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AN EXPLORATION OF MENTAL STRATEGIES OF ASTRONAUTS

MASTERS THESIS

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ABSTRACT

This study explored mental strategies and perspectives of eight Canadian astronauts within a theoretical framework developed in the field of sport psychology. An Astronaut Interview Guide was developed and the interviews analyzed using accepted qualitative analysis procedures. Astronauts attributed their parents and/or community experiences as young people, with providing supportive yet challenging experiences, and credited that environment with their success in being selected to the astronaut program. Attitudes towards achievement revealed a variety of approaches to achieving goals which overall imply a tremendous dedication, commitment and pleasure in doing things as well as they can be done. The use of mental strategies such as imagery, planning and preparation, and self-evaluation, were described. For some astronauts the preservation of family relationships and being a good parent were revealed as important components of their lives.

AN EXPLORATION OF MENTAL STRATEGIES OF CANADIAN ASTRONAUTS

There is evidence that the content of thinking, during training and competition is associated with the superior performance of the sports elite (Hemery, 1986; Loehr & McLaughlin, 1986; Mahoney, Gabriel & Perkins, 1987; Orlick, 1990, 1992, 1993; Murphy & Jowdy, 1992; Orlick & Partington, 1988). Together these studies demonstrate the importance of mental skills and perspectives to the successful achievement of performance goals. There is also evidence these success elements play a dominant role in achieving excellence in the workplace (Maddox, Anthony & Wheatley, 1987) in the medical profession in the area of surgery (McDonald, 1992, McDonald & Orlick, 1994), and among elite classical musicians (Talbot-Honeck & Orlick, 1995). Consequently, one would expect that similar variables would mediate success in any demanding high-performance context; the astronaut environment has received little attention from this perspective. While some research has been conducted to identify the psychological and physical stresses of space flight, (Christensen & Talbot, 1986; Kanas, 1987, 1991) much of

the literature regarding astronauts has focused on psychosocial aspects of crew interaction with implications for long term tours of duty on a space station.

The nature of those selected to face the challenge of performing in an astronaut program is an ideal environment for continuing our understanding of the nature of success and enhancement of performance through mental activity. Understanding the mental skills and perspectives of such high achievers will assist in developing a more comprehensive body of knowledge relevant to the pursuit of excellence in any high performance domain. A commentary by Connors, Harrison and Akins (1986) on the role of psychology in the space program indicates that the psychological community should work less to "salvage an endangered mission and more to foster a high level of well-being and maximum productivity" (p. 911). Clearly the potential for optimizing astronaut performance has important implications in conserving valuable resources such as the thousands of man hours and billions of dollars that support preparation for a trip into space.

The specific purpose of this study therefore was

to investigate those selected to perform as Canadian astronauts, from a mental strategies and perspectives point of view developed in the high performance domain of sport. This study will link what we have learned from sport to the astronaut environment in an effort to understand the performance aspects of becoming as well as being an astronaut.

Review of Literature

Mental Practice in Sport

One of the first significant studies examining the relationship between mental practice and athletic performance of free throws in basketball, was conducted by Vandell, Davis and Clugston (1943). Twelve senior high school subjects were placed into one of three groups: (1) physical practice on day one and on the last day (day 20), and (2) physical practice every day, and (3) physical practice on day 1 and day 20 with 15 minutes of mental practice every day in between. The results indicated that positive improvements were made by both the physical practice group (41%) and the mental practice group (43%). This study provided the groundwork for many subsequent laboratory studies on the effects of mental practice. Feltz and Landers

(1983) conducted a meta-analysis of 60 mental practice studies and found an average effect size of .48 suggesting that mental practice improves performance better than no practice at all. It should be noted that their analysis produced larger effect sizes for tasks with higher cognitive components than simple motor tasks. Thus suggesting that the higher the cognitive component the more useful mental practice can be.

Although there is some confusion in the literature due to the interchangeable use of the terms mental practice and mental imagery, Murphy and Jowdy (1992) propose the useful distinction that imagery be used to refer to the process of imagining while mental practice be used to refer to the use of imagery as a technique in achieving improved performance.

In a recent meta-analysis of 21 published studies different theoretical mechanisms proposed as explanations of the facilitative effects of mental practice on performance were discussed (Hinshaw, 1991-1992). The importance of this study however is that these theories ranging from physiological to cognitive are linked by their common emphasis on variables such

as the emotional and motivational state of the subject, focus, relaxation, imagery skill and type. Murphy and Jowdy (1992) suggest in their review of the mental practice literature that mental practice benefits performance because it allows participants to cognitively prepare and plan performance. Perhaps these skills can be viewed from the perspective that mental imagery forms the basis of mental practice, and skills identified with mental practice are in fact variables which mediate the effect of imagery and mental practice, by permitting participants to more effectively cognitively prepare and plan performance.

This perspective provides us with a link to the paradigms developed through applied research and consulting experiences with elite athletes in which mental practice forms the basis of a number of strategies used to enhance performance. These strategies include skill maintenance, mood regulation (relaxation), planning, rehearsal of emotions, self-image manipulation (imagining confidence to feel confident), and healing (Murphy & Jowdy, 1992).

One model of performance enhancement based on mental strategies has been developed by Orlick (1992).

The foundation for this model is the study by Orlick and Partington (1988) involving the 1984 Canadian Olympic Team, which provided solid evidence that the involvement of mental strategies was a significant predictor of success. The interview process revealed strategies such as precompetition planning, planning and focus for the competition, use of mental imagery, competition evaluation and distraction control. This relationship between mental preparation and performance excellence was established by gathering data on three readiness variables - physical, technical and mental. The results indicated that the highest and only significant predictor of final Olympic standings was the mental readiness variable ($r=.40$, $p<.0001$).

Further studies by Orlick (1992, 1993) as well as his consulting experience (1990) support these findings and also reveal that the central feelings of belief and commitment are associated with successful performances.

Orlick's 1992 model "The Wheel Of Excellence " proposes key mental elements necessary for achieving success. These elements are similar to the variables described by Hinshaw (1991-1992) which were found necessary for positive effect of mental practice.

Murphy and Jowdy (1992) reviewed the purposes of imagery based techniques used in the applied sport psychology field: skill acquisition; skill maintenance; arousal regulation; planning/event management; emotional rescripting (stress management); self-image manipulation; attentional and pain control.

The elements which Orlick proposes allow humans to excel, or to "become the best they can be", are categorised into seven components of excellence. The first two elements form the "hub" of the wheel and are the core of human excellence, namely commitment and belief. As Orlick describes them, together these concepts represent the "mental perspectives, orientations or visions about oneself and one's pursuit" that determine one's " willingness to persist in the face of challenges ... and the extent to which one believes in oneself and the meaningfulness of one's pursuit"....

Orlick proposed the remaining five elements (the spokes of the wheel) as essential for the achievement of one's goal: positive images, full focus, distraction control, constructive evaluation, and mental readiness.

Positive Images

Orlick's use of this term refers to imagery skill, imagery quality and imagery type. The ability to practice with positive images allows one to get what is wanted out of training, to perfect technical skills, simulate the performance environment, and to ultimately see oneself achieve one's goal.

Full Focus

Full focus is the ability to stay centred in the present, to be connected totally with what one is doing to the exclusion of any thoughts which are irrelevant to the successful outcome of the performance.

Distraction Control

This concept refers to the ability to deal with things that can pull you "off track". The development of plans for refocusing when faced with bad luck, and other distractions are crucial to a high performance outcome.

Constructive Evaluation

The ability to extract important lessons from every critical performance, allowing one to continually adapt or refine one's approach to attaining a higher level of performance, is considered central to

excellence.

Mental Readiness

The use of the elements of excellence in a systematic pre-event procedure incorporating warm ups and reminders about these strategies, produces a state of mental readiness.

When all the elements of Orlick's model are used or exist collectively, optimum mental strategies are in place to achieve performance excellence.

The "Wheel" serves as a means of studying those who have achieved success or excellence in their field as well as a framework for intervention in order to enhance performance in any high-performance discipline.

Several other applied researchers have found that performance results by elite athletes were clearly associated with factors related to an athlete's mental strategies (Heishman & Bunker, 1989; Loehr & McLaughlin, 1986; Ripol, 1993; Ungerleider, Golding, Porter & Foster, 1989).

Mahoney, Gabriel and Perkins (1987) studied the psychological skills relevant to exceptional athletic performance by administering a 51 item questionnaire to 713 athletes from 23 different sports in the elite, pre-elite and non-elite categories. A cluster of five psychological skills - concentration, anxiety management, self-confidence, mental preparation and

motivation, were found to be factors differentiating sport skill levels.

Hemery (1986) over the period of two years interviewed 63 of sports' highest performers, representing 22 sports from 12 different countries. In answering the research question "What makes a winner?" the results of the study were dominated by psychological factors, the key ones being athletic intelligence; creativity, visualisation and imagery; concentration and control; precompetition planning; competitiveness and the ability to get an edge.

Mental Practice in Other High Performance Domains

Recently the use by surgeons of mental strategies in the operating room has been studied (McDonald, 1992; McDonald & Orlick, 1994). Thirty-three highly proficient surgeons were extensively interviewed and on the three dimensions of physical, technical and mental readiness, surgeons rated mental readiness as important to success as technical readiness. As in the Orlick and Partington (1988) study, results indicated that mental readiness was the most important factor distinguishing between successful and unsuccessful performances - in this case - surgeries judged to be successful from those felt to be disappointing.

Following Orlick's framework, surgeons were asked a series of questions about their mental preparation

and focus in a recent challenging surgical procedure and the seven success elements of "Wheel of Excellence" were used to analyze and assess their responses. Interestingly the content analysis of the transcripts provided segments of text allowing for further subdivision of Orlick's elements into "profiling characteristics" (McDonald, 1992) as listed below:

Commitment Characteristics.

Dedicated Lifestyle, High Standards, Personal Responsibility and Compassion

Belief Characteristics

Acquired Versus Natural Self-Confidence, Mentors, Religion and Kinship

Positive Images

Imagery, Positive Thinking

Mental Readiness

Study Aids, Anticipation and Planning, Setting Objectives, Consulting with Patient, Consulting with Colleagues, Good Health Habits.

Full Focus

Concentration, Anticipation and Controlled Energy, Relaxation, Enjoyment and Rhythm

Distraction Control

Distraction in a Crisis, Distraction in a Hindrance, Distraction Control in a Lull

Constructive Evaluation (of self)

Assessment by Result, Post Surgery Visualisation, Visual Aids.

Literature relating to success in business evidences similar respect for the importance of mental strategies in achieving success. In 1980, a study of 400 successful executives and 400 unsuccessful executives found that positive attitude was the feature that distinguished the two groups in terms of how they handled stress (Pines, 1980). Successful executives looked at difficult situations as a challenge and as a problem to solve rather than as a stress to be avoided. Commitment, control and challenge were established to be three qualities existing in those who could keep themselves performing at their optimum through stress. These three variables were not present in those who suffered from stress related health problems.

Loehr and McLaughlin (1986) undertook a similar study with business persons and athletes, and along with their workshop and consulting experience developed a model of ideal performance. Included in this model are positive attitude, focusing, distraction control, motivation, visualisation, breathing control, humour, diet, exercise, rituals and attention to stress.

Space Flight Research

There appear to be several significant stressors in space flight that have been identified with

degradation of performance. Research into these effects has been limited to the documentation of physiological and psychological responses to the space environment, such as nausea, distortions in vision, smell and taste, as well as altered perceptions of time (Christensen & Talbot, 1986).

Two other areas of study have been the simulation of isolated and confined environments for studying the dynamics of small group interaction under those conditions, as well as the review of selection criteria in the established programs such as the US and the Soviet Union (Christensen & Talbot, 1984; Connors, Harrison & Akins, 1986; Harris, 1989; Harrison, Clearwater & McKay, 1989; Helmreich, 1983; Kanas, 1987, 1991). Much of the psychosocial work focuses on the implications for facilitating positive crew interactions during long term tours of duty on a space station, and is of little assistance to this study. The information concerning the selection criteria facilitates and directs this investigation by generating baseline information on the existence of some mental skills in astronauts comparable to those described in high performance athletes.

Criteria for selection arose initially out of the seminal research programs in the 1960s which focused on the stresses of isolation and confinement using the

Antarctic as a simulated environment. These selection criteria led to the conclusion (Gunderson as quoted in Harrison et al., 1989) that the successful crew member shows competence in his technical area, is able to sustain motivation throughout the course of the mission, is emotionally stable and socially compatible with other crew members. This information informs us about basic qualities of those selected at that time but little about the existence or use of any particular strategies for achieving the stated desirable qualities, moods and overall performance level. The focus is on what is needed but not how to achieve it, or indeed how it was achieved. Rather the underlying assumption seems to be, "either you've got it or you don't".

Lately, the changing needs of the space program, the increasing length of missions, and the emerging profile of a male or female astronaut with specific scientific expertise, has led to a renewed interest in the importance of performance in space (Christensen & Talbot, 1986; Harris, 1989; Helmreich, 1983; Kanas, 1987, 1991).

Stresses such as the unique environment of weightlessness, confinement, and danger, periods requiring high performance competency alternating with periods of extreme monotony have been identified

(Christensen & Talbot, 1986; Harris, 1989). However this literature seems more focused on the documentation of stresses for the purposes of assessing the potential contributions of different perspectives of behaviourial science to the space setting (Harris, 1989). Examinations of adaptability and performance in space, do not contemplate the use of a mental training perspective to enhance performance. Rather the assumed intervention style is of the medical model which waits for a problem to appear and then searches for a cure.

One interesting commentary (Santy, 1983) on the adequacy of the recognised psychological issues in space flight sets out the personality areas determined to be related to potential for successful mission accomplishment. These personality areas are similar to the elements of success recognised in sport, business, surgery and music, and are set out by Santy (1983) as: general emotional stability; high motivation and energy level; adequate positive self-concept, sense of adequacy, emotional control; and satisfactory and productive interpersonal relationships.

A review of cosmonaut training in the Soviet Space program (Kanas, 1991) indicates that training methods evaluate a number of important factors which appear to be closer to the model of pre-event preparation rather than to in flight or post flight problem solving

through psychological or psychiatric intervention. As well, the recognition by the Soviet program of the need for a close mind - body connection for performance in space is evident in that program's selection criteria. Factors that are selected for in training procedures include, stress tolerance; ability to self-regulate somatic, mental, and autonomic functions; and the capability of working under uncertainty.

While the selection criteria and psychological profile discussed in the foregoing studies, clearly have parallels in the world of athletics, there is little published documentation on the correlates of these criteria to actual performance in space. This is perhaps due to the tacit assumption that the selection criteria appropriately select for those who will deal with the challenges of space most adequately. Similarly there is no evidence of ongoing research specifically to identify the potential for enhancement of mental skills which would better able astronauts to deal with the challenges of space flight. The literature relating to mental models of success assists us in this regard by providing a framework for investigating mental strategies of astronauts.

The Development of Talent

In understanding the nature of those who excel in a given domain there has also been research into

developmental issues (Bloom, 1985; Csikszentmihalyi, Rathude & Whalen, 1993). More specifically, in a study of 200 highly talented high school students over the period of four years, Csikszentmihalyi et al., (1993) found that the students social environment was key: those who enjoyed emotional and material support from their families tended to develop their skills more. Bloom's (1985) interviews with 120 people at the top of their professions in athletics, art, music, math and science suggest that high levels of both support and challenge have a positive effect across all talent areas.

In summary the literature regarding mental strategies of athletes as well as the literature from other high performance domains brings to light a number of conceptually similar characteristics of those who have achieved success in their fields. It remains to be seen then what the attitudes, perspectives and strategies of astronauts are, given that they have achieved one of life's coveted goals in being selected for the program, and further (for some) being selected to go up in space.

Method

Introduction

This study utilized a procedural model similar to the 1988 Orlick and Partington study of the Canadian

Olympic team in which 75 athletes were subject to in-depth interviews. The subjective experience of 8 astronauts along the dimensions of mental practice strategies was being probed in this study and data from the interview transcripts was analyzed using interpretational qualitative analysis methods similar to those put forth by Orlick and Partington, (1988) and Cote, Salmela, Baria & Russell (1992).

Qualitative research and analysis procedures are becoming increasingly prevalent in sport and physical education (Cote et al., 1992; Sage, 1989), and in sport psychology, in the hopes of gaining a better understanding of human behaviour in these contexts (Martens, 1987).

One method of qualitative research is the idiographic approach involving a method of inquiry in which the researcher plays an active role in seeking out the subject's experiential knowledge about the circumstances under observation, through in-depth interviews and subsequent content analysis of the transcripts (Cote et al., 1992). This particular method has been used extensively in the field of sport psychology in particular in determining mental practice strategies of athletes, in the past several years (Jackson, 1992; Orlick & Partington, 1988; Ripol, 1993) Further, recent studies of excellence in other domains

such as elite classical musicians (Talbot-Honeck & Orlick, 1995) and elite surgeons (McDonald & Orlick, 1994) were conducted using similar qualitative analysis procedures.

Subjects

With the support of the Canadian Space Agency eight Canadian Astronauts were interviewed. Three of the astronauts had been in space, two others had training at NASA, the remaining three had just completed the initial year of training in the Canadian Astronaut program. At the time of the interviews two of the subjects were no longer involved in the program having resumed their scientific research careers. Five of the subjects had PhDs, two of whom had medical degrees as well. Three of the astronauts had Master's Degrees in engineering. All of the subjects had received numerous academic honours while at university/or military college, as well as professional honours while pursuing their careers in science or medicine. Each subject had a wide range of hobbies and interests, both sport and arts related, two astronauts had represented Canada internationally in sport. The ages of the subjects ranged from 30 - 58 years of age. Two of the subjects were female.

Instruments

The relevant portions of the "Athlete Interview

Guide" from the Orlick and Partington study (1988) which (a) explored factors associated with the athlete's mental readiness, (b) examined his or her background in mental training, (c) delved into details of the athlete's mental state at the Olympics, as well as best and worst performances, were adapted to relate specifically to the astronaut experience, and incorporated into the Astronaut Interview Guide. In addition, based on the literature, questions were included to explore personal perspectives surrounding achievement, as well as to explore the nature (if any) of childhood experiences felt to have contributed to success. Due to the multiple nature of the astronauts' accomplishments educationally, professionally and athletically, the guide was flexible in its ability to probe along the dimensions of any or all accomplishments. The interview attempted to explore the use of mental strategies recognised in the literature as important for success; however the open endedness of the questions allowed the emergence of information about other thinking patterns or predictors of success (see Appendix A for Astronaut Interview Guide).

Following a pilot interview with the Administrator of the Canadian Astronaut Training program only minor changes were made to the Interview Guide.

Procedure

This investigation incorporated the use of qualitative data collection through in-depth interviews with astronauts. Three interviews were conducted by both the researcher and thesis supervisor, three were conducted by the researcher alone, and two by the thesis supervisor alone. The study design and procedure paralleled previous studies of in-depth interviews with athletes, surgeons and musicians.

Design and Analysis

The interview transcripts were reviewed and analyzed using interpretational content analysis procedures. While there is no one accepted way of sorting, analyzing, categorising and interpreting data from in-depth interviews, according to Cote, Salmela, Baria & Russell (1992) several recent studies indicate that most interpretational analysis follows the basic procedure of dividing data into meaningful segments of information, and categorizing the segments according to themes extracted from the data themselves (Jackson, 1992; McDonald, 1992; Orlick & Partington, 1988).

Some authors have chosen to present the results of their analysis in a hierarchical tree diagram, (Jackson, 1992), while others (McCaffrey & Orlick, 1989; McDonald, 1992; Orlick & Partington, 1988; Ripol, 1993) provided a description of themes and higher order

concepts reproducing segments of text in support of these themes.

In this investigation the reproduction of segments of text in support of higher order categories was chosen as the best method of producing the data as the text segments were lengthy, rich, and detailed, providing important contexts for understanding the perspectives of the subjects.

Trustworthiness

During the analytic process meaning units were reviewed, sorted and categorised in conjunction with an experienced researcher in the field. Throughout the categorization period meaning units were compared with each other to facilitate the process of deciding which units were most like each other and which were most different (Lincoln & Guba, 1985). Once the inductive process of creating higher order categories was completed, a deductive approach was used by another researcher to place the meaning units into the established categories (Lincoln & Guba, 1985; Jackson, 1992).

The deductive process involved 80% of the meaning units (68 of 84). Brief descriptions of the categories and sub-headings were provided similar to the category descriptions which follow in the results section.

During the deductive process the balance of the

meaning units were categorised the same way as in the inductive approach (65), three of the meaning units were categorized differently. Thus indicating a 95% inter-rater reliability.

Results and Discussion

Elements of Success

The data were categorized into three main areas essential to success; (a) early influences that essentially developed unlimited senses of opportunity, (b) commitment to excel that combined enjoyment of learning with high performance standards, and (c) mental approaches to performance conceptually similar to those illuminated in the sport literature.

Early Influences

Six astronauts responded to questions asking if anyone or anything was essential to their success, (for example without them or it they could not have become an astronaut), by mentioning early influences in their lives. Each of the astronauts interviewed exhibited a willingness to reflect upon their lives, their upbringing and their experiences as a children.

Four astronauts (Subjects 2,3,5 & 8) mentioned their parents and/or the environment in which they were brought up; three astronauts (Subjects 2, 4 & 5) noted the importance of community or group involvement when young, to their development. One astronaut (Subject 1)

noted the importance of sibling rivalry, and at a later age having a mentor.

Two astronauts (Subjects 6 & 7) did not pinpoint any early influences as essential to their success. Subject 6 felt that technical knowledge was essential for success, Subject 7 attributed success to a personal ability to learn from every individual encountered in life.

Parental Influence

The exact nature of the parental influence seemed to vary among the four astronauts, and more than one aspect of parental influence was recognized by each astronaut. Descriptions of the parental influences were diverse and included such factors as, treating children with respect; parental involvement and support; providing a variety of experiences, supporting and letting go, giving a sense of confidence; never putting "nos" on things.

S5: I can tell you that the kinds of things that influenced me most when I was young to allow me to develop who I am, probably my parents were by and large the most influential.... They (parents) were interested in us as people and the most successful families that I've seen...they treat them, you know they have family conferences...they discuss problems. They're very, very open and they don't say "oh well you can't do that you're only a kid" or..."you children be quiet" or...there's nothing that smacks of...they're treated like people. Just younger people. And there are skills that they know these young people require. And that's what they (parents) did with...me....for me it was very, very helpful that I could pursue what I needed. Not that my parents did not provide some

discipline. I mean there were perhaps some times when I felt it was excessive or that the commitment to family was a bit more demanding than I felt I was prepared to....
Not to say there weren't rough spots, but by and large they taught us to allow us to express ourselves. And we were involved in a project and it didn't matter what it was. I remember one time my sister had a grasshopper, found this grasshopper with a broken leg and my dad and mum helped make this cage for this stupid grasshopper, you know. I was ready to step on it or dissect it further. They just wanted to get involved.

S2: I think its all my mother's fault. I've come to conclude that....There is nothing she will not try or do, if she wants to try it she'll do it. I tell you if you suggested to her that she should go take the high performance driving course at Shannonville raceway if she thought that's what she wanted to do she'd do it. That sort of support where she really believes in just living life and enjoying life and if you want to scuba dive go do a course. If you want to sky dive go do that too. Never putting nos on things, never saying that no you can't accomplish that, you don't have the ability or you can't do something.

S8: I think having parents who gave me a sense of confidence about what I could do was a big factor. My parents basically told me that everything was possible,...I think I felt that confidence going out from them. I was exposed to all sorts of things and so had an interest in all sorts of things. I think living in other countries probably did a lot, being reasonably successful in team sports...feeling good about myself, about being well rounded, I think.

S3: The fact that the family would let us try things, that is something I've identified a long time ago. I think, they encouraged us to participate in activities but didn't force one particularly upon us. They would encourage say, the piano at first. My brother took piano, I did, my sister did, but they didn't continue that as long as I did, because they didn't like it, nobody forced them to do piano, they did something else. There was strong family support for whatever activity you chose. And if you didn't like it, well, you dropped it. And you do something else. Then you choose something else. I did all kinds of

> activities when I was a kid...a lot of things I was terrible at. That's maybe the trick, once we decided on the activity, they would let us go there, also provide the equipment, pay for it, drive us down there, pick us up. If anything I can identify I'm sure it was because I was given a choice and I was then encouraged to continue.... I was always participating in activities somewhere else. Again, I think its the parental support and the parental letting go of me.

In general this data supports the findings of Bloom (1985) and Csikszentmihalyi et al. (1993), in that these early experiences were child centred, challenging, and driven by the interest and demands of the astronaut as a child. These experiences occurred within a supportive environment which at the same time created a wide and unlimited sense of opportunity.

Community/Group Involvement

In discussing their formative years Subject 2 discussed the importance of involvement in the Y, and its various programs, Subject 5 noted involvement in the Y, church groups and other unnamed volunteer activities and Subject 4 found membership in the high school drama club to be an important component of later success.

The following text segments describe community/group activities and the perceived benefits of the activities, which are summarized below: widening one's focus; interfacing with people; providing a balanced set of activities; providing support and preventing the normal adolescent stage of

discouragement and of feeling squashed; providing leadership experiences; providing experiences which developed belief in oneself through meeting other people; talking, sharing, growing; being pushed beyond the realm of expected capability; providing discipline, providing an environment where one learns that anything is possible.

S5: They (parents) weren't there all the time so the values were instilled in us not just through their actions and their words but also through groups they encouraged us to participate in, were really I think the strongest background forming. Just to give you an example we were involved in a balanced set of activities, what I consider balanced for young people. we were involved in church groups and then... not just on Sundays but you know in groups you know and then the camps and stuff like that. And community activities. Volunteer activities for the community in which you have some type of interface with other people. You weren't just dealing with a small focus....I think the protective environment that some of these groups had for me, was very very important for me. It allowed me to develop. Whereas perhaps without those support groups and without supportive parents I might have been like other adolescents and felt very discouraged and squashed.

S2: I mean when I first started with the Y and the group of people there, I think that group of people really helped formulate my approach to life. Wasn't really my parents as much, I mean I think my mother gave me the inherent creativity and sort of go out and look for challenges and stuff, but back then there was a lot of emphasis placed on believing in yourself and doing things, and challenging yourself, by contributing to the community and working with people, and talking and sharing and growing. All these sorts of things were all felt to be very, very important things. And when we were being taught, and keep in mind this was at a really young age, I was like 13, 14, 15, I was being taught how to teach Phys Ed., and I actually taught Phys Ed as a student teacher for a year. I taught grade 7 Phys Ed and grade 4 Phys

Ed, and coached the grade 7 basketball team. When I was in high school. This was part of this program that they allowed us to do this. It was incredible.

S2: But through the connections I made at the "Y" in those days they were very much into talking about group dynamics and talking about things... We were in a recreational leadership course and it was actually over the course of about two or three years leading us towards going to University to get into a Phys Ed program to become Phys Ed teachers. I was very interested in actually teaching and teaching physical skills and we learned how to teach everything from tennis, football, right through to any sport. You name it we got instruction in it. Even if we weren't good in the sport we would get instruction on how to teach the sport which was rather interesting from my perspective because if you can't play a sport I wasn't quite sure how you could learn to teach it. But in fact we were taught that the principles of teaching are generalizable and you could use the same sort of approach that you might use for teaching a backflip on the trampoline to teaching somebody to ski moguls...I used to teach mentally handicapped kids and physically handicapped kids and we used to always take the approach that there is nothing you can't do. They would say no I can't ski with one leg. You can, you know, you just have to adapt. It's not going to be easy, but you just have to adapt. We would have mentally handicapped kids and we would have them doing backflips on the trampoline and the teachers, the traditional sort of teachers would...how are you doing this...Well you just work with the assumption that anything is possible, it might not be easy, it might be harder for some people. But still the end result is possible.

S4: When I was in high school I enjoyed being involved in the clubs like the drama clubs, I loved that, and I enjoyed being the person behind the scenes that would get the things done. I rarely had the chance to be on centre stage, or be the main actor. I just didn't have the necessary skill for that, but in the lighting, in all the technical parts of the background I was heavily involved in all of that and enjoyed that quite a bit. I liked the discipline, whether that discipline came through the scouts or activities when I was younger like that, eventually I ended up in the

air cadets, wear the uniform, polish your boots, write a few tests and I went in and did it.

Subject 2 also described the importance of the experience of obtaining certification in scuba diving at an extremely early age. This accomplishment contributed in a major way to later success in life by breaking down conceptual limitations concerning what it is possible to learn if one wants to.

S2: (re: scuba diving licence at age 13) That was a tremendous accomplishment for me, I felt really proud of it a) because I could go out diving and that's what I wanted to do. But also just learning the physiology and the biology that you had to know to be able to dive safely and the hyperbaric physiology and stuff in early high school was sort of a bit of a feat. That sort of taught me about learning. That you know, we are put in little packages when we learn and if you are in grade eight you are supposed to learn grade eight stuff. You don't have to always learn in a package. You can actually very easily assimilate University level physiology if you have to, to accomplish a certain task.

Subject 1 did not mention early group/or community activity, rather people such as a high school coach and later a mentor, were referred to. The references are in the context of the necessity of being helped out along the way, to being successful.

S1: There have been important people from time to time in sports. I had a real good high jumping coach at University and also my first year of high school, the same guy. He was very successful. Getting into working with NASA I had a mentor, a boss who was a world authority and he brought me along. So I think its very important to get helped out along the way. ...it was sort of somebody that I wanted to emulate. I wanted to be like that guy. So he provided and example of what I wanted to be.

Overall the astronauts tended to credit these early activities with important personal development through challenge, support, interpersonal relationships, and delimiting experiences. This data is consistent with Csikszentmihalyi et al's (1993) theory of complexity and optimal experience which proposes that optimal growth is the result of the interaction between positive feelings of satisfaction and feelings of challenge that require action and change.

Early Dreams of Becoming an Astronaut

In response to the question "how long have you wanted to be an astronaut?", five astronauts reported early dreams related to becoming an astronaut.

Three astronauts did not report any early desires or dreams related to becoming astronauts. Subjects 2, and 8 indicated that their interest in becoming astronauts began with seeing the advertisement of the Canadian Space Agency (adulthood). Prior to that point they were satisfied with their careers. Subject 6 did not pinpoint any time where the interest in becoming an astronaut began.

Subjects 3, 4 and 7 reported that the desire to become an astronaut began as a child stimulated by seeing astronauts and knowing or believing that the possibility existed. Subject 5 reported the childhood desire to become a pilot (space travel was not yet

possible). Similarly, space travel was not possible during Subject 1's childhood, however the desire to become an astronaut is reported to have begun as soon as it became possible.

For Subjects 1,3,4 & 5 the goal was pursued in conjunction with other scientific pursuits which laid the foundations for their future acceptance to the astronaut program as payload specialists. One astronaut (Subject 7) pursued a successful career as a test pilot and was chosen to train in the U.S. program as a mission specialist rather than in the Canadian program as a payload specialist.

S1: Yes since I knew it was possible, which was about 1958 or so, I knew it was possible and I was at that time a pilot and so I thought - yeah that's my bag and I'd like to do that.

S4: I always wanted to be an astronaut when I was a kid. I remember watching the men landing on the moon and looking at the stars and the planets through the telescopes, just being fascinated with it all and wanted to explore and do that.

S5: I used to put plastic models together. I wanted to be a pilot. When I was eight I can remember going to an air show in Sioux, Michigan and they had the American armed forces and my dad took us and oh man I'll tell you the chap lifted me up and put me in the cockpit of this jet, I'm sure it must have been a T-33 or something like that, that vintage, but it was just...I loved it. I couldn't get enough of air shows, looking at the planes.

For Subjects 3 and 7 the data indicates that early thoughts of becoming an astronaut or pilot lent a focal point to future academic and career pursuits.

S3: I wanted to be an astronaut when I was a kid. I was at the time, I'd say between the age of 12 up to 16. Strongly enough to tell everyone. And I would say that if I couldn't make that, I would make a test pilot or fighter pilot...So, I was saying that, as you know, people were making fun of me all the time. But I was interested in the field, I would read about it make posters, post it on my door...In an old application form for a scholarship. A scholarship which I ended up getting, where I actually say that, a full paragraph, that one of the reasons why I'm going into engineering is because one day, I'm trying to work such that one day I become an astronaut... When I applied to become an astronaut, I gave a photocopy of this. So I guess it's been there a long...how strong? I think it was more of a dream. Something nice to do type of thing.... I still have this image of me walking in space, because that is what I was thinking about. That I could see myself in a suit and I was walking in space.

S7: Through the late '60s when there was all the big race to the moon and all that stuff, that's when I was just starting to be aware of newspapers and things and the night that they stepped onto the moon, you know I remember that real clearly and that's when I decided that I wanted to do this... Everyone asks me about that but that wasn't really any sort of...it wasn't the moment of my childhood or anything, it was just when I thought well sure that's what I want to do when I grow up. But it was just the thing, the exciting thing, while I was a kid growing up was this whole space race thing....Oh yeah, that's when I decided if I can, I'm going to be an astronaut. So I thought well I'll take an engineering degree and maybe I'll be a test pilot and see how it all goes...It's the goals, in my whole life I've been like in the distance there's been astronaut, you know, and then I'd come up to all these various cross roads and go well if I want to be an astronaut I should probably turn about east, you know just kind of go this general direction. Just keep sort of heading that way.

The comments of the astronauts regarding early influences develop a picture for us of how the roots of success are deeply embedded in early experiences.

Environments that provide support and challenge, that break conceptual barriers concerning what is possible and create perspectives that embrace an unlimited sense of opportunity, and that provide the opportunity to develop leadership and interpersonal skills at an early age, seem to be at the heart of the success of these people.

Commitment to Excel

During the course of the interviews it became clear that the astronauts were highly committed to doing things as well as possible. Seven of the eight astronauts spontaneously discussed their approaches to doing things well, exhibiting an awareness of, and commitment to the process of excelling. Questions probing the existence of doubts or attitudes when faced with obstacles became redundant as these lengthy descriptions of achievements and approaches to challenging situations exhibited positive, committed, constructive attitudes to doing well. These attitudes did not appear to permit recognition of obstacles or doubts.

The one astronaut who did not discuss ways of doing as well as possible, revealed the strongest reliance on natural ability.

The subjects (n=7) had common perspectives about excellence but different ways of describing their

approach to achieving their goals: getting pleasure out of doing something as well as it can be done; doing well is not achieving perfection but an approach to perfection; setting high personal standards; continually raising one's standards as one improves; setting high personal standards; learning for the purpose of getting the most out of the experience; taking pleasure in the effort and process of attaining a goal; believing in the relevance of the goal; responsibility to more than yourself; clearly defining goals.

S8: I think most astronauts are people who are similar to me in the sense that they get an enormous kick out of doing something as well as it can be done. And it doesn't happen very often but it is one of those addictive things, you keep trying and it is just the goal ring is slightly beyond your grasp, I think that is probably what makes most astronauts tick, they want to satisfy themselves that they did something really well. I think that is probably the kind of people that we are. It is not very complicated, so, that is probably what drives me more than anything else.

S2: Have you ever read the book Zen and the Art of Archery? Well that's sort of my approach....The greatest challenge...is because its always different and always changing you can never, ever, no matter how hard you try, you can never do it perfectly. And that was the ultimate challenge - to try to do it well all the time. You'd never succeed because its always different. That's frustrating but it can also be challenging. I tried to the best of my ability to do that and then after a while I went through all the phases of being frustrated by not being able to be, you now, perfect all the time. Then I recognized that you know, the best that you can shoot for is an approach to perfection and that you never will truly get there.

In trying to do things as well as possible Subject 2 expressed an insight into the nature of perfection - rather than a goal, perfection is an approach. Subsequently Subject 2 discussed this perspective in more detail, explaining that as one is improving one is continually raising one's standards of performance.

S2: I did actually go to Car Racing School and I went there oh this is going to be fun to race cars around the race track. Then when I was doing it and the professionals were teaching it, they were telling me that racing is not about racing and beating another guy, racing is about obtaining perfection. The fact that by virtue of obtaining perfection you will go faster than the other guy. What you're trying to do here is drive to perfection. It struck me that yeah that's what I'm trying to do .....It's this approach that you're trying to get closer and closer to the perfect turn, the perfect jump skiing or the whatever it may be, recognising that you never quite get it. As you get closer and closer you change your standards, you know that when I fly and I'm learning to fly I may do a steep turn in an airplane and be really happy to stay within a hundred feet. Then a hundred hours later now I want to stay within fifty feet. Give me another thousand hours and I might want to stay within 20 feet. You keep narrowing that window. The perfection becomes even closer and closer but you never get there. So that was the challenge of it. I think that's still my...part of the fun of life is trying to get there knowing that you're never going to get there.

Subject 8's approach to doing well is similar in that this astronaut is driven to prepare by setting standards of performance that are constantly demanding additional preparation.

S8: There may be people who are talented enough to react with minimal training to new and unexpected things. I don't know if I am one of those people, but I am going to assume I am not. I am going to

assume that if I am going to prepare myself I am going to do it. I have seen people who were not well prepared do very well, and do better than me even though I thought I was well prepared....It is very humbling being down here. It is very humbling because most of the time I feel I am only doing so, so, compared to my peers. I would like to think I was doing the best. OK, so there is enough to keep you continuously motivated. So I think being prepared...(is very important). Even though I come out of all the simulator sessions feeling I didn't do as well as I should have, I think to some extent that is a driver for the next session.

In addition to Subject 8's commitment to excel through preparation and setting personal standards of performance, part of the commitment is a commitment to others, a responsibility to more than oneself.

S8: Training classes are mostly throwing problems at you. Problem solving, that is what it is. So it requires you to think quickly, diagnose, take the correct responsive action. Sometimes my thinking is foggy, sometimes I take the wrong action. Sometimes I don't take action in time, so I have ample feedback after every single one of my lessons that I am not ready in my own mind. Other people may judge me differently, but you work at your own standard. So to be ready to do my job properly for that occasion when and if I get selected, I want to feel that I am totally prepared and I have got this stuff just nailed down. Part of it is personal, a personal feeling and the other part of it is I don't want to let my fellow crew members down I certainly don't want to let down all these people who are depending on me on the ground....There are thousands of dollars involved with training sessions per hour, and it is just not right to do a session if you are not prepared.

Subjects 5 and 6 evidenced their commitment to excelling by displaying an attitude of wanting to learn as much as possible.

S5: I tried to take an interest in absolutely everything on the flight. In everything that I

could, and tried to learn as much as I could because I thought if I get one crack at this I want to have done it well.

S6: In fact everything I did from the day I was selected which requires tremendous discipline, was absolutely every move I made professionally had something to do with the flight. In fact I never did anything if it wasn't related to my flight somehow. And that is not too hard to do because the flight encompasses such a broad spectrum of things. Like even geology, astronomy all that kind of thing, I had books piled up beside my bed because you're not going to get this trip very often. There is a probability I'll fly again but before you go the first time you figure it might be the only time. And then on my holidays I went to places around the world that I would see from space, like I went to Africa...places I hadn't been to already..along my orbit path so that when I was up there I knew what Africa was like. Whereas if I had gone without going to Africa I would not have the right perspective...its more interesting is all I'm saying. Like this is '92 (space flight) I went to Africa in '88 or something, was in the Southern States in '89, kind of backpacking type of thing and also geologically oriented. So it was fun. So I mean you do it kind of not...I won't say I was incredibly organised or overly logistical but you know there was like thirty or forty parameters that I knew about that I wanted to improve by the time I got there. Like little stars. Like what colour they were, you know. Where they were. Things like that. Or atmospheric phenomena when they happen. What the ratio of the sun to the geometic field is. And you'll get this particular atmospheric phenomena that can I see it from there. Like I did all kinds of things like that and I included that as part of the training program so that when I flew I was a student up there for ten days of all these things that I learned about before.

For Subject 1 an important ingredient of success was the pleasure found in working for future reward.

S1: It might be that people succeed if they can take pleasure in storing up effort for the future. In other words if you are by nature a saver, if it gives you pleasure to save... gives you pleasure to work at something knowing that you're going to

reap a reward in the future if you're capable or deriving pleasure from working for a future reward not just taking the reward but doing the work. If that gives you pleasure, then I think that's quite a thing for success.
Q: In anticipation of the pleasure?
A: Yeah if you can derive pleasure from work basically. I've known a lot of successful people who seem to be driven, and they didn't enjoy anything. But for me I think if I wasn't able to derive pleasure from work I probably wouldn't do it, I mean I'd stop succeeding right away.
Q: If I'm understanding you part of the pleasure comes from planning the reward?
A: Yeah its a pleasure to plan and its a pleasure to work. Its sort of building something that is good for the future, and its a pleasure to do it. The ability to derive pleasure from doing it, I think is something that's common for me all the time.

Subject 4 expresses difficulty being committed to doing well unless the goals were clearly defined and were common goals of the group. The lack of perceived relevance of goals affected this astronaut's desire to do well.

S4: I really feel, and maybe I feel it more strongly that the others, that you have to have a common goal, that you have to have the need that you are trying to meet, now all the planning in the world is not going to help, and there is a couple of great analogies I read, of working. That you have management and you have leaders and you can have all the workers. you know with machetes in the jungle, and this is the analogy hat they are chopping down the forest, and behind them are the managers sharpening the machetes, bringing them food, doing the planning to make sure that they have cut down the highest amount of vegetation and the leader is the guy at the top of the tree, who looks around and yells down "wrong forest". He usually gets told "shut up, we are making progress". So I find myself questioning an awful lot about whether we are in the right forest. The other analogy that applied, everybody talks about climbing a ladder to success to find that they are leaning on the wrong wall. I find that, I am more

concerned with those areas than with any of the others, and that affects to some extent how I perform, or how my motivation to do some of the work that we have to do is, because I am not convinced that this is as important or useful.

Similarly Subject 7 discussed ability to excel in terms of goal setting.

S7: I always do best when I know what the task is. When I know what the target is. If I have a clearly defined set of goals. I can do well at most things. I can't draw worth a damn, there are some things I cannot do but if its something that's within my power, I know what the goal is, I can generally do well at it. But if its something where I just don't have enough information, I get frustrated by my lack of ability to do the right thing at the right time.

The foregoing text segments reveal an awareness of the process of doing things well, which indicates an attitude of dedication and commitment to doing things as well as they can be done. It is interesting to note that several of the astronauts mention the pleasure involved in doing things well. Subject 8 uses the words "enormous kick" in reference to doing things as well as they can be done. With respect to the fact that perfection is an approach, not a goal, Subject 2 uses the words "part of the fun of life is trying to get there (achieve perfection) knowing that you're never going to get there. Subject 1 mentions the word pleasure in conjunction with achieving success.

Collectively these perspectives towards achievement are characterized by high standards, a readiness for learning and getting the most out of the

experience, the need for goal setting and goal relevance, dedication and pleasure in doing things as well as they can be done.

This is similar to the findings of McDonald and Orlick (1994) where the profiling characteristics of elite surgeons' commitment were described as: being dedicated to their profession; giving extra time; and setting high standards. The fun and enjoyment aspect of excelling brought out by the astronauts seems unparalleled in the McDonald and Orlick (1994) study.

Fear of Failure in Front of Others

Although the astronauts were not directly questioned on this aspect of performance three Subjects (1, 7 and 8) spontaneously mentioned fear of failure in front of others as a stimulus to achievement in their training programs and in space flight itself.

S8: If you mess up something because of a lack of attention, because there are a lot of challenges up there physiologically, compared to down on earth, you have to live with that, and that can affect your subsequent work. I think probably what worries astronauts, and maybe I shouldn't generalise, more than anything is a fear of failure. They want to be able to come back down to earth after and say I did what I was assigned to do and I did it well. If you screw it up I think it can weigh very heavily for a long time.

S8: ...it is fine to say down here on earth yes I will do those (secondary experiments) if I get around to it. You get up there you somehow feel compelled to do them because you have in a sense told people that you were going to try to do them, again, it has to do with fear of failure.

S7: (re: pilot) No, I was very confident because if

everything fell apart, if the whole thing was a disaster, I'd just eject at ten thousand feet. Oops, program's over. It was more a matter of kind of having laid my reputation and everything on the line here and I didn't want to blow it, you know, I didn't want the thing not to go as I'd convinced everyone it was going to go. But its more like sitting in the cockpit talking at myself, shaking my head and going okay, okay, you told them, now do it.

Subject 8's comments concerning fear of failure arose in the context of discussing work (scientific experiments) to be performed in space. Similarly Subject 7's concern is not wanting be wrong, having laid his reputation on being able to pilot the plane a certain way.

Two astronauts mentioned peer pressure and fear related to fearing for one's life. In the context of discussing anxiety control, Subject 1 noted that fear (for one's life) is controlled by the pressure of fearing to fail in front of others.

S1: Dealing with fear I know in one situation I asked one of the guys, everybody gets scared as hell at launch time, I knew damn well they did, everybody does, you're taking a 3% chance of getting killed, so its a thousand times more dangerous than skydiving. So they got to be scared and I'm scared doing my first parachute jump. So they got to be scared doing something a thousand times more dangerous the first time. One of the American astronauts says oh yeah he said when they close the middeck door on you it goes "clank" then you start wondering how you could possibly have got yourself into this situation. Another American astronaut was standing beside him, he says " yeah, the only reason anybody ever launches is that it takes more guts to say I won't go than it does to just sit here and be quiet and let it happen". So again what pushes you through the fear is peer pressure, and determination. I mean you want to do

the job, but I think your determination is created by peer pressure. We are social animals.

Subject 8's comments were made in response to a question concerning feelings on the launch pad before flight.

S8: (re: fear in the shuttle on the launch pad) I was saying if I get out now, if I sort of say stop this vehicle I want to get out I am going to embarrass a lot of people, including myself, Canada. I really did feel that Canada was watching, and they were down there watching. Maybe that pressure kept me in there I don't know. But I would guess, I have never talked to anybody else about it, but I would guess that it is not unusual, to feel that certain pressure. I think that if you are not feeling that pressure there is something missing.

The two other astronauts with space flight experience, Subjects 5 and 6 did discuss fear during the course of their interviews, but not in the context of performance. During the course of the three interviews with the astronauts in training in Canada, fear of failure in front of others was not mentioned.

The astronaut environment as in the surgical arena is full of risk situations. Interestingly, in the Mcdonald and Orlick study (1994), for 72% of the surgeons commitment was also related to fear of errors. The notion of fear as a component of commitment to excel (doing things as well as can be done), is deserving of further investigation in the astronaut environment.

Balanced Success/The Importance of Family

Two distinctly different questions produced answers from the astronauts which were similar in their demonstration of the considerable value placed on family/interpersonal experiences.

When asked what they felt had been their most significant achievement to date, three astronauts mentioned their children. Two felt it was in raising their children, one astronaut felt it was being involved in the delivery of his children. At the time of the interviews these three astronauts were the only subjects who were parents.

S6: (re: Having children) Well for sure that is the most amazing thing. There is no question. I got to deliver two of my kids myself. And I'll tell you doing that is being in space, in terms of what you feel in one second in time.

S8: Well to tell you the truth, my most important accomplishment is raising my two kids. Because that is what it is all about. On a personal level doing well for yourself is, it gives you a good feeling, but it is transitory in a sense. Your kids, in a sense, well it is a far more, it is the lives of people you are dealing with and I am not suggesting for one minute that I have done a good job because my kids are only 18, and maybe if you ask me 50 years from now, if I am around 50 years from now, I will feel more confident about saying whether I think I prepared them properly. But that had certainly been the most important part of the whole thing.

S1: I think my major achievement is something that didn't take an awful lot of effort for me...raising my daughter to me is very satisfying. To see my daughter, she's got her Master's degree, and she's employed and happy and sort of an international jet setter, enjoying life.

In response to a question probing the most challenging part of being an astronaut, four astronauts (Subjects 2, 5, 7 and 8) described the greatest challenge of the astronaut program as one of maintaining family relationships or of doing without family support, while meeting the demands of the program. Three Subjects (2,7, and 8) spontaneously included their approaches to dealing with the problem.

Interestingly, the two astronauts who made no mention of family related factors were at the time of the interviews, single and the youngest of the group of subjects.

S2: It isn't as much the training per se more the psychological issues, more being away from home a lot of the time. Having my wife in another city. Always sort of doing things on the run and never having everything that you need all in one place. Having to plan things (re family) seven days ahead of time and stuff. That has been the hardest. It sort of wears you down after a while and in terms of your ability to do the job. Sometimes it sort of impairs your ability to do the job. You get sort of blah, you know. That's been the hardest part.... (re: strategies to deal with this problem) We go on dates. It works, it really works. My wife and I started doing this last fall, and this weekend you know its sort of like going to University, phone her up on Tuesday and "what are we going to do Friday night, do you want to go to the movies?" And we're going on a date and its our date and nobody else is going to be there. You sort of take time and you commit time for yourselves.

S5: The most difficult part for me was the lack of social contact with my family and friends for those three years. That had to be the most difficult. Financial stuff, you know I'm going to die I can't take money with me, but the actual social contact, the things that I missed in

growing with these individuals. And they tried keeping me in their lives, in the best way that we could. But things slip by, you don't get a chance to go on summer holidays, Christmas holidays are cut down to a day.

S7: The demands in time here are higher than just about anywhere I've ever been and I've said to several people but I want to come out of here with a space flight experience and a family and most, probably the majority of people here come out of here without a family and so I'm willing to accept the fact that maybe I'm not working quite as hard at work as some people because I've got to keep my family healthy. This place is very hard on marriages. So I recognize that and it makes me a little bit uncomfortable but its part of the price of the way I'm going to do my life, I guess... Some of the guys have fallen to pieces afterwards (return from space) and I'll just take it when it comes, I guess. I've been lucky in that a lot of my self worth and things that make me comfortable with myself have happened as a result of heading this direction and are not purely tied up with being here. So a lot of the things that I've done to this point that helped me get here also made me what I'm happy with. All of those things have already happened. And so if some the things that I want to do don't happen, I still have all that when I'm sitting by the fire to look back on and smile about you know, and so I think I'm going to be okay. But that's one of the large reasons I want to come out of this with a family. You know I need to come out of this with a healthy environment around myself. There are some people who work way too hard in here. And they are coming out of this with a space flight and that's it and it's not worth anything by itself. You got to be in context. So we'll see.

S8: (re: return from space)...after the debriefings which took about a week I went on holiday with my wife. We had planned this and took a 10 day holiday, because we knew that when I got back to Canada I would be doing the public relations circuit. That was going to be very time consuming, so we actually took 10 days holiday. We had, you know the 6 months leading up to the flight had been very hectic, it was a good time to take a holiday.

The fact that family/interpersonal relationships

can have a significant impact on the well-being and thus the potential for achievement of an individual has not been documented in detail. However, there have been investigations in the sport context with national level coaches and the impact of their coaching pursuits on family life/interpersonal relationships (Zitzelsberger & Orlick, 1995). In this study National level coaches felt that their occupation had a definite effect on their relationships. The demands of the coaching profession in terms of time and travel as well as the commitment coaches made to excel in their jobs made it difficult for some and impossible for others to attain a balance in both their profession and their relationships.

The Zitzelsberger and Orlick (1995) study and related studies of burn-out which focus on health consequences of the profession to the individual, centre on what the occupation does to the family. Feelings of achievement as a parent and the family related concerns which emerge in the present investigation, focus on what the family does or can do for the person pursuing excellence. Combined, the data illustrates importance of the family as a component of achievement. The data implies that being a successful parent, a successful family member, having successful interpersonal relationships, is a key component of

overall feelings of achievement.

Mental Approach to Performance Situations

The astronauts were asked about their approach to challenging situations. The choice of situation to discuss was left up to the subject. Accordingly a number of mental perspectives and mental practice strategies for enhanced performance across a diverse set of circumstances emerged from the data: (a) preparation and planning; (b) mental imagery, mental rehearsal and use of checklists; (c) distraction control/refocusing; and (d) learning from experience/constructive evaluation/learning from others.

Preparation and Planning

Four of the astronauts interviewed (Subjects 1, 4, 7 & 8) showed a strong inclination for planning and preparation. While Subject 1's comments were general in nature, two of the astronauts described detailed planning and preparation with respect to the astronaut selection process. Subject 7 had lengthy descriptions of these activities during pilot training, astronaut selection and training.

S1: (re: piloting)
A: It gives you experience in planning a flight. Space flight or any other kind. You know basically what is going to happen, you know there's going to be a commander in charge and you know how to relate to a commander of an aircraft. You know how to relate to a commander of the space craft the same way. You get along with people better....I

think the basic approach to an examination or astronaut training is basically the same. That is to try to see it and plan it all out.

S7: (re: astronaut training) I went through a few of the simulators as practice and tried to pick out "okay this is what happens, this is what happens" and then I get a piece of paper and I'd write out "okay this is important, this is important and everything I could notice going through these things that I thought, you know, sequence of events. Little hints from people, you know, trying to put it all together in my mind of how this should go and then I wrote in like two or three pages of just random notes. And then as I do it more I sit down and I try and order those notes and see what's really important and what's not, and focus it down so that now when I get into an ascent sim., most of those things are now familiar to me and I know how its going to go....I know I'm going to have a simulator the next day so I'll just sit down for one hour the day before, go over all my notes, try to focus in on the areas that we're liable to be looking at that day, refresh myself on those areas, you know, just prep myself for what's going to happen.

The focus of Subject 7's preparation and planning described above is performing well in a simulator session. The planning aspect of the activity involves planning how to get the most out of a simulator session by learning and remembering important event sequences, in order to improve subsequent performance, i.e., planning the preparation. The preparation involves taking notes, reviewing notes from previous sessions and getting "hints" from others.

Subject 4 described a plan for submitting an acceptable application in the first stage of astronaut selection.

S4: (re: Stage 1 of astronaut selection process) My

involvement with the selection process started when I heard on the news that they were asking for astronauts. It is the kind of news that makes you stand up in the middle of your room and get excited. It is happening again and we are going to go for it, we are going to try it and maybe get an interview, it is exciting time, and I got the clipping from a friend out of the newspaper that had the address, it was in French and reading through it and trying to figure out what they wanted, that is where the difficult part started. Trying to understand exactly what they wanted in the few paragraphs that they had, and then trying to write a CV, which was the first CV that I had written in my life and agonizing over that, and the wording and what do you include, what don't you include. Do they want to know about this or don't they. Is this trivial? What will influence them? The covering letter. Trying to understand what mentality do they want, do you come across strong or excited or what? I gave the CV to a number of people to read and got back as many different responses, it is good, it is bad, it sucks. When it got accepted they sent another package with more detailed information. The same sort of process there, what are they looking for, they want a paragraph written in French about why you think the astronaut program is important in Canada, what are they looking for? Trying to second guess.

S7: (re: Final stage of astronaut selection process) I prepared like crazy for the astronaut selection.... This is something I really want, I'm competing with all these people, let's get ready. So I researched the Canadian Space Agency, I wrote out a list of a hundred questions I thought they'd ask me and then I rewrote out answers to a hundred questions so that all of those questions I could sound natural and familiar and spontaneous and coherent about. Umm, I tried to do research on the people that were going to be on the Board that were selecting me so I wouldn't commit some gaff but also so that I would have some idea of where their interests would be. Umm, I tried to prepare physically, you know, they're doing a big physical on me so I tried to, you know, do all the right things to my body for the few months prior to get it ready. There are whole interview preparation processes that a lot of airline pilot applicants use. There's books and people that their whole job is to prepare people for airline pilot interviews

> and so I didn't actually hire anybody but a friend of mine was a pilot so I got his books and went through how you should prepare for an interview. What to do, what not to do, that kind of thing. Umm, so I guess its the way I do all these things but I try to think of all the things that they might do to me and figure out what I was going to do as a result and then when I came into all those different things, you know including the interview, I felt confident...But anyway I try not to leave things to chance.

In going through the astronaut selection process the focus of the preparation and planning activities for Subject 4 was on getting an interview. The planning activity was the strategy of planning the best response by second guessing the selection committee at every possible aspect of the application, such as the contents of the covering letter, the contents of the CV, and the level of excitement to display in the application. The preparation activity involves the implied execution of the plan and the attention to all of the planning details.

The focus of Subject 7's preparation and planning (described above) for the final stage of the selection process is selection as a Canadian astronaut. Here again the planning activity involves formulation of ideas of how to second guess the selection committee, by learning how to prepare for an interview, researching background material on the Canadian Space Agency and members of the selection panel, creating a list of one hundred practice questions, etc. The

preparation activity involves actually going through the lengthy process of executing the plan. Notable in Subject 7's description is the extent to which the planning and preparation strategies are taken.

Subsequently, during the interview Subject 7 discussed similar strategies in pilot training school.

S7: It (planning and preparation for astronaut selection) is the same thing I did when I was going through pilot training where there was a lot of competition and I knew that the person who came first...pilot training if you come first in the course you get your choice of what airplane you want to fly, if you come second or anything else, it's a lottery as to what airplane you're going to fly for the rest of your life. So I thought it would be good to come first....When a test was coming up, I'd look at all the possible scenarios and then I would try and figure out exactly what I wanted to do for each one of those scenarios for, you know, how I'm going to respond, what I want to do with the airplane. Where I want to be, how I want to think ahead.

Q: What would be an example?

A: I took a map of the whole area and I drew on the map where I was going to be over the ground, what the distances were like. What the proportions looked like. If I extended, if I had to do a hold where the hold would be over the ground, to try and get in my mind a real complete three dimensional picture of how this was all going to look so that I'd know when anything happened. I'd know exactly. I know its about that far and that distance. I can picture it all so much more easily because I'd spent some time mapping it out....One of the tasks was minimum time to intercept. You're simulating that you're sitting runway alert and you are scrambled to go intercept some sort of incoming threat....And so we set down on paper and figured out, you know, with all the books and the airplane, figure out what's the most efficient and fast way to do these things which, you know, we got maps, mapped out all the possible routes, what the best way to get out there would be and then once we got out there we tried all different, I

> did it with one other guy, we tried all different types of, its like a waiting pattern, you go into waiting until you can turn your nose and come in on someone. We tried those at all different altitudes and different designs and things until we found what we thought gave us the best compromise of lookout and energy and all that. And then, our tactics for rolling, we tried a bunch, we evaluated and we figured out what we thought was the most flexible and the most efficient. And then we practised identification on a bunch of different airplane types so that we would learn the best way to roll in and come up and be able to identify what it is we're looking at. And so we just went over those, over and over and over, until the whole thing became very familiar so that when the first time we ever did it in competition, it was, we'd been there before.

Here the object of the preparation and planning is to come first in pilot training school. The planning activities centre around figuring out all the possibilities and response patterns in flight tests. The preparation stage involves learning new geography, new technical and strategic material, setting it down on paper, mental practice and finally physical practice to test and become familiar with all possible scenarios.

Subject 7 added later that preparation is the difference between doing well and not so well, explaining further that having a plan for all possible contingencies includes planning to fall back on and trust one's basic skills if none of the specific plans are working.

S7: Q: Like in situations where you haven't done as well is it usually a focus thing or a preparation thing? I mean like sometimes I'm sure you get into

those one on one's (fighter pilot competitions) and you're just awesome. And other times its not quite as good. What seems to be the difference? A: Preparation normally. Currency, preparation. Being ready to go.

S7: I try and get specific plans and then I have a general plan as well. So they do this, I'm going to do this. If they try and pinch me from the right-hand side, we're going to kick this way, we're going to implement this plan. But if someone comes into the fight from that area, then you know, if you're shot well then I'll do my best, I'll try and come back. I try and go to a much less specific plan. I mean you can't plan for everything so.
Q: So is that plan kind of just being ready to trust yourself to respond. Do you think that's the same thing?
A: Yeah. Sure. And you really have to have that trust and you have to have that confidence that if it falls apart, I'm going to have to drop back on my basic tool box full of skills here to deal with these things and then go back to my basic rules of how I fly airplanes or how I go to an interview or how I give a speech or how I answer a question because it could all fall apart.

S8: ...I think that when I look at a flight opportunity what is most important to me is to be well prepared. I think that if you are well prepared then everything else falls into place. When I say well prepared it is taking every one of your simulator classes seriously. I don't think I can say that I have come out of a class yet where I have felt happy with myself, to be honest with you. I felt, you are making progress but you are not there. I want to be able to before I fly feel that I am so well prepared that I am acing these training classes.

S8: Q: What do you do to get, how do you get the most out of every day?
A: You prepare for it. I don't come in cold. If I come in cold I am not going to, it affects my learning ability as well as the fact that I am not going to do well, so I prepare for it.
Q; What does that mean?
A: Prepare for most of the runs that I do involves reading material. I am operating the arm, there are physical skills involved, eye hand coordination, that kind of thing. There is a

> trainer down on the second floor where I can go and practice that. But apart from that you have to know the procedures, you can only do that by reading the material.

For Subject 8 the importance of preparation was in learning new material in order to approach simulator sessions most effectively.

Overall the various preparation and planning activities described by the four astronauts are focused on planning to avoid surprises, to deal with any contingency, and on assessing performance requirements. This carries with it a high component of (a) learning new material, such as technical material, event sequences, lists of questions, new geography, interviewing techniques, as well as (b) assessment of others, such as the astronaut selection committee, flight test examiners. As such the preparation and planning processes differed from the anticipation and planning component of mental readiness to perform surgery (McDonald & Orlick, 1994), where anticipation and planning related chiefly to planning to be mentally ready. In the surgical environment assessment of others and learning new material did not emerge as important attributes of anticipation and planning.

In a recent study Talbot-Honeck and Orlick (1995) found that equally important to planning and preparation for elite classical musicians were spontaneity, creativity, and flexibility. The musicians

credited these latter qualities with making the difference between being good and being great. Only one of the astronauts (Subject 7) mentioned the notion of flexibility.

S7: But maybe I'm giving you the impression of being too narrow. I also think its really important to not over channelize. You have to remain very flexible and one of the things that I go into all these things is expecting everything to go to feathers. You know, I think for example the U.S. Air force overtrains tremendously and the British Air Force coming into the second World War, they only knew certain ways of doing things and when that didn't work, they just got shot out of the sky. and so I've always really enjoyed the way Canadians fly airplanes as opposed to say the U.S. Air Force, sometimes the navy, in that you train like crazy to get as good in this vehicle as possible but you've got to expect everything to break, nothing to go as you plan, all of your things are failing and your wingman's gone and you know, expect it all. Try to have enough depth and breadth to be able to deal with a real breakdown of the order that you've been expecting.
Q: So you really prepare for everything but also be flexible to deal with anything maybe you didn't anticipate?
A: Right. Better to prepare for everything than not prepare for something. Because its not going to happen; nothing's going to happen the way you plan so try and see as many ways as you think things can happen but then try not to only visualize it from a point of view of one way of things occurring.

Mental Imagery, Mental Rehearsal and Use of Checklists

Six of the eight astronauts interviewed discussed the use of mental imagery in a number of situations: (a) parachuting (astronaut training), (b) flying, (c) checklists, (d) interpersonal relationships, (e) stress control, (f) sport, and (g) academics, learning techniques, presentations.

Subject 2 described use of mental imagery academically, in sport, and during astronaut training, noting that imagery assists one in risk situations (sky diving).

S2: (I used mental imagery) throughout my academic life primarily giving presentations and oral examinations and clinical examinations where your clinical skills are being assessed in an exam, any specific technique that I would be performing that is new or something like that. With the athletics. In any form of athletics I've found that its really helped and actually this year in terms of the training (astronaut training) because it is so broad based. You know we go from things like sky diving to gliding to aviation. It helps with all of those. I mean if you can't actually sit in a chair and see yourself jumping out of an airplane, reaching down and pulling on your ripcord you're not going to do it. I mean you're going to close your eyes and you're going to scream "oh my god am I going to die?".

Astronaut Training

Subject 6 described the use of imagery in learning to parachute during astronaut training. The imagery was used to rehearse emergency procedures, consisting of important sequences of events.

S6: When you do parachuting, you have an emergency procedure to go through which is if A not B, if C not D, depending on what kind of failure you have with your parachute. You've only got a few seconds to go through that matrix. ...anyway the first time you jump you know that if you have a failure you better know that matrix. Its not something you can learn by experience....If you have failure on the first day its a big step. So I spent a great deal of time sitting in a chair imagining all the failure sequences. On my fifth jump I had a failure, what's called a roman candle. We were on a progressive free fall course meaning you jump free fall pretty early in that program. But I spent a great deal of time visualizing the scenarios and it happened to me. And its

incredible because you've got that matrix down flat you just go through it. And by four hundred feet I had the problem solved and I didn't die....That was probably the first experience I had in training where I was tested - my coolness was tested. And I thought I'm no different than anybody else, how did I manage to do that?...It really is because they just teach you that matrix, you learn that matrix and then of course you take it on yourself to make sure you know it. They don't tell you how to know it, you figure that out.
Q: How often did you think you ran it through your head before that?
A: A hundred times. Easy a hundred times.

Similarly Subject 1 used imagery during astronaut training for learning emergency drills.

S1: I'd run through all the emergency drills in my mind so I'd have them all memorised....And I would imagine myself going through the drills reaching in the right place to get the right things.

Flying

Subjects 1, 2 and 8 described use of imagery in association with piloting aircraft. For Subjects 1 and 2 the imagery described is for obtaining a pilot's license or for learning to fly a new aircraft. The use described by Subject 8 of imagery for flying is not associated with learning new skills or being prepared for an examination, rather it is used routinely before every flight for remembering appropriate procedures.

S1: When I tried out for pilot training they had a little flight simulator you had to fly, and they tested over the weekend with three or four sessions in this thing. After I had one session of it that evening I sat for about two hours imagining myself flying it, and I knew I was doing the same thing I was doing when I was...(involved in sports). You imagine yourself doing it so that you can practice in your mind doing it. And I went

back there for my second one after having practised in my mind, because I imagined myself doing it. It was almost as good as really having that practice for two hours. I was two hours ahead of everybody. The testing officer said he had never seen anyone do it so well, he wondered how I could do it. Well I'd been practising for two hours in my mind.

S2: When I did my private flight test, I sort of sat there, and I knew...I have to have a physical image, its like I knew who the examiner was I knew what he looked like and I imagine ok he's getting on the airplane and I tell him this and we're going through step by step in great detail and imagining remaining in control throughout the whole thing.

S2: So for me to image something I have to have a very clear idea of the ideal performance and if I don't have an idea of the ideal performance I can't imagine myself doing that but if I go away from gliding lets say the new aspect that I had to learn there was taking off behind a tow plane and following the tow plane and I had an opportunity to watch the instructor do it so I had the ideal performance demonstrated so I had to think about ok what its going to feel like and this is what you're going to be like. I worked with that.

S2: So for instance like today when I'm going flying a new airplane, I've sat in the airplane. I know what it looks like in the airplane. I know where all the controls are, I did that yesterday. So last night when I was sitting in bed, I was sitting thinking, ok fine, the throttle's here I'm going to push both of these forward, after I take off the gear is going to come up I can pull the power back I am going to pull this back and I keep going through it in my mind. Until getting in the airplane is second nature I mean you've done it so many times already.

S8: I do it a lot for flying for example. I fly. I have been flying for about 10 years now. Just a private pilot, yes I visualize, the day I am going to go flying, I visualize how I am going to walk around that plane and check it out and how I am going to take the controls, how I am going to communicate with the tower and other planes, how I am going to taxi out to the runway, how I am going to take off, how I am going to fly, how I am going

to navigate.

Checklists

The use of imagery by Subjects 7 and 8 appeared to be associated with deriving and learning checklists. In a continuation of the text segment above, Subject 8 describes using visualization in a checklist approach to remembering procedures.

S8: You have to do that (visualize), because all the fatalities that you read about are because somebody forgot to go through that mental checklist. So you have to do it. Same thing when you scuba dive. You methodically go through. It is a checklist approach to everything. That is very much the way this whole astronaut business works. It is very much patterned off fighter aircraft procedures. I don't know if you fly an airplane, but anybody that flies an airplane goes through a checklist. In other words you are saying to yourself you don't trust your memory. Or its maybe so complicated that nobody can trust their memory. But if you don't you are going to forget something. Preparing, visualizing and then using your checklists when you actually do the procedures. That is basically it. When the problem occurs, you may or may not be good enough to grab it quickly, but at least you have done what you can to prepare.

In the following three text segments Subject 7 describes a process whereby drawing images on paper assists in the visualization of the event, and the mental picture then assists in the derivation of a checklist of items to remember. This checklist gradually becomes less detailed - a list of reminders, in some cases no longer necessary as the checklist becomes mental.

S7: (re: fighter pilot preparation) I generally draw

it out on paper and try and get a picture in my mind and then I try and write out a chronological sequence of what I expect to happen and where I'm going to be and where they're going to be. I give myself a three dimensional picture. And once I have a good three dimensional picture, then I can run through it in my mind what I'm going to be doing, when, you know, what I have or might need, normally some sort of check list. And normally I make up a very detailed check list but by the time I actually go do something I never have to look at the check list any more but the check list was part of my learning process to prepare for something.

Q: So the check list - did you use that when you were kind of going through scenarios in your mind? Did you have the check list right there, or?
A: Yes to develop it. I mean I do the same thing here (astronaut training). I make up a whole sequence of events of how I want it to go and as I get more and more familiar with doing it, I can just pick out key words out of the thing until I've done it enough times that I don't need the check list any more.

Q: Where did you come up with that kind of approach? Did you think of it or did someone talk to you about it?
A: Nobody ever told me about it, its just the way I've always done things.

S7: I have lots of note books. I try and what I actually ever take to an event with me, I'll take in the cockpit with me or something, I try and simplify down just to a check list. And actually you know, maybe just a page that has a few words on it so that I am reminded.

S7: Before I take off in any airplane I have a mental check list that I go through. You know no matter what airplane I'm getting in. This check list of the airplane is ready to go and I probably carry that across to a lot of things. You know I run through in my mind okay I want to have all these things lined up before I plunge into this environment. But its all very specific to whatever it is I'm trying to do and to the pace and the risk of what I'm doing. The faster and riskier it is then the more I want to have done beforehand.

It is clear that the imagery described in the

sections on astronaut training, flying and checklists, has a common theme, in that in each case imagery is used as a strategy for learning or remembering technical procedures. In only one instance, Subject 2, was there reference to using imagery in a flight situation to familiarize oneself with the situation in a more global way. That is, for subject 2, the imagery included seeing and having conversations with the examiner, and visualizing staying in control.

Interpersonal Relationships

Of all the astronauts, Subject 2, described the widest range of use of imagery, not only full images including feeling in technical situations, but also use of imagery in interpersonal relationships.

S2: In the past I've used sort of imagery in dealing with people, in confronting problem people. The typical example in emergency is the problem patient. Well, if you can never imagine yourself dealing with a problem patient you're always going to have difficulty so we used to sit down and think about how to deal with the problem patient and go through scenarios and that.

Subject 4 also describes the use of imagery for learning or changing behaviour patterns.

S4: Your roommate or your children are watching tv and you think why couldn't they have cleaned up the damned kitchen. You have two choices of response, you can fly off the handle, yell, and put them down, do something like that or you can just put the emotion aside and get on with cleaning up the kitchen and not respond. The choice depends upon your values and things like that. Whatever you choose, if you choose the one that is contrary to your nature which is to rant and rave, that is a very hard thing to do that is a hard thing to

learn. Using imagery or something like that helps you, you see yourself responding to negative situations with a positive proactive approach, it is helpful. It really is.

Stress Control

Subject 2 was also the only astronaut to explicitly discuss the use of imagery for controlling stress.

S2: Towards the end of my (former career) I was using more imagery to help me survive in the sense that you...things happen you can never predict what's going to happen to you, and what you're going to be involved in...this to me was very stressful at times. I would sit there and I'd try to figure out how can I minimize my stress? And then at one point I thought about it and said why don't you just imagine yourself with the department falling apart, and being in control, being able to handle the problems when they arise. When (co-worker) comes to you instead of blowing up and decompensating, imagine yourself with six problems on the go. And dealing with it calmly and dealing with it in an efficient manner. When I did that I would go in and work and it would be great. Its the same people, same volume, same problems and yet it would work out really well.

S2: For instance if I wanted to imagine myself controlling a bad shift I'd sit down and I'd create the worst shift in my mind when we've got (work) coming out of our ears.... dealing with multiple problems simultaneously. I can imagine, I can run through the whole scenario of how to treat the (problem) in my mind without them even being there, ahead of time. That would very accurately correlate with what I do in the real situation.... Going through the various things that could be problems that I would encounter and drawing from my past experience in imagining the things that would help me. So it would be fairly detailed.

S2: I think if you run through it in your mind and you see yourself coping in your mind and then if you can cope with the worst that you can give yourself then you go in and you actually do it. Often times it just reaffirms how the sort of mental preparation works because the shift isn't as bad

as you thought it was going to be. You see yourself in control and it worked and you feel good about it and you know you're not reacting inappropriately to nurses because you've put yourself mentally in a stressful situation and you've said to yourself " no I'm not going to yell at them". you know, " I'm gong to deal with it in this manner". and you try it and it works and it's self affirming. In that sense you get positive feedback when it does work.

S2: (re: preparing for the astronaut selection process) We were asked to give a presentation to again the same panel and I did a lot of sort of mental preparation. Sitting there imagining what the room was going to look like, imagining the people sitting there looking at me, everybody staring at you not looking or saying anything. Imagining my talk and how its going to go. If...again with lectures I feel that if I can't run through my whole talk in my head ahead of time I won't be able to give it the way I want to. I don't use cue cards or anything I just get up and talk. The reason why I can do that is because I'd given the talk about fifteen million times in my head, ahead of time. So I did a lot of that. To avoid stress because I thought that if I could imagine the table with all these people sitting around and the CBC camera in the back and I look straight at the camera because I know that its going to be there and I've thought about what its going to be like. Then I thought it would go a lot smoother. So I did a lot of that.

Sport

In an earlier description by Subject 1 of imagery in flying, reference is made to having used imagery before in sport situations. Similarly for Subjects 2 and 7 descriptions of imagery included its uses in sport. For Subject 2, imagery was used for skill acquisition in learning to ski, for Subject 7 imagery was used for remembering and mentally practising slalom runs in skiing, as a ten year old.

S2: So I started skiing never having skied before in my life. And thought about skiing a lot, and I skied with two people who were experts far beyond my level of skiing. I would go home and I'd think about what they did and I'd think about how they had approached it and I'd try and get the feeling for weight shifting and things like that and the next year I was teaching skiing. I went from being a snow plower to skiing parallel in one season, I was amazed because I don't consider myself a phenomenal athlete by any stretch of the imagination. To me that just showed that you really can if you assume that you can do it and if you get rid of the mental biases...no I can't do this...and you get over that hang up and then you just sit down and think about the actual physical task, keep going over it and over it until you can imagine yourself doing it then to me it was really inherently easy to go out and ski parallel.

S2: I'd say when I first started doing it (Mental Imagery) it was more difficult and skiing was really where...the first example that really showed me how it works. Because I didn't expect to go from never having skied to skiing parallel in one season. To me that was a bit ludicrous. But I was actually able to do it by concentrating a lot and spending a lot of time concentrating and sitting down doing sort of mental exercises.

S7: When I was ten years old, we'd draw slalom courses and you'd just draw a theoretical course and just choose the best line through it and picture if I was skiing this course, what's the best way to get through this thing in minimum time. And then when a course was put on hill you'd walk the hill and pick up what the best line is going to be, where it's going to be tough and if they'd let you, you'd run the course a few times but normally you can't run a course before the competition. But again, the same thing so that when you go through the course, you aren't surprised.
Q: Well, did you know, like when you first did it with your skiing, was it easy to visualize the course or your line or was it something that you really had to work on?
A: No, that's easy. That's the best way to do it.
Q: But you had no problem kind of getting that image or getting these three dimensional images?
A: No. No. You've got to think in flying everything's three dimensional and air fighting, if you're going to go air fight with someone, its

> a big three dimensional ballet and you've got to think in three dimensions.

The uses of imagery have been well documented in the context of sport (Murphy & Jowdy, 1992), as well as in other domains such as business (Loehr & McLaughlin, 1986) and surgery (McDonald & Orlick, 1995). The use of imagery by the subjects in the present study directly parallels some of the uses identified in the applied sport psychology field, namely: skill acquisition; planning/event management; emotional rescripting (stress management); (Murphy & Jowdy, 1992). The use of imagery by astronauts also parallels the uses of imagery in medicine for learning surgical techniques, rehearsing in preparation for surgery, and recalling and evaluating performance details (McDonald & Orlick, 1995).

Distraction Control

Distractions can create performance disadvantages. The concept of distraction control is described by Orlick (1992) as the ability to deal effectively with things that can pull you off track, or the ability to refocus effectively in the face of distractions. The development of plans for refocusing when faced with set backs and other distractions are crucial to a high performance outcome. The surgical environment provides support for the importance of these skills in other domains. All surgeons in the McDonald and Orlick study

(1995) reported the ability to get back on track quickly and to maintain a constructive focus during high action periods.

In the present study four Subjects (1, 3, 4 & 8) discussed thought patterns aimed at refocusing or controlling distractions such as stress, fear, lack of focus during interviews, feeling inadequate during the selection process, and crises during flight simulations. Refocusing or distraction control was achieved through various means; physical exertion such as running, review of instructions in one's mind, reminders to keep calm, and positive thinking to bolster confidence.

As a strategy for controlling nervousness, Subject 3 found that physical exertion, such as running, was effective.

S3: Q: How do you prepare for situations that are really challenging?
A: I go running. Get the stress off. Well maybe when something is important what you are thinking about it is right there, it is right in your mind. I remember that the first day of the 20 finalists (astronaut selection), ... we all had to give a 7 minute presentation...then in between that presentation and the dexterity test I was like a lion in a cage. I was thinking what am I doing here, dexterity test, I am nervous. I took my shoes and went running. Didn't help very much. No it does, same with just before I got my private pilots licence a few months ago.... I was having the hardest time to calm myself down, so I ran one of my best runs ever.

S3: Another example is when we were doing gliding September last year. Took my shorts and then went running, knew that I needed to do this in order to

retain a bit of sanity before I go into this plane. I was so nervous....So the only way I know of coping in these situations is going and straining myself.

Mental rehearsal of the procedures to be followed enabled Subject 1 to concentrate on the job to be done and to turn off the fear.

S1: Going up for the first sky dive I can remember thinking...you'd have to be pretty dumb to jump out of a perfectly serviceable airplane.... And then I also thought that you better quit thinking about that and review in your mind what you are going to do, because you're probably going to get thrown out by peer pressure, and you better remember to do things right. So I'd run over in my mind repeatedly what I'd have to remember. And what I had to do.... So then I was able to sort of turn off the fear and concentrate on the job to be done and that sort of took my mind off it.

Subject 4 reported the strategy of consciously trying to remain focused, in control and calm, by "being aware" of what was going on during the interview process.

S4: (re: preparation for interview in astronaut selection process) Just be extremely aware of situations. Of the questions, trying to be mentally quick on the answers, trying not to babble on, keep in control of what I was saying, not be afraid or anything like that when faced with unknown questions. Remaining calm in the situation. Things like that.

During flight simulations the "freeze reaction" experienced by Subject 8 during simulated malfunctions gradually disappeared due to repeated practice and familiarity with the simulator problems.

S8: (re: flight simulations) ...when bells and whistles go off (malfunctions), something happens to your mind, it is just not the crystal clear

thing that it was when you were sitting down in the room preparing for it. Suddenly there is a freeze reaction, which as you do more and more training and you practice more and more and get more and more used to seeing the problems, goes away. (Then during simulated malfunctions) it is quite clear at least in my own mind, I may be going down the wrong path, but in my mind it is clear and it is unaffected by the panic of the moment.

In order to avoid being distracted by the strengths of the other candidates, to remain focused and positive during the final stages of the astronaut selection process, Subject 4 followed a strategy of actively trying to bolster confidence, through positive self suggestion, and positive comparison with the attributes of the other candidates.

S4: (re: final interview stage of astronaut selection process) About the time that the interviews started I would start doing things like get up in the morning and look in the mirror and go "you are the greatest". To bolster my confidence and things like that. It worked. My confidence was strong. My enthusiasm stayed strong all the way through, each time I kept getting a response it was reinforcement, it was good. When I got to the final week, the 20, I am telling you I really needed it. Because those were 20 of the strongest people I have ever seen in my life. I felt like an insignificant person standing in a room of giants, and it was tough. It took all of the week to build my confidence....So I found out where I was strong in comparison with the other people, and when the interview came and they asked why should they pick me I had the answer ready, I could say that I had the qualities that I see lacking in the others, I feel that these are necessary qualities, was able to make a pretty strong case. I don't think I would have done as well if my final interview had been on the Monday rather than on the Friday. Because it was on the Friday I really felt that when I came out of the interview that they had my best performance that there was not much else that I could have done to influence their decision....

> That was a big difference from the Monday, where I was feeling well I should just pack up and go home.
> Q: Would it be fair to say that your confidence grew?
> A: Throughout the week, yes. As I got to know the people, as I could assess where I was stronger, and by just continually bolstering my own confidence. I guess reaffirming that belief in myself. I think I can, I think I can.

For these four astronauts there appears to have been a conscious effort to change thought patterns, in challenging situations. During discussions of preparation for challenging situations with the other Subjects (2,5,6 & 7), no conscious effort to alter or redirect thinking patterns were mentioned.

Interestingly, the controlling of distractions plays a major part in the surgical environment. All 33 surgeons in the McDonald and Orlick study (1995) reported the ability to get back on track quickly and to maintain a constructive focus during high action periods in surgery.

Constructive Evaluation/Learning from Experience/Learning from Others

In the course of the interviews 5 astronauts indicated the importance of learning from previous experiences, describing strategies for learning from their own mistakes on a regular basis through the use of personal debriefing systems. Two of the subjects indicated a desire to learn or "get" from everybody they meet. This willingness to learn from one's own

experiences and from others is characterized not only by the desire to learn or improve upon skills/techniques, or to increase knowledge, but also is aimed at learning about oneself. This self-evaluation was conducted through internal grading systems, personal debriefing systems, or group debriefing and consultation.

Subject 5 describes a system of personal debriefing with journals for long term learning about certain situations and oneself. Subsequently, subject 5 discussed the use of tapes for daily debriefing as a strategy for learning about one's moods and for coping with fatigue and irritability.

S5: I have on record what it was that I'd done during the day, or my feelings or how I approached a certain problem. Because I liked learning from what I've done. It doesn't do me any good coming back from a flight and then going up on another one and not having learned something. I mean I'd like to be able to have learned not just techniques but learned how to deal with certain situations or learned about myself. Its very important. I'm always trying to do something a little better day by day and sometimes I give myself a B and sometimes I give myself an A+ but mostly they are Bs. I tend to be very critical about my own activities.

S5: I've got a bag of tapes dealing with training for the flight. I also do journals, and I would do more of them if I had more time. I find I dictate a lot of them. But I have a stack about this high of journals that I've written during the course of the three years in training.
Q: So in terms of the content of your journals and your debriefing tapes they deal with technical things and they also deal with...?
A: A lot of personal things, interpersonal...
Q: Do you have an example?

A: I found that when I was really, really tired...it sounds obvious but you never know you are tired sometimes, you can't admit when you are tired. So I started going back and thinking now how can I stop doing this... so I don't appear edgy or twitchy or...because I'm tired and I don't want to appear that I cannot cope with this stuff. But obviously whatever I've been using as coping mechanisms or dealing with this is not working....I'd listen to these tapes and I'd think oh, goodness I need help. So then I really tried to put in things to make a change because I didn't like the way I was having to deal with these people.

Subject 6 noted the value of learning about one's work from meeting others in the same field. Further a process of self growth is described in which one's perspectives about oneself alter due to exposure to other people.

S6: What I like when I meet somebody that is in the same area that I am, is that you learn more. The other thing is that your perspective of how you are looking at something compared to how you are being perceived...when you are in tight situations like that you do narrow down on what the truth is. Its not like...that's an interesting thing that you find out about yourself and then you do modify yourself according...not in an insincere way..but just every day you are trying to be a little bit better person. And when you get into close training situations like that whether they are in the gym, in athletics, or in a tight situation where everybody's life depends on it you do learn how to do that. And that's fascinating, not because of the group situation but because you are learning more about yourself. I have to say...find out things little things about yourself that you never would have thought that is what you are doing...but you are.
Q: Was part of your perspective then to learn something everyday?
A: Oh yes. That's actually what drives me.
Q: That's been true for...?
A: Since I was a kid, for some reason, and its not that I have this checklist in my head like what did I learn today, its just that jeez there is so

much out there. You know...Why does that work this way? Or why does that work this way. You just feel like you are in continual state of learning. And that is a driver for sure. Its not a driver, its just what bubbles up, you know.

Daily review of behaviour, looking forward and looking back from actions, characterized the evaluation and learning for Subject 7.

S7: I look at myself, I try to look at myself at the end of every day and say you did that badly. I tend to come across to people as very self-, not possessed but pre-occupied, and not particularly friendly to people. And its not that I'm not, its just that I know I come across that way. And so I look at myself at the end of the day and well tomorrow I'll try and do that a little better. And I look at how I treated my kids and you know, did I do that today. Shoot, I shouldn't have done that. So I try and you know I look at every day and I think well I blew that and I did that okay. Did that pretty well.

S7: I try and look forward and I try and look back and learn from what I did. Some things I've just given up on and okay I'm going to do it like that for my whole life, I can't help it.... but that's basically how I approached everything as long as I can remember. There was no significant event that changed the way I do things. Its just been a gradual evolution my whole life.

S7: I try and get from everybody I meet, if somebody's doing something well, or doing something that I'd like to do. I try and learn how they do things from everybody. And I look at certain, almost everybody does something better than I do, and its really good to learn how they do that or why they do that. And there's some great examples in this office. That's one of the beauties of working here is that there are some really competent people here. Good leadership and people skills and the way they run their lives. Very much worth mimicking. But no individual. I've tried to do that throughout my whole life. Look at a person, see what they're doing, try and filter out of it what applies to me or what's good for me and then see if I can apply that to myself.

With respect to performance in the pilot training environment, Subject 7 describes the value of group debriefing sessions, for learning from others who performed better that day.

S7: (re:fighter pilot competitions) Once and a while you run into somebody who's just better that you are. At least better that day and then you just try and find what they were doing that you weren't. What they were doing with that plane.
Q: And how would you do that?
A: We debrief extensively. Go through every single flight, every turn. What did you do here? What cues were you using, how did you do that and how, you know, how did you make the airplane do that? And try and learn. You know that's the reason we all do that in peace time is so that we know as much and we're as competent as anybody can be so that if we have to go fight with those things, we're better than anybody else.

Personal debriefing including written notes was described by Subject 8 as important for improving performance during astronaut training.

S8: I do a debrief to myself, I certainly jot down the areas where it is obvious to me that I made the wrong response and I have learned, because we get debriefed by training people what to do, so that I will hopefully not make that mistake the next time. Basically I think about it, sometimes it will linger on for a little while, it doesn't stop me from sleeping or anything, because I do a lot of these. The first time that you screw up you carry it with you for a long time, then you do so many simulations that you get into a sort of routine of... where you debrief yourself, learn from your mistakes and then when the next sim starts it is a different ball game.

A less specific description of personal development as a process of evolving due to important experiences in life is given by Subject 3.

S3: I can certainly say that there has been enormous influence in every stage for what you become later. For example (educational experience in another country), a lot of what I have become as an adult is direct from this experience. I learned almost unconsciously and I won't even be able to pinpoint what it is I learned there is something there that has been dramatic in my evolution. Definitely, sport is the same, music the same, there have been ups and downs, now I am talking to you about the ups, but there had been a number of downs, a number of times when it didn't work here, or it didn't work there and where you learn I guess to assert what are your priorities and then go for them.

Orlick (1992) describes constructive evaluation as the ability to extract important lessons from every critical performance, allowing one to continually adapt or refine one's approach to attaining a higher level of performance. The McDonald and Orlick (1995) study of elite surgeons found that the very best surgeons had developed persistent, ongoing procedures to evaluate and draw the lessons out of their performances. Each of the text segments reproduced in that study refers specifically to surgical procedures, and no mention is made of evaluation of interpersonal relationships for drawing out lessons of behaviour. Interestingly for five of the subjects the data in the current study reveals a willingness to learn from more general experiences. The existence of strategies for doing so reveals an important component of the thinking of these astronauts, namely the desire to improve upon their own attitudes concerning performance in a variety of

domains and in living their lives.

Conclusions and Recommendations for Future Research

The purpose of this study was to investigate Canadian astronauts from a mental strategies and perspectives point of view. The literature regarding mental strategies of athletes and others in high performance domains brings to light a number of conceptually similar characteristics related to excellence. Some of these characteristics were found to exist among the astronauts interviewed.

While the diverse nature of the past and present achievements of each astronaut produced rich and interesting lessons concerning excellence, this diversity present some difficulty in implementing the interview guide in a consistent manner. No one activity or performance was isolated that was of equal challenge to each astronaut. Therefore the descriptions of preparation, activities and approaches were inherently and necessarily different in context and content.

Both interviewers encountered an ability and willingness on the part of each subject to describe their perspectives and experiences in lengthy detail. In many cases the interview protocol was virtually set aside as the subjects began to talk with an eagerness, flow and control that at times made interruption by the researcher virtually impossible. Often one question led

to responses that touched upon most other questions in the interview guide. This demonstrated that following a detailed set of questions precisely, with a group of subjects as experientially and intellectually sophisticated as astronauts can be problematic.

The data elicited from the interviews offers interesting and important insights into the astronaut environment and multi-domain excellence. The data grouped together as Commitment to Excel, and Mental Approaches to Performance adds to the understanding of the nature of success and enhancement of performance through mental activity. As well the data relating to Early Influences in life opens up interesting areas for further examination of the development of the achievement perspectives that allow one to excel.

The following points may be drawn from the findings of this study:

- A committed, positive and constructive attitude links a diverse set of achievement perspectives;
- The main focus of these perspectives is learning;
- Factors important in pursuing high level goals were; high standards; a readiness for learning; getting the most out of the experience; dedication and pleasure in doing things as well as they can be done; and the relevance of the

goals being pursued.

- Early influences can contribute in a major way to later success in life by: breaking down conceptual limitations concerning what it is possible to achieve if one wants to; and by providing both challenges and support.
- Mental approaches to performance are characterized by a thoughtful structured approach involving detailed preparation and planning, mental imagery, mental imagery and use of checklists, and constructive evaluation of self and others.
- The maintenance of personal relationships and satisfaction of parenting, can have significant impact on the well-being and thus the potential for achievement of an individual.

These points paint a picture of becoming and being an astronaut beginning with early influences which provide a sense of unlimited opportunity, a supportive yet challenging environment creating a wide focus and fostering leadership and interpersonal skills. Commitment to high standards, to doing things as well as they can be done and the devotion to the process of learning, can be balanced with a commitment to the maintenance of relationships, and with the joy of parenting. Through the detailed descriptions of their

work and experiences these exemplary individuals present us with a mental approach to performance which focuses on planning and preparation through the use of mental imagery and related strategies. With the use of journals, tapes and other debriefing strategies these people have the ability to evaluate themselves for the purposes of reaching high performance goals as well as for personal growth. In addition to these self evaluation tendencies the ability to evaluate and learn from others adds another dimension to our picture of astronauts, namely that these people understand and work with their limitations. This aspect of their performance strengthens our picture of astronauts as persons whose approach to high performance demands is consistently related to strategies devoted to learning and constant improvement, emanating from the perspective of desiring always to do as well as possible.

It is evident that in multi - domain excellence such as that of astronauts, attitudes towards doing as well as possible are of primary importance and thus deserve further examination. The performance literature from the athletic world has focused on the ability to do well in a singular domain. The attitudes to achievement revealed in the present study focused on the development of multiple abilities, and may assist

in the formulation of more direct and relevant questions for future studies with similar subject groups.

It is anticipated that fun and enjoyment, and getting the most out of the experience, may emerge as primary factors characterizing the attitudes of people with multiple abilities and achievements. Taking pleasure in the effort and process of attaining a goal is alluded to by astronauts in the present study.

The focus of the day-to-day effectiveness of astronauts is based primarily on at least one (if not more) known and previously documented strategy - mental imagery, planning and preparation, and evaluation. The focus of these mental strategies is learning. The use of imagery was documented primarily for learning new tasks and lengthy technical procedures. Planning and preparation activities involved a high component of learning new material during the preparation phase, and the main characterizing feature of evaluation processes was the desire to learn more about either one's work or oneself.

This study has laid a foundation for further study of the astronaut domain with a larger group of subjects. Further insight into what is required to excel in this domain may be achieved by investigating the optimal use of mental imagery, planning and

preparation strategies and methods of evaluation. In particular, the use of imagery by astronauts and those in related areas (pilots), for learning complicated procedures and technical material is an area where more detailed work would be of benefit across a number of domains. Isolating certain performance areas and conducting a detailed study of the type and frequency of imagery used would assist in the overall understanding of this aspect of performance.

According to the astronauts not only are past experiences useful for improving specific performances but they are useful for improving ways of being. For some of the astronauts this behaviour was deemed to be necessary for overall achievement. A logical extension of this study would be to investigate with more direct and specific questioning the frequency and type of evaluation processes among a larger group of subjects.

Important for astronauts was the preservation of close personal relationships, and for those who were parents-the joy of parenting. Future investigation of the importance, abilities and strategies for maintaining relationships in the face of the high demands of astronaut training would be of benefit across many high performance domains.

In reflecting upon the privileged experience of meeting and interviewing astronauts the most powerful

and overriding impression was of people who although very different from each other, were linked by the common bond of enjoying the challenge of the high demands of their domain. Further, despite their differences, there was a common ability of being able to meet these challenges with a joy and enthusiasm that recognized no barriers to doing things as well as they can be done.

REFERENCES

Bloom, B. (Ed.). (1985). Developing talent in young people. New York: Random House.

Christensen, J., & Talbot, J. (1986). A review of the psychological aspects of space flight. Aviation, Space and Environmental Medicine, 57 (3), 203-212.

Csikszentmihalyi, M., Rathude, K., & Whalen, S. (1993). Talented Teenagers: The roots of success and failure. Cambridge: Cambridge University Press.

Conners, M., Harrison, A., & Akins, F. (1986). Psychology and the resurgent space program. American Psychologist, 41 (8), 906-913.

Cote, J., Salmela, J. H., Baria, A., & Russell, S. (1992). Organizing and interpreting unstructured qualitative data, The Sport Psychologist.

Feltz, D. L., & Landers, D. M. (1983). The effects of mental practice on motor skill learning and performance. Journal of Sport Psychology, 5, 25-57.

Gibbons, R., Baker, R., & Skinner, D. (1986). Field articulation testing: A predictor of technical skills in surgical residents. Journal of Surgical Research, 41 (1), 53-57.

Harris, P. (1989). Behavioral science space contributions. Behavioral Science, 34 (3), 207-227.

Harrison, A., Clearwater, Y., & McKay, C. (1989). The human experience in Antarctica: Applications to

life in space. Behavioral Science, 34 (4), 253-271.

Heishman, M. F., & Bunker, L. (1989). Use of mental preparation strategies by international elite female lacrosse players from five countries. The Sport Psychologist, 3, 14-22.

Helmreich, R. (1983). Applying psychology in outer space: Unfulfilled promises. American Psychologist, 38 (4), 445-450.

Hemery, D. (1986). Sporting excellence: A study of sport's highest achievers. Champaign, IL: Human Kinetics.

Hinshaw, K. (1991-1992). The effect of mental practice on motor skills. Imagination, Cognition and Personality, II (1), 3-35.

Jackson, S. (1992). Athletes in flow: A qualitative investigation of flow states in elite figure skaters. Journal of Applied Sport Psychology, 4, 161-180.

Kanas, N. (1987). Psychological and interpersonal issues in space. American Journal of Psychiatry, 144 (6), 703-709.

Kanas, N. (1991). Psychosocial support for cosmonauts. Aviation, Space and Environmental Medicine, 62 (4), 353-355.

Lincoln, Y., & Guba, E. (1985). Naturalistic

inquiry. Beverly Hills: Sage Publications, Inc.

Loehr, J., & McLaughlin, P. (1986). Mentally tough: The principles of winning at sports applied to winning in business. New York: M. Evans and Company Inc.

Maddox, N., Anthony, W., & Wheatley, Jr., W. (1987). Creative strategic planning using imagery. Long Range Planning, 20 (5), 118-124.

Mahoney, M. J., Gabriel, T. J. & Perkins, T. S. (1987). Psychological skills and exceptional athletic performance. The Sport Psychologist. 1, 181-199.

Martens, R. (1987). Science, knowledge and sport psychology. The Sport Psychologist, 1, 29-55.

McCaffrey, N., & Orlick, T. (1989). Mental factors related to excellence among top professional golfers. International Journal of Sport Psychology, 20 (4), 256-277.

McDonald, J.(1992). An investigation of mental readiness and its links to performance excellence in surgery. Unpublished Master's Thesis, University of Ottawa.

McDonald, J., & Orlick, T. (1994). Excellence in surgery: Psychological Considerations. Journal of Performance Enhancement, 2, 13-33.

Murphy, S. M., & Jowdy, D. P. (1992). Imagery and

mental practice. In T. Horn (Ed.), Advances in sport psychology. Champaign, Il: Human Kinetics

Orlick, T. (1986). Psyching for sport. Champaign, IL: Leisure Press.

Orlick, T. (1990). In pursuit of excellence (2nd ed). Champaign, IL: Leisure Press.

Orlick, T. (1992). The psychology of personal excellence. Contemporary Thought on Performance Enhancement, 1.

Orlick, T. (1993). Going after the dream and reaching it: The Olympic downhill--Terry Orlick and Kerrin Lee-Gartner. Contemporary Thought on Performance Enhancement, 2, 110-122.

Orlick, T., & Partington, J. (1988). Mental Links to excellence. The Sport Psychologist, 2, 105-130.

Pines, M. (1980). Stress tolerance makes the difference. Psychology Today, Dec., 3-36.

Ripol, B. (1993). The psychology of the swimming taper. Contemporary Thought on Performance Enhancement, 2, 22-64.

Sage, G.H. (1989). A commentary on qualitative research as a form of scientific inquiry in sport and physical education. Research Quarterly for Exercise and Sport, 60, 25-29.

Santy, P. (1983). The journey out and in:

Psychology and space exploration. American Journal of Psychiatry. 140 (5), 519-527.

Talbot-Honeck, C., & Orlick, T. (1995) The essence of excellence: A picture of elite musicians mental readiness to excel. Manuscript submitted for publication.

Ungerleider, S., Golding, J., Porter, K., & Foster, J. (1989). An exploratory examination of cognitive strategies used by masters track and field athletes. The Sport Psychologist, 3, 245-253.

Vandell, Davis & Clugston. (1943). The function of mental practice in the acquisition of motor skills. Journal of General Psychology, 23, 243-250.

Zitzelsberger, L., & Orlick, T. (1995). Balanced excellence: Juggling relationships and demanding careers. Manuscript submitted for publication.

APPENDIX A

ASTRONAUT INTERVIEW GUIDE

1. Thinking about your background and upbringing what do you consider to be the major accomplishments in your life? What are you most proud of?

2. Thinking back to your childhood and young adulthood, what would you say contributed to these achievements?

3. How long have you wanted to become an astronaut? How important was becoming an astronaut to you?

4. Why do you think you were selected as an astronaut?

5. Have you ever doubted that you could achieve your goals?
   If yes, why ?
   If no, what made you believe in yourself?
   (Probe for "road blocks" and methods of overcoming them)

6. Thinking back to (name major achievements), what if anything, did you learn that contributed to your subsequent successes and to being selected as an astronaut (and to go in to space if applicable)?

7. Is there anything or anyone you think was essential to your success? For example without them or it you could not have become an astronaut?

8. Are there situations you have experienced where you really need, or needed to be mentally ready?

9. What kinds of things do you generally do and think about before a challenging situation? Do you do and think the same things every time? (Refer to a major achievement from Qu.2 and probe for feelings, thoughts and focus, before, during and after) Did you prepare yourself the same way for the selection process, or the training program ? (Include space flight if applicable.)

10. How do you approach sessions in the astronaut training program? Do you have ways of preparing yourself to get the most out of these sessions?

11.(a) What has been the most challenging part of the program to date?

11.(b) How do you overcome these obstacles or push yourself when faced with difficult physical, social and/or intellectual demands?

12. Do you think you prepare differently from other astronauts?

13. Do you do much reflection or evaluation after experiencing challenging or difficult situations?

14. When you compare challenging situations where you performed well, to those where you haven't, what (if anything) was different in terms of your thinking, feeling, focus etc.?

SPACE FLIGHT

15. Describe your feelings on the morning of the flight. What were you thinking, saying to yourself? Did you feel ready?

16. What were you thinking, saying to yourself or feeling during the launch?

17. Do you think you prepared for the mission differently from other astronauts? In what way? What could you have done to feel more ready?

18. (a) Did you have any problems sleeping? If yes: What did you do?

(b) Did you have any problems concentrating during the flight?

If yes: What, if anything, did you do?

(c) How did the crew get along?

19. Did anything unforseen happen, either before or during your flight which may have affected your performance? What were you thinking or saying to yourself at that time? Were you able keep "on track"? How?

20. What were you thinking, saying or focused on :

(a) during the flight during periods of action/work?

(b) during lulls in flight activities?

21. Do you feel that you performed as successfully as you could have during the flight?

22. What could be done to improve the overall or mental readiness of other astronauts such as yourself?

23. How have things been going since your return to earth?
    Have you changed in any way?
    Have the demands on you changed in any way?
    What are you goals now, career and personally?

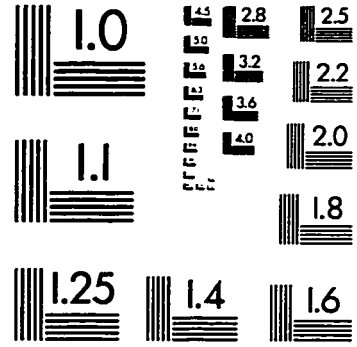
CONCLUSION (Applies to all)

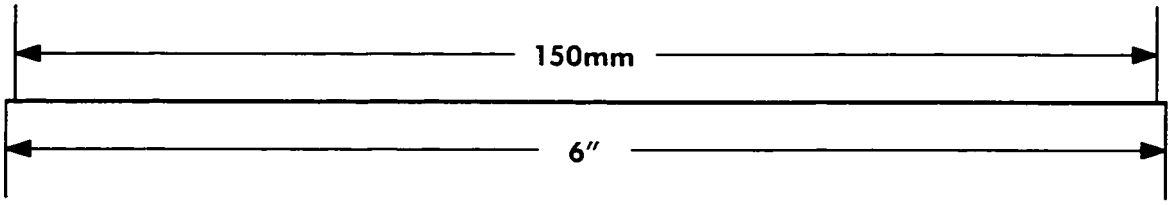
24. What do you think are the most important mental skills for astronauts?

25. What is the most difficult part of being an astronaut?

26. Is there anything else you would like to talk about?

TEST TARGET (QA-3)





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