, where diversity is squelched by the industrial production process of the music business. By placing such importance on only the facets of music which can be wrought into profit, the ubiquitous nature of music has been obfuscated.

Marking clear this difference are the two studies “America’s Performance Art”<sup>10</sup> by the non-profit choral service organization Chorus America, and “Effects of Group Singing and Performance for Marginalized and Middle-Class Singers”<sup>11</sup> by Bailey and Davidson.

America’s Performance Art concentrated on questioning and polling established choral groups and participants, both professional and volunteer. As well, the choristers were inquired as to the perceived benefit of singing; there were no further examinations. Their findings agreed that early introduction is key to lifelong interest in choral music; furthermore, this early introduction sets the stage for a stronger social and personal experience with singing. Choral singers are more likely to be highly involved in their community, and are generally better informed than most Americans. Choral singing is the most popular public arts activity in America and has over 250,000 groups nationwide. Most importantly, choral singers reported overwhelmingly that participating in a chorus improves their lives and helps them contribute more to society. Additionally, Chorus America reports that actively participating in a chorus helps to build a variety of social and personal skills, and can help bridge the perceived divides between people due to differing culture and class.

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<sup>10</sup> *Op. cit.* 2.

<sup>11</sup> Bailey, Betty, and Davidson, Jane: “Effects of group singing and performance for marginalized and middle-class singers”, *Psychology of Music* (2005): Vol. 33, No. 3, 269-303.

The second study, “The Effects of Group Singing and Performance for Marginalized and Middle-Class Singers,” examined a group of experienced and inexperienced middle-class singers and attempts to contrast by examining a group of poverty stricken individuals, some with mental illness and some without shelter, who were participated in a chorus together under the premise of this study. The marginalized individuals found the act of singing to be cathartic and helpful in maintaining emotional balance. They reported a sensation of heightened arousal which seemed to relieve for a time the stress and harshness of a life of poverty, as well as being an event that was looked forward to by the participants. Additionally, some individuals found purpose in choral participation, and felt it was a motivating factor towards self improvement and accomplishment. The effects of singing as a group, not just the act of singing, had a much stronger impact on the lives of the marginalized individuals; the chorus provided a support structure and a sense of camaraderie, helping some participants to make changes to lifetime behaviors and habits. Some participants noticed a reduction in pain from chronic conditions, increased energy in other aspects of life, and an increase of life satisfaction. In the aspect of the interviews concerning choral performance to an audience, the marginalized individuals found a sense of pride, empowerment, and a bond with society at large.

Both choral groups expressed a perceived benefit from the cognitive stimulation associated with singing music, but the middle-class group saw it as merely an addendum to a much greater tome of knowledge, challenge, and achievement. For the marginalized individuals the processes involved with participating in a chorus helped in a fundamental way, reminding and encouraging concentration and an ordered though process.

The differences and similarities between the experiences described by the two choral groups illuminate the modes through which participation in choral music can potentially help a person. It seems many of its benefits, specifically those relating more directly to the act of singing, are passive and do not require a certain mindset. However, some of the psychological benefits towards emotional well being and feelings of normalcy would be impossible to note among those choral singers who lived relatively comfortable and stable lives. Dually, it is also certain that the poverty stricken, the depressed, and the schizophrenic, are most apt to be touched and changed positively by group involvement and attention by society because of the neglect it has historically offered them. For these individuals, choral music then is most profoundly important in that it is a group experience and accomplishment. And, given, there are countless other ways individuals could come together for an entirely different purpose and achieve the similar benefits. Nevertheless, music and choral music in general stands out as an activity particularly well suited to be done for the pure sake of a group activity. It is accessible to everyone with little training and infrastructure, and it requires honest interaction on level playing field. The latter, combined with the love and support garnered from the group and from the audience, is the best explanation of the phenomenon of intense and nearly immediate camaraderie.

Choral music has been shown to be beneficial as singing and as a group activity, but it is also beneficial as the unspecific practice of music. There is a wealth of research on the role of music in education, and its effects. Firstly, music is an essential component of culture, and as such familiarity with music is important to a person who wishes to be active in said culture. Its practice has been shown to correlate strongly to decreased

abrasion between society and the individual. Secondly, its practice in a school environment has been shown to teach students how to be better students: improved study habits and appropriate behavior conducive to group success. Thirdly, the study of music helps to develop several aspects of intelligence, specifically skills in mathematics, spatial understanding, and reasoning. Further, music requires parallel processing that trains multitasking and pattern recognition. Lastly, the education and practice of music can improve attention skills and uncover the ability to express and gain knowledge of oneself, and moreover a wisdom and understanding of life that leads to a lasting happiness.

## **V. Music as a possible solution to certain human challenges presented by space travel**

The current human space frontier is a manned mission to Mars. Such a trip would be a great deal shorter than any possible future interstellar travel or colonization, yet current estimates for the trip time for a group of six to seven astronauts (provided that the shuttle is launched at the appropriate time for optimum trajectory) call for 180 days of transit time each way, along with a 500-600 day surface stay.<sup>12</sup> This amounts to a minimum of 860 days, or approximate two and one-third years, in relative isolation. A trip to our nearest star is currently technically infeasible, with our fastest interplanetary spacecraft taking over 73,000 years to reach Proxima Centauri.<sup>13</sup> Even if future advances shrink that time by a factor of a thousand, the time required would be most of a human

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<sup>12</sup> Dr. David R. Williams, NASA Goddard Space Flight Center: "A Crewed Mission to Mars..." (accessed September 29, 2006). Available online at <<http://www.spds.nasa.gov/planetary/mars/marslaun.html>>

<sup>13</sup> Scott, Jeff: "Ask Us – Interstellar Spacecraft" (accessed September 29, 2006). Available online at <<http://www.aerospaceweb.org/question/spacecraft/q0225.shtml>>

being's natural life. Such amounts of time spent in isolated environments along with the other stresses of space and the limited access to medical care makes space travel "inherently hazardous" for humans, with a host of physiological and psychological risks to astronauts.<sup>14</sup>

While there has not been enough research to authoritatively state all of the risks to astronauts in space, data from previous space missions combined with what is known of the risks of long periods of isolation in high-stress environments, e.g. submarines, provide insight into some of the hazards that may be faced. Some of the physiological risks include ergonomic problems, orthostatic hypotension, changes in pulmonary circulation and gas exchange, altered sleep cycles, and immunological depression.<sup>15</sup>

Psychological stressors involved in extended-duration space travel (defined as longer than 100 days, between 10-12% of the estimated length of a trip to Mars) include isolation, confinement in cramped quarters for long periods of time with other astronauts, high noise levels, insufficient lighting, diminished privacy, boredom, fatigue, and stress. According to experts from the National Research Council and the Space Studies Board, "these and other psychological stresses could turn out to be the most worrisome risk of all to astronaut health."<sup>16</sup> These stresses are risk factors for several depressive syndromes, anxiety, irritability, and interpersonal dysfunction. These and other possible psychological issues "may exert cumulative detrimental effects... sufficient to jeopardize the mission."<sup>17</sup>

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<sup>14</sup> Institute of Medicine, *Safe Passage: Astronaut Care for Exploration Missions* (2001): 39. National Academies Press, also available online at <<http://fermat.nap.edu/books/0309075858/html>>

<sup>15</sup> *Ibid*, 39, 95-96.

<sup>16</sup> *Ibid*, 28 and 107.

<sup>17</sup> *Ibid*, 107.



Much of the most scientific research conducted on how humans will be affected by space travel has occurred aboard the space stations, including Mir and the International Space Station. Having doctors on board a space station is essential, both to treat whatever maladies may befall the crew as well as to conduct medical tests over the course of the mission. This data has been invaluable in helping us understand many of the physiological effects of space travel on human beings, and some accidents that have occurred have also shown us how crisis situations may be dealt with. For example, on the space station Mir, Russian cosmonauts needed to deal with a serious health crisis in which one of the oxygen-generating lithium perchlorate canisters on board caught fire, filling the space station with smoke. Luckily, the crew donned gas masks and put the fire out within ninety seconds, averting a possible disaster.<sup>18</sup> Beyond such events as these, however, little is understood of the extreme psychological stresses that would be imposed in a very long space expedition. Some of the most valuable psychological data has come from military submarine missions, Antarctic researchers, and inhabitants of an experimental ecosystem known as the Biosphere.<sup>19</sup>

The Biosphere, actually known as Biosphere 2, was a trial in which eight volunteers were sealed into an artificial closed ecological system.<sup>20</sup> The system, housed in a huge dome of glass and metal with an internal volume of 7.2 million cubic feet, included seven biomes filled with various substrates and raw materials and populated with plants, insects, animals, fish, and microbes. There were two such experiments

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<sup>18</sup> Culbertson, Frank, NASA Shuttle-Mir Program Director: "Culbertson on the Fire" (February 28, 1997). Available online at <<http://spaceflight.nasa.gov/history/shuttle-mir/history/h-f-linenger-fire-cul.htm>>

<sup>19</sup> *Op cit.* 3, 106.

<sup>20</sup> David, Leonard, Space.com Senior Space Writer: "Biosphere 2—Science Under Glass" (November 8, 2000). Available online at <[http://www.space.com/scienceastronomy/generalscience/biosphere2\\_001110.html](http://www.space.com/scienceastronomy/generalscience/biosphere2_001110.html)>

conducted at the facility, the first spanning two years and the second merely six months. During the first trial, oxygen levels dropped to levels that could not sustain the human inhabitants or some of the important species including pollinating insects, and emergency oxygen and food were introduced into the environment. As a result, the project lost credibility and little scientific respect was given to the second six-month trial in which seven more volunteers attempted to live off this “land.” While the project did run, however, it offered a more in-depth view of some of the problems associated with self-sustaining ecosystems such as necessary in space colonization or very long-term space voyages, especially given current technological limitations.

Another experiment along those lines is the Haughton-Mars Project. Sponsored by NASA and others and run jointly by the Mars Institute and SETI, the Search for Extra-Terrestrial Intelligence project, the HMP attempts to be a “terrestrial analog” of Mars on Earth.<sup>21</sup> Run near the Haughton impact crater on Devon Island, off the coast of Canada and inside the Arctic Circle, the project substitutes rocky tundra struck by cosmic debris for Mars’s surface, and explores the similarities in terrain while planning to conduct simulations of Mars surface exploration and manned missions in order to gather valuable data in a safer and easier-to-reach setting. However, the research conducted by the project up to this point has been largely centered around soil and terrain analysis and determining whether the site is indeed a reasonable analog for Mars at all.

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<sup>21</sup> Mars Institute, “Haughton-Mars Project (HMP)” (2006). Available online at <<http://www.marsonearth.org/>>

## **VI. An evaluation of the application of music participation in the form of choral singing to the human challenges of space travel**

While trials have not yet been conducted on applying the benefits of choral participation to the problems associated with space travel, it is our stance that in several areas choral music participation may ameliorate some of these negative physiological and psychological effects. If research is conducted into this subject, it may be fruitful to focus inquiry into the following areas of connection.

### **1. Possible solutions to physiological problems**

Two of the problems facing astronauts are orthostatic hypotension, which is a drop in blood pressure when standing up, and ergonomic problems, which “increase fatigue, decrease performance, and predispose crewmembers to injury.”<sup>22</sup> The training of muscles involved with singing, including abdominal and intercostal muscles as well as muscles in the shoulder and neck, may help to promote greater ease of maintaining correct posture. Proper posture is an essential element of learning to sing, and likewise is essential to ergonomics. Further, one of the main treatments for orthostatic hypotension involves a series of posture exercises. While it may not be sufficient to fully combat the effects of space, singing with proper posture may help to alleviate this problem as well.

Pulmonary circulation and gas exchange were also cited in the Institute of Medicine report as being negatively effected by space travel. A study published in the *Journal of Asthma* may be somewhat analogous. In this study, a group of asthmatic

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<sup>22</sup> *Op. cit.* 14, 95-96.

children who played wind instruments had improved bronchial symptoms as well as positive changes in mood and decreased fatigue. Given the similarities of singing with playing a wind instrument, perhaps similar respiratory benefits could be obtained by astronauts via singing.

Two further physiological problems encountered by astronauts are sleep cycle disturbances and immunological depression. The study by Krutz cited in Section IV investigated the effects singing has on measured levels of cortisol and immunoglobulin-A. Cortisol is the body's stress hormone, and immunoglobulin-A is one of the immune system's main systems of defense. The studies showed consistently elevated immunoglobulin-A levels along with decreased cortisol levels during practice sessions. This suggests that singing may be helpful in bolstering astronauts' immune systems as well as helping to reduce stress, which in turn would aid normal sleep patterns.

## **2. Possible solutions to psychological problems**

Participating in a chorus should not be considered a stand-alone solution to the psychological rigors of space travel. These stressors are, quite actually, like nothing experienced here on earth. When astronauts are selected and trained, the influence isolation, separation, and interpersonal conflict have on their psychological well-being is an important criterion and focus. Nonetheless, choral singing is perfectly suited for a group activity to ease the impact of these factors. As reported in the study *The Effects of Group Singing and Performance for Marginalized and Middle-Class Singers*, many of the marginalized individuals formed some of the strongest and healthiest bonds of their lives

over the short duration of the choir. Approached with the right attitude, participating in a chorus helps the group to learn to work together effectively and equally, and produces a very satisfying product upon success. Additionally, the very act of singing serves as a cathartic release and distraction from negative feelings and emotions that arise from one's environment and surroundings, specifically, a tin can floating in the vacuum of space. Finally, future voyages can expect remain and continue to become more culturally and socially diverse; as noted in the Chorus America study, choral singing helps to bridge the gaps between cultures.

Choral music is a music form uniquely easy to bring into space, as it's technological and payload requirements are minimal. With the advent of technologies like digital music and Virtual Choir, one very small and lightweight device could hold within all things necessary for recreating a worthwhile choral experience outside the atmosphere of this planet. Without any expensive of equipment, and without even adding a significant amount of weight to the all-important payload sum, we can bring an established institution of Earth into space with fidelity. Given the cultural history of music, one cannot overestimate the great benefit that having this solid point of contact with home and familiarity will have on space travelers.

## **VII. Conclusion**

Truly, it is a necessity to make sure music leaves this planet with us. The benefits of having music as part of a person's education and life are clear and myriad, essential to helping an uprooted sapling of human society survive in a distant and foreign place.

Choral music appears promising as a tool for addressing several of the unique physical and psychological problems presented by space travel. Choral music is also of great cultural importance, and serves as a primary means of emotional expression. Given that participation in choral music is free and has no known negative outcomes or side effects, it would be foolish to not take music with us.