Beyond the "Right Stuff": The role of group processes in isolated confined extreme environments

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DECLARATION

The research reported in this thesis is my own, except where indicated and has not been submitted for higher degree at any other institution

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ABSTRACT

The purpose of this thesis was to apply mainstream theoretical social psychology to the problem of group dynamics in isolated confined extreme (ICE) environments, with a particular focus on the context of long duration spaceflight. This was done by providing a thorough review of both the ICE environment psychology literature and the social psychological literature. From this it emerged that significant gaps existed within the ICE literature, particularly around the understanding of group processes. A review of relevant social psychology literature suggested that social identity theory and self-categorization theory (referred to as the social identity perspective) may have much to offer in advancing the understanding of group processes in these environments. It was argued that processes related to social identification had the potential to play a key role in the ability of teams in these environments to function effectively together. Of particular note was how the "norms" of a social group could influence both social identification processes and group functioning more broadly. Crew heterogeneity had been cited as a major source of concern in much of the ICE literature, so group norms that related to diversity were investigated from the social identity perspective.

Three theoretical chapters provided a thorough review of the space and ICE environment psychology literature (Chapter 2), the social psychology literature (with a particular focus on social identity theory and self-categorization theory) (Chapter 3) and the diversity literature (from the ICE literature, and the social/organisational psychology) (Chapter 5).

Five experiments are reported in this thesis. The first was an exploratory field study which applied social identity perspective thinking to an ICE environment for the first time. This study took place during an expedition into the Australian Outback and made general predictions about how the way people identify with different social groups might be constrained by the extreme environment context. Identity processes were indeed found to play an important role in the group's dynamics. Interestingly it was found that the presence of a pro-diversity group norm seemed to have a positive influence on group outcomes. In order to explore this issue in more detail, Studies 2, 3, 4 and 5 all investigated the role of diversity norms in effective group functioning. Study 2 was also a field study which took place at the Mars Desert Research station in Utah. Studies 2 and 3 were both conducted in

the laboratory and Study 5 took place during a winter-over period at the Concordia Research station in Antarctica. Collectively these four studies demonstrated that ingroup identification played an important role in driving group functionality in extreme environments. In addition they also demonstrated that the presence of a pro-diversity group norm had the potential to increase group identification while also reducing the likelihood of negative outcomes (crew alienation and sub-group conflict).

Studies 1 and 5 also introduced two advanced statistical analysis techniques (Multilevel Linear Modelling and Social Network Analysis) that could be used in future extreme environment research which have the potential to significantly improve the validity of results. By using these techniques in this thesis, the certainty surrounding the research findings was greatly enhanced.

Taken together the literature reviewed and the experiments conducted demonstrated three key points. The first was that mainstream social psychology theory and research has much to offer extreme environment research. The second was that social identification processes play a key role in the group dynamics of people in extreme environments and the third was that a pro-diversity norm, under certain conditions, can play an important role in maximising group functioning. The contribution of this thesis, then, has implications for the ICE literature as well as the social/organisational literature on group diversity and building unified systems while fostering the diversity that is needed within those systems.

- Chapter 1 -

Overview and Definition of the Thesis

1.1   Purpose of the Thesis

Over forty years have passed since the first human being was launched into space. In that time there has literally been hundreds of human and robotic missions launched beyond our atmosphere. On January 14th 2004 however the US President George W. Bush set out a new vision for the future of human space flight. This dramatic shift in space policy will see a program of space exploration which takes humans further away from the Earth than ever before. The plan is for human exploration of Mars and other parts of our solar system (National Aeronautics and Space Administration, 2004). For the first time in history people will be almost entirely isolated from the Earth. There will be no way of seeing our planet and communications will be under time delay of up to 40 minutes.

In order for such missions to be successful, the psychological functioning of crewmembers must be taken into account (Dion, 2004). There is no point spending the billions of dollars to send humans to Mars, if a mission then fails due to the crew's inability to cooperate with one another. It is all well and good to build a spacecraft capable of taking people to another planet, but ultimately any human mission requires the well-being of its crew to be of the highest priority. Due to the potential stress of the space environment it is therefore necessary to understand what will happen psychologically to the crew of such missions. This thesis examines certain aspects of the social psychological functioning of small groups within this and related contexts, with the goal of generating knowledge which will improve the chances for the success of such missions.

The importance of psychology to these missions is only now being fully realised. While billions of dollars have been spent ensuring the physical safety of space crews,

comparatively little has been invested into their psychological well-being. Areas of psychology of particular interest include those to do with cognitive functioning, crew selection and personality, clinical psychology and social psychology.

The amount of research actually conducted in space (for a few examples see Kanas, Salnitskiy, Grund, et al. 2001; Kanas, Salnitskiy, Gushin, et al, 2001; Kanas, Salnitskiy, Ritsher, et al. 2006; Kozerenko, Gushin, Sled, Efimov, & Pystinnikova, 1999) is exceptionally limited with most research undertaken in space 'analogue' environments. This is mainly due to the lack of opportunity to conduct research in space.

In order for an environment to be an analogue of space, it needs to have essential features (such as isolation, confinement, real danger, etc) in common with space flight. The most commonly used space flight analogues for psychological research are polar missions, in particular, Antarctic research stations. Other analogue environments include submarines and other locations in which people are in isolated, confined and/or extreme environments (or the appropriately named ICE environments).

There have also been various studies conducted in specially designed analogue environments. One important example was the SFINCS-99 International Space Station simulation conducted by the Institute for Biomedical Problems in Russia (see Gushin, et al. 1997; Inoue, Matsuzaki & Ohshima 2004, for examples of published work from this simulation). Other examples include the American underwater laboratory Aquarius (used by NASA to study the effects of isolation; see Miller & Cooper, 2001) and the Mars Desert Research station in Utah (see Clancey, 2006, Dawson; Roesch & Solignac, 2004 for examples).

Of the psychological research conducted in space and its analogues, only a small minority has concerned the social dynamics of such groups. The kind of research that has been conducted is mostly in areas such as cognitive load (how much work a person can do before performance decreases and how space impacts on a person's task load capability; see Fowler, Bock & Comfort, 2000 for an example), personality and crew selection issues (who the "right" people are for such missions; see Fassbender & Goeters, 1994), clinical and sub clinical issues (such as managing depression or other psychopathologies that might emerge; see Peri, Scarlata & Barbarito, 2000), management of deviant behaviour (see Dudley-Rowley, 1997), human-environment interactions (human factors including habitat and equipment design; see Whitmore, McQuilkin, & Woolford, 1998), management of stress, interpersonal relations and psycho-social issues (Dawson, 2002).

While some work has been done in these areas, there is not a sizeable body of literature and far more work is needed. The current state of the literature surrounding this issue is that it is mostly applied in nature and does not draw directly from mainstream psychology. Due to the small amount of work that has been done, and the very different perspectives taken by researchers, it is difficult for one to suggest that there is a comprehensive or coherent picture of human psychological functioning in space. The field is mostly in its infancy with many gaps yet to be filled.

The social psychology of ICE environments can be conceptualised at three levels. That is, processes occurring at the personal level (such as personality, self image and clinical issues), the interpersonal level (such as relationships between individuals), or the group level (processes by which groups are formed and how norms emerge, change and impact on behaviour). To date almost all social psychology conducted in ICE environments has been done at either the personal or interpersonal level, there is little if any work done at the group level.

Many years and thousands of studies in traditional social psychology have highlighted the importance of taking group-based processes into account when trying to understand human social behaviour. This highlights a large gap which is yet to be filled within the field of space psychology. This thesis has been developed to address this gap by applying mainstream group-based social psychological theory to the space flight context. More specifically, the focus of this thesis is on the process by which individuals see themselves as group members (the development of shared group identities) and how particular cultures develop and impact on a group affecting mission outcomes.

This thesis is unique in that it is the first collection of empirical research, to apply mainstream, group-based social psychology theory to the space flight context. It does this primarily from the perspective of two interconnected theories: social identity theory (Tajfel, 1972; Tajfel & Turner, 1979) and self categorisation theory (Turner, Hogg, Oakes, Reicher & Wetherell, 1987). These two interrelated but distinct theories deal with the interplay between individual psychology and group-level processes that affect psychological functioning. A large body of supporting literature has developed around these theories over the past 30 years (e.g., Haslam, 2004; Turner & Reynolds, 2001). These two theories provide a framework within which to understand the group processes that are likely to occur during any human space flight and are especially relevant to long duration missions where adaptive group dynamics are crucial for mission success.

It is argued in this thesis, that understanding group-based processes is essential to maximise success of future long duration space missions. More specifically it is argued that, the emergence of shared ingroup identities within this context cannot be guaranteed, and that finding ways of promoting shared identities should be a priority, due to the benefits they provide. It is also argued that certain types of groups (in terms of norms, values and beliefs) will function much better in the space flight context. These kinds of groups would be expected to allow for unity and cohesiveness but also recognise the importance of diversity. Not only is it the case that there is likely to be demographic-based diversity in such groups (e.g., gender, nationality), there also will be diversity in skill and expertise so that the necessarily complex tasks can be successfully achieved. The impact of certain group norms (e.g., pro-diversity, pro-uniformity), in the face of underlying group diversity (which is likely to exist in the space context), on positive group outcomes is directly investigated through the course of the thesis. This is done by reviewing and interpreting the relevant literature and by means of both field and laboratory studies.

The primary purpose of this thesis is to demonstrate the importance of understanding the group-based processes relevant to the successful management of future crews on space missions of long duration. It is also the case, though, that through this process the work may inform current understandings of group norms on group outcomes particularly in teams where there is diversity but also a need for unity and common purpose. In this way, this work that is oriented to focus on issues within the spaceflight context may also be informative for the broader social psychological literature.

1.2 Objectives of the Thesis

The general objective of this thesis is to advance the understanding of human social psychological functioning in the context of long duration space missions. In order to make a unique contribution to the field this thesis does two things that have rarely been done in the space psychology field. Firstly the thesis applies a mainstream social psychology paradigm and uses a group-based level of analysis. Secondly the thesis provides a comprehensive review of the literature surrounding space psychology as well as important and relevant issues that have arisen through the general history of social psychology. More specifically the literature of social identity theory and self categorisation theory will be discussed in detail.

This thesis empirically investigates two social psychology issues relevant to the spaceflight environment. The first is to shed light on the workings of social identity processes within spaceflight and related contexts as well as the kind of groups that emerge within such environments. Building on this work the second objective is to investigate what type of group norms and associated social identity processes might be effective in a space environment.

1.3   Method of the Thesis

The thesis includes five empirical studies, which were conducted to investigate the two areas of inquiry. Three of the studies were conducted in the field (in space analogue environments), while the other two were conducted in a laboratory.

1.3.1   Study 1

Study 1 was conducted in August 2004 and took place on the Mars Society's "Expedition Two", which was a four week expedition in an isolated region of northern South Australia. All 25 crewmembers participated in this study by completing a daily questionnaire which contained both qualitative and quantitative measures. The purpose of this study was to take a qualitative 'picture' of the kinds of groups people identified with, and to measure quantitatively the stability of the social environment and the relationship this had with the emergence of certain social identities. A number of other relevant social psychological constructs were also measured such as group cohesion. It could be assumed that given the geographic isolation of such groups and the stability in group membership, that a particular shared social identity may emerge through group interaction and the focus on achieving individual and group goals. If this were the case then one could assume that group-level processes have and will be in operation necessarily within such groups. This work, though, revealed that although salient sub-group identities did emerge (e.g., amongst "away" and "base" team) there was less evidence of a higher-order shared social identity becoming meaningful for participants in this expedition. In short, the nature of the groups themselves did not lead inevitably to social identity-type outcomes. There was a need to recognise the possibility that such a context could be characterised by individuals interacting as individuals, sub-groups interacting with other sub-groups or some "mission" identity. Furthermore, that the character of such groups with respect to group diversity in terms of demographics, skills and expertise and individual/sub-group goals, could mean

more attention should be given to "whole-group" norms or group culture and the impact on positive group outcomes.

1.3.2 Study 2

Study 2 took place during two connected expeditions to the Mars Desert Research Station in Utah, during April and May 2005 (titled the Mona Lisa Leonardo Project). The two expeditions had similar programs, but one consisted of an all male crew while the other was all female. The aim of this study was to investigate the link between group identification with the expedition groups, group culture or group norms and positive group outcomes. It was predicted that a crew with a culture of acceptance of diversity would be less likely to suffer negative events such as the alienation of individuals within the crew. Measures of these constructs were developed to quantitatively test this link. The questionnaire was completed on two different occasions by each crew. This is an important study in the context of this thesis because it demonstrates that the variables and measures of these variables that have been used widely in social psychology work on social identity processes were applicable to these expedition groups and that the variables related to one another in ways that would be theoretically expected.

1.3.3 Study 3

Study 3 took place in a laboratory and was designed to test similar hypotheses as the second study, but under controlled experimental conditions and with a much larger sample size. This study was conducted on computers and involved participants interacting with other 'virtual' people, who they believed to be other students, but in fact were computer generated responses. In this experiment the norms of the group were manipulated, as well as how different one 'virtual' group member was from the others. It was predicted that by promoting a group norm (or culture) of acceptance of diversity, the different group member would be less likely to be ostracised and the group would perform better as a whole. Similar quantitative measures were used in this study as in the second study. A core question was the impact of a pro-diversity versus pro-uniformity norm on group outcomes under conditions were there was or was not group diversity. The argument being that certain group norms or culture would be more likely to lead to group success under conditions of varying group diversity. It was argued that this question applies equally to

situations where work teams are created because of people's different skills and expertise as to any other form of group diversity.

1.3.4   Study 4

Study 4 was the second laboratory study of the thesis and followed up on the findings of Study 3. It investigated the same issues but this time in a more streamlined and explicit way. This was a vignette study, which was more simplistic than the previous study. It is in this study that the core ideas of the thesis are explored directly and are supported. It is demonstrated that where there is individual and sub-group diversity within a group, it is the pro-diversity rather than the pro-uniformity norm that is related to a range of positive group outcomes. Furthermore, there is support for the mediating role of social identification. In situations like these group success is an outcome of the way the pro-diversity norms serve to build shared group identification.

1.3.5   Study 5

Study 5 was conducted in the field and involved the collection of data from a crew spending the winter at an Antarctic research station. The station was completely isolated from February until October of 2006, and had 10 crewmembers. Participants complete fortnightly questionnaires which they emailed back to the Australian National University. This study sought to explore the same variables that had been explored in the previous studies but in a more genuine ICE environment. As would most likely be the case in a space flight context there was diversity amongst the crew that comprised both French and Italians nationals. Perceptions of the group norms (pro-diversity or not) as well as group identification and measures of group functioning (e.g., co-operation, trust, advice seeking) were completed over the winter-over period. Although the aim was to use complex modelling of social networks to explore these dynamics more fully, incomplete data prevented such analyses. It was possible though to examine some of the findings in order to explore the main hypotheses of the thesis. This study also demonstrated the usefulness of using another advanced statistical technique, Multilevel Linear Modelling, when working with non-independent data. The findings of this study confirmed the importance of identity processes and group culture to mission outcomes.

1.4 The Scope of the Thesis

While this thesis is intended to be an exploration into the social psychology of space flight, it is not intended to be a comprehensive guide to the successful management of social issues in space, nor a training guide for future space missions. The scope of the thesis includes reviews of relevant extreme environment and social psychological work. It is not an attempt to deal with every issue of human psychology in space, but rather to deal with a number of specific issues that arise from a reading of the related literature.

The thesis reviews the history of extreme environment psychology that relates to space flight but not all extreme environment work. In this way it covers the history of polar psychology, and work done in other space analogue environments, but does not go into great depth with work such as decision making in stressful environments, task load research or other unrelated work.

A history of social psychology is recounted, which focuses on what "social" really means, and the importance of understanding behaviour and cognition from an individual, interpersonal and group perspective. This history does not focus on personality, cognitive, neurological or clinical psychology.

The interconnected theories of social identity theory and self categorisation theory are reviewed, as well as much of the surrounding literature. That is not to say that all literature connected is reviewed, but rather that the seminal works are discussed, as well as work which directly relates to the issues explored in this thesis.

Each study that was conducted as part of this PhD program is discussed in detail. Extensive information is given discussing the reasoning behind each of the five studies, the methods used, the results found, and the meaning of these results in the context of the thesis and to other related work.

The thesis also provides a detailed discussion of the general findings of the research conducted. This outlines what each of the studies means in turn, as well as how they relate to each other and previous research. The implications of the work for future space missions are also discussed.

The final part of this thesis summarises the key finding of this research program and explores the theoretical and practical implications of the work. In this way this final chapter will demonstrate the contribution this thesis has made to both social and space psychology. It will then outline potential directions for future space psychology research.

1.5 Benefits of the Thesis

There are four distinct benefits of the research contained in this thesis. The first benefit is to people wishing to understand previous work in the field of space and polar psychology. By giving a detailed historical account of the research done in this area, this thesis may aid others who are trying to understand previous work. It is hoped it will be a useful resource to people trying to understand what kind of work has been done in the past. To date few attempts have been made to integrate the previous research done in this field. In this thesis, the main theoretical developments in space psychology are recounted, as well as how they relate to one another and where gaps in understanding exist.

The second benefit of this thesis is that it provides a unique approach to space psychology. By using mainstream group-based social psychological theories, new insights into human behaviour in the space flight context, which have not been made as explicitly and systematically before are provided. By using an existing paradigm, concepts are used and inferences are made based on a wide body of existing literature that has not previously been utilised as extensively in the space flight domain. This work may serve as an example for other space psychology researchers that it is both useful and important to draw on mainstream psychological theory rather than finding it necessary to invent their own separate and distinct concepts.

The other two benefits of this thesis come in the form of the specific knowledge gained from the two issues investigated empirically. The first issue, in regards to change in the social environment and its effect on social identification, is of interest to those wishing to understand the processes by which people come to see themselves as group members. The second issue, regarding the impact of the nature of a psychological group on positive group outcomes, is of great interest to anybody wishing to maximise the performance and well being of a group. For example, if it can be shown that certain types of groups are able to take full advantage of the diversity of its members, rather than suffer the negative effects of this diversity, then this may be of benefit to mission planners and those who manage the social relations during future space missions. A more specific example of this is the link between diversity and alienation. If a group does not embrace the diversity of its members then this could lead to the alienation of individuals from the rest of the group providing a source of ongoing conflict and/or affecting individual and group health and well-being. Within a space mission this could have disastrous effects (due to the degree of cooperation

required between crewmembers), this knowledge could be very useful in the development of intervention and training programs to avoid this form of social dysfunction.

1.6   Limitations of the Thesis

As an initial attempt to apply social identity and self categorisation theories to the space flight context, this work has encountered a number of difficulties. Due to the nature of the research samples, appropriate research methods were difficult to find and in some cases were not used to use, which could lead to criticism of a number of inferences that are made during the thesis. In each of the three field studies, there were small sample sizes where there was interaction between participants leading to non-independent data. These are problem that underpin much extreme environment work, and lead to problems in the robust nature of the findings and their generalisability to other small groups.

The thesis is also limited in that only a few specific research questions could be empirically evaluated, and that the evaluation of these issues could have been more thorough with more time and more available samples. Due to the difficulty in acquiring the necessary field samples this problem was also largely unavoidable within the context of the time frame available for PhD research. In this way while providing useful insights; there are aspects of this thesis which could have been investigated further. Having said this though, as a program of research there are a number of laboratory-based studies as well as field experiments conducted in Australia, The United States of America and Antarctica. What we do know is that the inclusion of social identity measures in such work provides a very promising direction for future work and more work of this kind may now seem possible as a result of the measurement efforts and preliminary findings reported in this thesis.

1.7   Chapter overviews

The current chapter introduces the thesis and outlines the purpose, objectives, methods, benefits and limitations of the thesis.

Chapter 2 provides a comprehensive review of the psychological literature of space as it relates to group functioning. A large portion of this will be drawn from space analogue studies, such as those done in Antarctica. The literature will be separated based

on broad categories of work, such as personality issues, metal health issues, issues of cognitive load and habitat design, interpersonal relations and the use of countermeasures.

Chapter 3, outlines how the lack of focus on 'group processes' within the space psychology domain leads to the opportunity to apply mainstream group-based theories to the context for the first time. It then highlights two theories that are particularly appropriate to this context, as they seek to explain how groups are formed psychologically: They are social identity theory (SIT) and self categorisation theory (SCT). This chapter will discuss the main tenants of both SIT and SCT.

Chapter 4 explores how SIT and SCT can be applied to the domain of space psychology. It discusses common social problems that have been observed in space and space analogue environments and attempts to explain these issues using the social identity perspective. It then develops the point that it is important for crewmembers on any long duration space flight to have a sense of 'shared social identity'. This chapter also discusses how the level of change in the social environment might impact upon this. In order to investigate this issue, Study 1 is devised and discussed in this chapter.

Chapter 5 follows on from the previous chapter by exploring issues of diversity within both the context of space psychology and organisational psychology. It draws upon findings in both these domains to suggest a way that diversity can be taken advantage of. Arising from the organisational and social psychological literature is the notion that groups can incorporate "value in diversity" into their identity and that if they do this, it can have a number of benefits. The first is that it can act as the basis for strong identification and the second is that it allows for improved group functioning through mechanisms such as decreasing group fragmentation and perhaps increased flexibility and creativity and innovation. This chapter then discusses the value of this simple but potentially very powerful idea to the domain of space psychology.

Chapter 6 tests the ideas developed in the previous chapter and describes three empirical studies to this effect. The first study of this chapter was a field study and the second and third studies were conducted in the laboratory. The findings of these studies showed some support for the potential of diversity cultures to resolve problems associated with crew heterogeneity, although the strong empirical results occurred in the laboratory studies raising questions (again) about the applicability of these ideas directly to spaceflight and related contexts.

Chapter 7 follows on from the findings of the studies conducted in the previous chapter and describes the fifth study of the thesis. This study utilised two new advanced statistical methodologies that did not rely on assumptions of independence within the data and drew data from a highly ecologically valid source. Because of this the results of this study in combination with previous work allows more confidence in making conclusions about the central findings of the thesis. Perceived diversity, pro-diversity norms and group identification all seem important in the functioning of groups in ICE environments.

Chapter 8 provides a summary of the thesis and describes the contribution that has been made both in terms of theoretical and practical implications as well as suggesting future directions for this line of research. In doing this it ties together the five studies with the relevant theory while also discussing implications for long duration space missions. The future of social groups in space will then be discussed with reference to future research and likely future scenarios.

- Chapter 2 -

Understanding the Psychology of Space Flight

2.1   Introduction

Since the first human space flight by cosmonaut Yuri Gagarin on the 12th of April 1961, there have literally been hundreds of manned missions into the Earth's orbit and beyond. While many of these flights have been of a short duration (days and weeks rather than months and years), there is an increasing tendency towards longer duration missions. With the development of the Russian Mir space station, more recently the International Space Station and expected future long duration missions to the Moon and to Mars, there has been an increased emphasis on understanding what happens to people psychologically in space. One cannot simply assume that human beings are and will be able to cope with the many stresses they face while isolated in a confined extreme environment. There are many potential dangers and as the cosmonaut Valeriy Ryumin said "all that one needs to effect a murder is to lock two men in a cabin eighteen feet by twenty feet and keep them there for two months" (quoted in Oberg, 1981, pg 213).

Right from the beginning of human space exploration there has been an interest in the psychology of space flight, with the early space programs choosing astronauts based on them having the "the right stuff" (Santy, 1994). While advances in the understanding of the psychology of space flight have not been as profound as the advances made in space flight technology, there have been numerous psychological studies conducted over the last forty five years.

Due to difficulties and lack of opportunities to study human psychology "in space", much of the knowledge in this area has come from anecdotal sources or from studies conducted in space "analogue" environments.   These environments have certain

psychological similarities to space flight, such as cramped confined conditions, isolation from other people or no options for evacuation.

The most common space "analogue" environment used in research is the Antarctic (Suedfeld & Weiss, 2000). Other important space analogues include studies of submariners, bed rest studies and other specifically designed simulation environments. One important example was the SFINCSS-99 International Space Station simulation conducted by the Institute for Biomedical Problems in Russia (see Inoue, Matsuzaki & Ohshima, 2004 and Sandal, 2004, for examples of published work from this simulation). Other examples include the American underwater laboratory Aquarius (used by NASA to study the effects of isolation, see Miller & Cooper, 2001) and the Mars Desert Research station in Utah (see Clancey, 2006, and Dawson; Roesch & Solignac, 2004 for examples).

While these environments have been very useful sources of experimental data, unfortunately nothing beats actual research conducted in space, with Kanas and Manzey (2003) making the clear point that "the ideal way to study what happens to people in space is to study what happens to people in space!" (p. 4).

The other source of knowledge mentioned was that of anecdotal evidence. Much of what is reported in space psychology literature comes from the personal accounts of astronauts and other people who have spent time in space analogue environments. While these anecdotes provide important insights into potential areas of interest, they cannot be considered definitive sources of data. Anecdotes often do, however, provide an ideal starting point for research and are often used to provide real life examples of the psychological phenomenon that have been studied in more systematic ways.

The research that has been conducted in space or analogue environments over the last forty five years can be broadly separated into five categories of work. These can be thought of as:

1. Issues concerning the stressors of the space environment and how different people cope with this stress as well as understanding how the space environment can lead to certain psychopathologies or sub-clinical psychological problems and how the environment affects mood over time.
2. How cognitive performance and one's ability to carry out different tasks is affected by the space environment and human factors, ergonomics and other issues of habitat and equipment design.

3. Personality and how this relates to numerous other aspects of astronaut functionality (research in this area is extensive in terms of selection procedures).

4. Interpersonal relations and social psychology in space, such as how issues such as culture, gender language and other crew compatibility factors influence crew performance and wellbeing.

5. Finally, countermeasures to identified psychological pitfalls, such as crew selection techniques and work on the benefits of various training programs.

The purpose of the current chapter is to explore these five broad areas of space psychology research in such a way as to give the reader a general understanding of the work that has been done to date. This will be done by providing examples of the different kinds of research, without being a complete record of space psychology literature. Seminal works will be discussed as well as the numerous idiosyncratic studies that make up a large portion of the literature body. After this the problems that plague most extreme environment research will be discussed along with possible future directions.

2.2   Domains of Space Psychology Research

2.2.1   Stressors, Stress, Mood and Psychopathology in Isolated Confined Extreme Environments

The space flight environment presents numerous challenges both physically and psychologically to human beings. To date there has been a considerable amount of research done to understand the impact that this environment has on a person's emotional well being. This research has included attempts to understand what the factors are that may contribute to psychological hardship, otherwise know as stressors. It also encompasses how stress is manifested in people's behaviour along with how some people fare better under stressful conditions than others. There has also been much work done on understanding how ICE environments impact upon peoples' mood states, with special interest shown in how mood changes over time. Along with this, there has been considerable work conducted on assessing levels of psychopathology and sub-clinical psychological problems of people living in extreme environments as well as how to screen potential crewmembers who may have predispositions to these disorders. What follows is a

discussion of how the space flight environment is thought to impact on emotional functioning.

Kanas and Manzey (2003) describe a stressor as a "stimulus or feature of the environment that affects someone, usually in a negative or arousing manner" (pg 1). They identify four general categories of stressor that are characteristic of the space flight environment. These include: physical stressors such as extreme acceleration, microgravity, radiation and irregular or unusual day-night cycles; stressors from the actual habitat the astronaut lives in such as vibration noise, temperature and other environment discomforts; psychological stressors such as isolation, confinement, danger, monotony and heavy work load; and finally interpersonal stressors such as conflicts within the group or between individuals, issues of crew size and problems with leadership. In fact Kahn and Leon (1994) reported that during an all women expedition to the South Pole, the expedition members reported interpersonal stressors as the greatest source of stress for the whole mission. This interpersonal stress eclipsed even the extreme weather conditions the women faced.

The way that stress can be manifested in crew members has also been described by Kanas and Manzey (2003). They suggest that it can be manifested physiologically, in terms of its effect on performance, through damage to interpersonal relations or most damagingly through the development of psychiatric problems. Physiological effects can include sleep disturbance and space sickness where people suffer from nausea and disorientation. Effects on performance can include visual illusions, disorientation and other detrimental effects on cognitive functioning. Stress is thought to impact negatively on various aspects of interpersonal functioning such as social withdrawal, increased tension in interpersonal relations, the scapegoating or alienation of specific individuals within the crew and displacement of negative affect onto others such as mission control.

Rosnet, Cazes and Vinokhodova (1998), in a 135 day space station simulation study, provide an example of this process of projecting problems onto others with the scapegoating of one particular crew member by two others (this particular case is also described in detail in Sandal, 2001a).

The projection of stress onto mission control or other outsiders is also a well documented phenomenon with Gushin et al (1997) referring to this process as "psychological closing". Harrison and Connors (1984) as well as Kanas et al (2006) provide further evidence of this mechanism of coping with stress referring to it as the

"displacement" of hostility away from the real problem onto an outside source. This has obvious problems associated with it due to the dependence of any space crew on mission control. Interestingly however this displacement seems to be directed towards mission control rather than a crewmember's family or friends (Harrison & Connors, 1984).

The development of psychiatric problems however, is potentially the worst possible impact that stress can have on a space flight crew. According to Palinkas, Glogower, Dembert, Hansen and Smullen (2001), 5.2% of 313 men and women who spent the winter in the Antarctic developed DSM-IV diagnosable disorders during their time there. This is especially interesting considering that all of these people had been psychologically screened prior to embarking for the Antarctic (Palinkas, 2001). This suggests that disorders can arise during a long duration mission that may not be detectable beforehand, possibly as a direct result of the extreme environment.

According to Palinkas et al (2001) the most commonly diagnosed problems were mood and adjustment disorders (31.6%) followed by sleep related disorders (21%), substance related disorders (10.5%) and then personality disorders (7.9%). Adjustment related disorders can be thought of as those which arise directly from exposure to a stressor and usually involve undue stress and impairment of social or occupational functioning (Kanas & Manzey 2003). Mood disorders include conditions such as depressions, anxiety disorders, manic depression and others, while personality disorders can include problems such as Borderline Personality Disorder. (For a more complete account of these mental disorders refer to the Diagnostic Statistical manual of Mental disorders (APA, 2000)).

Other reported problems include somatoform disorders and Asthenia (Kanas & Manzey, 2003). Somatoform disorders are described in the DSM-IV as physical symptoms or ailments that are not explained by a real medical condition and are not under the voluntary control of the person suffering the condition. Whether or not these conditions are brought about by the extreme environment is unclear as it is possible that this is just a problem that occurs in space with the same frequency as it does on Earth.

Asthenia (or sometimes referred to as neurasthenia) was originally conceptualised as a possible underlying mental disorder which resulted in a range of symptoms such as exhaustion, anxiety, sense of hopelessness, mental irritability, lack of concentration, forgetfulness, headaches and other problems (Kanas, Salnitskiy, & Gushin, et al, 2001). From anecdotal sources Aleksandrovskiy and Novikov (1996) reported that many cosmonauts develop what they refer to as hyposthenia, or a mild form of the condition

which is characterised by fatigue, sleep disorders, anxiety, productivity declines, difficulty with concentration and increased sensitivity to loud noises and bright lights.

There is controversy over the existence of asthenia or hyposthenia with Kanas, Salnitskiy and Gushin, et al. (2001) in a retrospective study of four and half years of data pertaining to the mood states of Russian and American crewmembers, finding no evidence of the development of mood patterns associated with asthenia. Having said this however, their study was limited to only self-report measures of emotional state during space flight and these kinds of measures can be influenced by extreme social desirability factors. This is due to the fact that astronauts usually wish to fly again and so want to present their "best face" to those who select personnel for flying (for more on social desirability see Sandal, Musson, Helmreich & Gravdal, 2005). Whether or not asthenia and hyposthenia are real phenomena or not, this particular area of research still requires more attention, especially in regards to possible countermeasures for when it does occur.

Less extreme than the potential dangers of space travel that have just been outlined, there are the possible effects on general mood states. Mood fluctuations, while not being as serious as psychopathologies, can have a negative influence on the functioning of a crew. To date there has been a considerable amount of work done in this area, with much of it focused on monitoring mood states over time. Other areas that have been investigated have been the positive benefits of being in space and how the mood states of people from different cultures may vary (see Ritsher, Kanas, Weiss & Marmar, (2003), for an analysis of cultural differences).

Bechtel and Berning (1991) first postulated from anecdotal reports that there were negative shifts in mood at the half way point of extreme environment expeditions. They referred to this effect as the "3rd quarter phenomenon", and described it as a decline in positive mood state with the lowest point occurring at around the mid point of the mission. Interestingly they describe it as not being related to the length of time in the environment, but rather at the point where crew members have come to the realisation that they have as much time still to go on the mission as they have already experienced. Steel (2001) suggests that this phenomenon is guided by decreased arousal levels around the midpoint of a mission and that the specific negative emotions experienced depend on these arousal levels. In his study he found some quantitative support for the phenomenon, but his findings suggested that this phenomenon would not always lead to dysfunction within the

crew. This was mainly due to the observations that crews which had generally high levels of arousal and hedonic tone (which was quite common), would not suffer the ill effects.

There have been a consistent number of studies showing some evidence of the 3rd quarter phenomenon. For example, Sandal (2001a) reported increased negative emotional expression and decreased crew cohesion during the third quarter of a 135 day space simulation. Palinkas, Johnson and Boster (2004) reported higher levels of tension-anxiety, depression and anger and decreased levels of social support in two studies of people spending a year in Antarctica. This decrease in the seeking of social support over time was also found by Peri, Scarlata, and Barbarito (2000) in a study of people in Antarctica.

Support for this phenomenon in space has not been as forthcoming however with Kanas et al (2006) finding in a detailed study of crews to the International Space Station and to the Mir space station, no evidence for decline of mood state during the 3rd quarter of the missions. In this study they analysed data from the Profile of Mood States (POMS) and also from the Group Environment Scale. Neither sources of information suggested any decline during the 3rd quarter of the missions. Similar findings were also found in a four and a half year study of crew members of the Mir (Kanas, Salnitskiy, Grund, et al, 2001). It is possible that space missions differ from polar missions in terms of seasonal variability, and this may be due to the actual differences between the two. In Antarctica very real seasonal changes are present such as outside temperature and extreme changes to the day-night cycle, whereas in missions to the Mir and ISS, temperature would be constant and the day-night cycle can be standardised. What would happen during a long duration mission to Mars where extreme changes and disruptions may occur is as of yet unknown.

There may be positive benefits to being in space however and a number of studies have looked into this possibility. Ihle, Kanas, Ritsher, Weiss and Marmar (2003) describe what they refer to as the "salutogenic" effect of being in space. This "salutogenisis" can be thought of as a positive state of mind which helps to promote a positive state of physical wellbeing. This beneficial state of mind is thought to arise from the wonder of actually travelling into space and seeing one's home planet as a single entity below. Ihle et al (2003) report from numerous anecdotal sources, that travelling to space can have an inspirational and long lasting positive effect on a person. People are also reported to gain new understandings of the meaning of life, a greater recognition of the unity of the human race and some people have deeply held religious beliefs upheld. In Ihle et. al.'s study they systematically investigated these issues and found that all participants had a positive

reaction to being in space. They also found that of the insights that people gained from the experience, the spiritual ones were the least commonly reported.

These positive effects of space travel have also been examined in other systematic studies. Ritsher, Ihle and Kanas (2005), in a study of 39 members of the Association of Space Explorers (people of various nationalities who have flown in space), found a consistent pattern of positive experiences reported by space travellers. They found two clusters of people with one group displaying much higher reactivity from the space experience. While both groups showed positive changes the people from the more reactive cluster were far more likely to report major behavioural changes such as strongly supporting environmental causes on their return home.

Another systematic study by Ritsher, Kanas, Ihle and Saylor (2006) supports these findings and also came to the conclusion that this experience may actually help astronauts and cosmonauts deal with the many stressors faced during such missions. How these potential benefits might impact on travellers to a different planet is unknown. While they may experience distress from seeing their planet disappear into a simple speck of light (Kanas & Manzey, 2003), this may be countered by the absolute wonder of being the first humans to step onto another world.

2.2.2 *Habitat, Human Factors and Performance Issues during long duration Space Flight Human Factors*

Characteristics of the environment in which astronauts live in space have a fundamental effect on the way that they function (Connors, 1992). There are certain physical realities of living in a space habitat that constrain behaviour and which to date have not been surmountable. These include cramped confined living spaces which do not allow much in the way of personal space or environmental variability, high work loads causing stress and fatigue due to limited time, the use of advanced technology which is customised to fit in with tight size and weight limitations and most importantly the effects of microgravity which impairs performance through biological and psychological mechanisms. The interaction between human and environment, often described in terms of human factors, is a science which goes far beyond simple considerations of space flight (Kanas & Manzey, 2003). Indeed much of the knowledge acquired in earth-based human factors work is applicable and has been applied in the field of space psychology. The

following is a brief overview of what is known about how habitat design and other human factors issue impact upon crew functionality in a space flight environment.

The most detailed account of human factors and habitat design to date is the NASA-STD-3000 Man-Systems Integration Standards (NASA, 1995). This is a comprehensive manual which covers all the major issues of human-technology interface for manned space flight. The areas covered in this guide include information pertaining to: biomechanics and limitations of human movement; human performance capabilities; environmental factors such as atmosphere and microgravity, issues of crew safety; health management issues that need to be taken into consideration in habitat design; various architecture considerations such as traffic flow and grouping of compartments; workstation design so that both productivity and comfort can be maximised; the design of activity centres (for example areas for recreation, microgravity countermeasures and facilities for personal hygiene); the use and storage of tools, equipment and other hardware; considerations of how equipment and facilities can be maintained by crew members; and finally guidelines on the conducting of EVAs (Extra Vehicular Activities). As can be seen from this list of topics, there are many different human factors issues to be taken into consideration for space flight, some of which are more "psychological" than others.

Despite this comprehensive guide for human factors and habitat design by NASA, work in this area is ongoing. Clancey (2006), for example, outlines a study which took place in the space analogue Mars Dessert Research Station (MDRS) in Utah. This study explored new ways to assess work practice and develop techniques for observing participants' efficiency while conducting certain tasks. It also investigated how the structuring of daily schedules could impact upon crew productivity levels. Whitmore, McQuilkin and Woolford (1998) also provide a detailed account of habitability and performance issues in space. They outline a model for understanding how habitability and workload both effect crew performance and how this in turn impacts upon overall mission effectiveness. In their paper they discuss how these factors can be measured for the spaceflight context. Other recent literature in this area includes a summary of human factors and habitability issues by Morphew (2001) and a detailed account of these issues by Suedfeld and Steel (2000). Suedfeld and Steel also describe how knowledge from psychology in general can be used to improve life inside a space capsule in terms of personnel selection, environmental design and how to counteract boredom.

Performance Performance issues in the space flight environment can be broken down into two general areas. These are biological and physiological changes, such as changes to the operation of specific brain functions due to microgravity and other more general psychological effects such as workplace stress, increased workload, sleep disruptions and other human factors issues as already discussed (Kanas & Manzey, 2003).

The microgravity environment of space has a distinct effect on the human body which is not present in other space analogue environments. Of particular note is disruption of the vestibular system by the lack of gravity (Fong, 2004). Fong describes how in microgravity the normal functioning of the otolith organ does not take place and this may cause sensory conflicts which can lead to interference with sensory motor tasks which rely on visuomotor skills. So called space sickness is associated with this during the first days of space flight and includes symptoms such as nausea, disorientation and visual disturbance (Kanas & Manzey, 2003).

One particular issue in this regard that has been investigated in space is that of dual-task performance decrements brought about by microgravity. A study by Fowler, Bock and Comfort (2000) for example investigated how an astronaut's ability to switch attention between two tasks would be affected by microgravity. Counter to their predictions they did not find any specific effects of microgravity but rather other more general sources of stress were thought to contribute. This was counter to findings by Manzey, Lorenz, Heuer and Sangals (2000) however, who found that microgravity did have a negative impact on astronauts visual tracking performance. The findings of these studies, in combination with others suggest that declines in cognitive performance do occur in space with some attributable to microgravity and some to other space flight stressors.

The negative effects of space travel on cognitive performance are not however constant over time. As mentioned space sickness usually only lasts for a few days and there is evidence that astronauts actually learn to adapt to the space flight environment. A study by Manzey, Lorenz and Poljakov (1998) examined a range of different aspects of cognitive performance for a single cosmonaut over the course of a 438 day space flight. From their study they concluded that there was significant adaptation to the space flight environment with the first three weeks of the long duration space mission showing the greatest levels of adverse effects on cognitive performance. This was then followed by a second critical period of decreased cognitive performance of two weeks once the cosmonaut had returned to earth. This has particular implications for a potential long

duration mission to Mars, as one could expect adaptation during the early stages spent travelling between Earth and Mars, then a second period where travellers would need to readapt to the Mars environment, then a third period once disembarking for Earth. From this, mission planners should be wary of placing too many demands on astronauts during these critical times.

Research into habitability, human factors and their effect on performance is ongoing and possible one of the most developed areas of space psychology. Why this particular area has received so much attention is unclear, but it could be due to the engineering focus of organisations such as NASA and RSA. As can be seen from the NASA-STD-3000 Man-Systems Integration Standards (NASA, 1995), knowledge in this area is very developed. Having said that however there is always more work to be done and as new space transportation systems and different types of habitats are designed in the future, there will be a need to assess how to best design these habitats to maximise comfort and performance. One could imagine that there will be new requirements and different constraints which need to be investigated for future Luna and Mars bases.

2.2.3   *Personality, Crew Selection and Individual Functioning in Isolated Confined Extreme Environments*

One area of psychology that has been extensively applied to the spaceflight context is that of personality psychology. A long history of personality psychology suggests that people differ in stable ways from one another. In the context of sending humans into space, it has been reasoned that in order to maximise chances of success on space missions one must have the right "kind" of people sent into space. In other words those people with the personality profiles which are most adaptive in the spaceflight environment. The screening and selection of astronauts based on personality can be broken down into three different areas (Kanas & Manzey, 2003). Firstly there are "select out" procedures, whereby those who have specific undesirable traits (such as predisposition towards mental illness) are screened out and prevented from taking part in extreme environment missions. Secondly there are "select in" procedures whereby characteristics which are thought to most likely engender mission success are proactively selected for. Thirdly there are issues of personal compatibility where teams are formed where people have compatible personality traits which do not conflict with one another (Harrison & Connors, 1984). This section will deal with each of these issues as well as other factors of individual and personal functioning. It

will also discuss some of the problems associated with this area of psychology in the extreme environment context. For a thorough review of personnel selection see Santy (1994).

"Select out" procedures for ensuring that people with personality characteristics that are undesirable in an extreme environment setting have been used since the beginning of manned space flight (Manzey, Schiewe & Fassbender, 1995). In the main they have involved screening of potential astronauts and cosmonauts for psychiatric problems in their own or their family's history or for those who may decompensate under the stressful conditions of space (Kanas & Manzey, 2003). Investigations in this area typically involve standard clinical testing using tools such as the DSM-IV (APA, 2000).

Santy, Holand and Faulk (1991) describe how psychological screening has developed over time. During the early days of manned spaceflight an intensive 30 hour examination was used where applicants were put under enormous stress and evaluated for psychopathology. Since that time Santy et al (1991) describe how this process evolved into more structured clinical 2 hour interview using DSM criteria. A detailed account of this kind of procedure can be seen in Endo, Ohbayashi, Yumikura, and Sekiguchi (1994). In this study they outline the procedure of psychiatric interviews which were used to screen out potential Japanese astronauts. Using this technique they found that 4.4% of applicants met Axis I or Axis II criteria for having a disorder and a further 28.9% of applicants were "Qualified with Reservations" (most were diagnosed with hypomania). Of these applicants all were rejected based on this screening. This kind of testing is now thought to be absolutely mandatory for potential space travellers and is accepted by all the space agencies.

To date there has been considerable work on discovering what the profile of an "ideal" astronaut would look like. Kanas and Manzey (2003) point out that it is very difficult to discriminate against otherwise healthy, able minded and bodied would-be astronauts. Galarza and Holland (1999) describes in detail the kinds of factors that have been deemed as attractive in potential astronauts. These include high levels of emotional and mental stability, performance under stress, group living skills, teamwork skills, communication skills, conscientiousness, leadership ability, motivation and an ability to make good decisions. As of yet however these dimensions have not all been empirically tested as good predictors of performance in space.

Empirical work has been done in this area to correlate personality types with performance however. In a series of studies by Chidester and colleges (see Chidester, Helmreich, Gregorich & Geis, 1991; Gregorich, Helmreich, Wilhelm & Chidester, 1989) three distinct personality clusters have been discovered which are useful in assessing an astronaut's potential. They refer to these clusters as "the right stuff", "the wrong stuff" and "the no stuff". These clusters represent subpopulations of candidates on measures of instrumentality and expressive personality traits using the Personal Characteristics Inventory (PCI). According to their research people with "the right stuff" have a positive instrumental/expressive cluster, while those with "the wrong stuff" have a negative instrumental cluster (with high and low instrumentality but low expressiveness), and those with "no stuff" being low in both instrumentality and expressiveness. In other words those with the "right stuff" are good at getting things done, but are still able to relate well to others, the "wrong stuff" are focused on doing tasks but are not able to get along as well with others, and the "no stuff" are not good at getting tasks done or socialising with others. These profiles have proved very useful as "select in" criteria for both aeronautical pilots and spaceflight crews. Interestingly a study by Bishop, Santy and Faulk (1998) conducted on a caving expedition suggested that failure of the group was due to certain key members of the group having "the wrong stuff".

In addition to this, who will make the best leaders of space missions has been investigated. A study by Nicholas and Penwell (1995) for example details how leaders that are most effective during space missions tend to be people that put a lot of effort into achieving mission goals, are optimistic, are respected by the crew, often use participative decision making (but are still directive during critical operations), sensitive to crew emotions, able to make crewmembers feel valued and are able to maintain harmony within the group. It is important to note here however, that while some of these attributes may be considered stable personality traits, others are far more subjectable to group dynamic influences. These sorts of issues will be discussed in more depth in the section on group dynamics.

Work has been done to find out how certain aspects of personality may relate to general group functioning. Bishop, Dawson, Rawat, Reynolds, Eggins and Bunzelek (2006) for example related aspects of personality with group functioning variables such as ingroup identification and levels of organisational citizenship behaviour (behaviour which purely benefits the group and has a personal cost to the individual). This data was taken

from a number of Mars simulation studies which were conducted at the MDRS between 2002 and 2004. Findings from this study suggested specific personality profiles associated with higher levels of group functioning.

Harrison and Connors (1984) make the important point that is not simply a matter of "who" is on a given mission, but rather which combinations of people are sent to space. A series of studies conducted by Haythorn and colleagues during the 1970s demonstrated that isolated groups which had members who were more compatible with one another on a number of key dimensions, tended to function far better than those which were mismatched. Smith and Haythorn (1972) for example found that participants who were matched along dimensions of affection, control and need for achievement, adapted to their isolation far better than groups who were not. More recent developments in this area have included the use of assessment centers to find crewmembers who can work together effectively as a team. Manzey, Schiewe and Fassbender, (1995) for example discuss an assessment center they used to select the final team for the European space agency 60 day simulation study EXEMSI'92. They found this technique very effective for the assessment of compatibility and they suggest that tools like this could be used to help minimise the risk of interpersonal tensions.

Despite all the work that has been done in this area however, there are some problems with using assessments of personality to predict performance in space. Sandal, Musson, Helmreich and Gravdal (2005) suggest that basic personality testing such as the use of the PCI and NEO-FFI may not provide accurate profiles for potential astronauts. This they claim is due to the fact that applicants may produce biased responses due to social desirability. Social desirability occurs when applicants report what they think the assessor wants them to say rather than their own honest appraisal of themselves. However this kind of social desirability can be a useful measure in and of itself. In their second study they showed that applicants with higher calculated levels of social desirability tended to correlate negatively with cognitive test performance. Sandal et al (2005) suggest that more work is needed in this area in order to investigate whether social desirability relates at all to performance under stress.

Possibly the most serious problem however with using measures of personality, whether by paper and pencil test or by assessment center, is its potential instability over time. There is a considerable body of social psychological literature (which will be discussed in depth in Chapter 3) that suggests that peoples' behaviour is highly dependent

on social context. In addition to this there is evidence that the actual experience in space can change a person. For example the salutogenic effects that have already been discussed which have the potential to give people a completely different outlook on life (Ritsher, Ihle & Kanas, 2005) or the potential for development of psychopathology as seen in the Antarctic (Palinkas, Glogower, Dembert, Hansen & Smullen, 2001). If this is the case, it is possible that measures of personality can only provide a limited level of prediction of astronaut behaviour.

While not personality psychology perse (but still worth mentioning here), there is also a body of literature which is related to this area, which deals with certain "individual level" psychological processes. For example a study by Burns and Sullivan (2000) in a study of people stationed at an Antarctic base investigated perceptions of risk taking. They explored how various factors contributed to individual risk taking. Another example is that of Rosnet, LeScanff and Sagal (2000) (in another Antarctic study), who investigated how discrepancies between a person's perception of their "real self" and "ideal self", impacted upon their performance. They found that the greater the discrepancy, the more motivated people were to perform on the expedition.

In general, understanding personality and individual processes is absolutely necessary for the prediction of human behaviour in space. There is established evidence for the usefulness for selecting astronaut candidates "in" and "out", as well as making sure that crewmembers are compatible with one another. Having said this, personality is not the whole picture and as the next section will explain, understanding interpersonal relations and "group level" processes, is also necessary to gain a more complete understanding.

2.2.4   Crew Interactions and Group Life in Extreme Environments

Understanding the social behaviour of astronauts has possibly been one of the more challenging areas of the psychology of space flight. To date most work has been based on the observations of social behaviour during space missions rather than specific avenues of enquiry with hypotheses based in established psychological theory. In this area there is more of a bias towards evidence gained from anecdotal sources rather than from more quantitative forms of enquiry. There are good reasons for this with issues of group level processes being difficult to study quantitatively if only a small number of sample groups are available during any one study. Having said this however there is a wealth of material concerning social psychology in the space flight and space analogue environment literature.

The following section will discuss the different areas of interpersonal and intergroup psychology that have been investigated to date.

The investigations and discussions of group dynamics in space can roughly be divided into seven broad areas of enquiry. The first concern issues of diversity in space. This is probably the most discussed area in the literature and focuses on how demographic diversity, whether it be age, gender, race, nationality, culture or language, impacts on the ability of space crews to function effectively together, whether that be operationally or socially. The other important issues which have been investigated include: optimal crew size and the impact of different kinds of social structuring; issues of interpersonal relations such as tension, conflict or bonding between individuals and general assessments of the "group climate"; issues of group cohesion, including discussion of whether or not high cohesion is something that is desirable during long duration space missions; how issues of personality and crew selection techniques (such as compatibility) can improve chances of social harmony; intergroup relations including discussions of consistent group conflicts that have been observed in the past; and finally issues of "group culture" or the kinds of small group cultures that develop among crews of extreme environment expeditions.

Diversity   While the crews of the early space flights (especially in the USA) predominately consisted of white male pilots, since that time there has been a marked increase in the demographic diversity of space crews (Kanas & Manzey 2003). There has been an even greater boost within the last 15 years with numerous multinational crews participating in missions such as those to Mir and the ISS as well as in numerous simulation studies such as SFINCSS-99 (Inoue, Matsuzaki, & Ohshima, 2004) and EXEMSI (Gushin, Kolinitchenko, Efimov & Davies, 1996). This increase in diversity raises some very important questions for crew functionality. This issue will be discussed in much greater detail in Chapter 5, but to date it has been seen as a potential problem for space crews rather than an advantage.

Differences in culture have been thought to be the major source of problems in numerous examples of social dysfunction in space related contexts such as during SFINCSS-99, when a sexual advance made by a Russian man on a Canadian woman lead to a complete breakdown in relations between subgroups of the mission (Sandal, 2004). In this instance the man's flirting behaviour was considered as harmless by many of the Russians involved in the study. The Canadian woman and some of the other members of her subgroup (an Austrian and Japanese man) perceived this behaviour as totally

unacceptable however and the problem escalated into a conflict in which the connecting hatch between the subgroups was locked until the conclusion of the simulation. While on the surface this was clearly an instance on inappropriate sexual behaviours, it has been argued that this came from differences in perceptions of appropriate behaviour. These differences in perceptions of "appropriateness" can be thought of cultural, whether linked to National culture or not.

Ritsher (2005) goes into depth about the kinds of cultural differences which have been noted to cause friction during space and space-related missions. In this paper she focuses mostly on differences between American and Russian culture as the vast majority of space travellers to date come from these two nations. She points to eight key areas of cultural differences.

The first is basic differences in central cultural values, such as a bias in Russian culture towards being more collectivist compared to Americans who tend to have a more individualistic culture. In collectivist cultures there is far more of a focus on group wellbeing, goals and the importance of social relations, whereas in individualistic cultures the individual's needs, rights, desires abilities etc are considered to be more important. Ritsher makes the point that these cultural differences can even be seen in the way that work is often structured by the different space agencies, with NASA being more likely to structure work programs in such a way that individuals complete their own tasks, compared to in Russia where tasks are more likely to be shared amongst different people.

The second difference she describes is in regards to a difference in perceptions of subjective wellbeing. She cites evidence of Russian crews being more likely to have a lower sense of subjective wellbeing compared to their western counterparts.

Following on from this she provides evidence for a difference between the two cultures regarding emotional expressivity, with Russians being more expressive than Americans. In this regard Russians are less likely to suppress negative emotions and are less likely to display non-genuine positive emotions.

According to Ritsher, Russians also are more likely to be able to tolerate the lack of personal space found in space habitats than Americans. This she argues arises from smaller living spaces that many Russians are accustomed to. What's more she suggests that the whole concept of "personal privacy" is not seen as being as important in Russian culture. Potential problems can arise from this as offence can be taken if this need is expressed by astronauts with a different cultural background.

The next issue is in regards to differing personality profiles according to Costa and McCrae's five factor model (McCrae, Costa, del Pilar, Rolland & Parker, 1998). Ritsher points to a tendency for Americans to be much higher than Russians in both Extraversion and Openness. How these differences may cause problems in space however is not made clear by Ritsher.

Differences in perceptions of gender roles can also lead to problems according to Ritsher. She suggests that Russians tend to adhere more strongly to traditional gender norms. This claim is backed up by research by Leon, Kanfer, Hoffman and Dupre (1994) who found during a Soviet-American polar expedition that the Russians men tended to be more chauvinistic towards the women than their American counterparts. This kind of difference relates to gender stereotypes and the way high achieving female astronauts can function with those from more chauvinistic cultures.

Another area described by Ritsher (2005) as being an important cultural difference between Americans and Russians is that of attitudes towards personal relationships with co-workers. According to Ritsher, Americans are far more likely to focus on job roles rather than personal relationships with the people that they are working with. This has potential serious consequences as positive social relationships between crewmembers are essential for mission success, especially for long duration missions.

Ritsher then moves on to discuss the bias of English speaking people to not learn foreign languages. This, she suggests, can lead to resentment and conflict if those of non-English speaking backgrounds are always forced to accommodate their English speaking crewmates. This leads to the more general issue of language diversity.

Language incompatibility has the potential to provide the largest obstacles to group functioning amongst international space crews as it can prevent both effective work and social communication (Kanas & Manzey, 2003). For example Norm Thagard, an American Astronaut who spent time on the Mir, reported feeling socially isolated from his Russian crewmates because of the language barrier (Benson, 1996). More evidence also comes from a study by Kanas and colleagues (Kanas et al, 2000) of astronauts and cosmonauts during expeditions to the Mir that suggests that dissatisfaction amongst American crewmembers stemmed from them being socially isolated due to being unable to speak enough Russian. Communication one could argue is the basis for human social interaction, so it is not surprising that where language barriers exist, the social wellbeing of a group is diminished.

As mentioned earlier, an important cultural difference between Americans and Russians is their attitudes regarding gender roles. This issue is of course relevant due to the fact that space and other extreme environment crews are quite often heterogeneous when it comes to gender. This was not always the case with a 19 year gap between the first woman to fly in space and the second (Valentina Tereshkova as the first in 1963 and Svetlana Savitskaya as the second in 1982). The American space program was even slower to introduce women to space flight with the first female American in space being Sally K. Ride in 1983. Modern space flights however are far more likely to have both men and women, with selection criteria not having specific gender biases. What this means for crew functionality is not entirely clear, but some evidence suggests that gender heterogeneity is advantageous.

Leon and Sandal (2003) for example in a study of three mixed or all women groups engaged in extreme environment expeditions found that women were able to provide a higher degree of emotional support than had been observed in all-male groups. Another example of this can be seen in the space flight simulation EXEMSI run by the European Space Agency. Here it was observed that the female crewmember was seen as a "peacemaker" amongst the crew (Gushin, Kolinitchenko, Efimov & Davies, 1996).

There are potential dangers of having mixed gendered crews however, with problems of male chauvinism and the potential pitfalls of sexual relationships or jealousies developing. In regards to sexual behaviour in space and issues associated with space travellers forming romantic relationships with one another, there has been no research conducted to date, so the potential impacts are unclear.

A recent incident in the United States however, involving a "love triangle" between three U.S. astronauts demonstrates the seriousness of romantic jealousy (Wong, 2007). It has been alleged that a female astronaut developed feelings for one of her male co-workers, who was in a relationship with a third astronaut. While not much information is available at the time of writing, it seems that romantic jealousy drove the woman to an alleged attempted murder of her rival. Allegedly she drove 1,500 kilometres to confront the other female astronaut and then assaulted her with pepper spray. She has been charged with attempted murder, as she was carrying dangerous weapons and it was believed her intention was to kill her rival. This incident is of the utmost seriousness and if it had occurred during a long duration space mission, could have had disastrous consequences. What happened in this particular case is still unclear, but if this kind of murderous behaviour was a result of

romantic jealousy then it represents an area of psychology which needs far more attention in the future. It is possible though that this incident was simply a very unlikely event, which resulted from the pathology of one individual, however if this is the case then it raises serious questions about astronaut selection procedures.

In relation to more general issues of sexuality in space, Kanas and Manzey (2003) make the point that problems could be avoided by either enforcing abstinence or having only married couples taking part in long duration missions. But they suggest that this kind of solution would not be practical as enforcing abstinence would be impossible and there would be no guarantees that secret liaisons would not develop or that relationships would not breakdown. Indeed in the recent incident just described, the female astronaut charged with attempted murder, was in fact married and had two children. This did not prevent her from falling in love with another man, or experiencing sexual jealousy.

These issues however need further investigation as the potential conflicts that could arise from relationship breakdown or sexual jealous could be an exceptionally negative social force during a long duration space flight and to date there has been no empirical work conducted.

The kinds of diversity discussed so far however have mostly concerned demographic diversity and when culture has been discussed it has been with reference to national or "macro" culture. Other kinds of diversity are also important and hold the potential for causing tension amongst space crews. These could include any number of aspects of difference such as, music preference, sense of humour, even political beliefs. There are literally limitless imaginable ways in which people could be considered different from one another. In reality it may be very difficult to predict which differences count most to people.

A related point to this is what we actually mean by culture. Culture is not simply related to large groups of people such as nations, races or religions; idiosyncratic culture can be observed at many levels, from large organisations such as companies and military institutions down to individual work teams or friendship groups. Culture in this respect refers to the specific norms, values, beliefs and behaviours that a particular group of people adhere to. This kind of "small c" cultural diversity could also potentially be an issue in spaceflight. This issue of group or expedition culture has been dealt with in the literature to a small extent and will be explored later in this chapter. Both of these issues however will

be dealt with in far more depth in Chapter 5, which explores the importance of small group culture in dealing with diversity amongst space crews.

Crew structure and size   Moving on from issues of crew diversity is the issue of social structure and optimal crew size. This area of work encompasses what the best imposed social structures of space flight crews are, such as leadership structures and job roles, as well as the kinds of emergent social structures that develop and which tend to lead to more positive group outcomes. Related to this area of work, is that concerning the development of cliques and subgroups within a space crew, and how this impacts upon the effectiveness of a crew. This area also deals with what the optimal size for space crews are, taking into account the advantages and disadvantages of larger or smaller crews. The following section will provide a brief discussion of these issues.

Suedfeld and Steel (2000) point out that the organisational structure of space flight crews is important to crew functionality. They claim that well defined roles for each crewmember can help to prevent conflict and allow for the development of a more secure self-concept. Even with defined roles, care must be taken to ensure that different crewmembers do not have incompatible roles. This, Suedfeld and Steel (2000) say, is especially important when there is a mix of different subgroups, such as military personnel and civilian scientist working together.

Even with carefully planned social structure involving role definition and subgroup membership, social groups tend to change overtime. What may have started out as an effective structure may change over time into a dysfunctional one and visa versa; a dysfunctional structure (or lack of structure) may evolve into a more functional one. A recent study by Johnson, Boster and Palinkas (2003) investigated how certain social structures emerge over time. They used a new technique called social network analysis, which measures the relationships between individuals in order to create "relationship maps". This technique is also employed in the final study of this thesis. Johnson et al (2003) studied three different winter-over groups in the Antarctic and found that certain emergent social structures were better than others. Generally speaking they found that groups which were more "globally coherent" (relationships between individuals suggesting one whole group rather than specific cliques), were more likely to share consensus regarding specific roles such as who the "informal" leader was and were more functional in general. They also found that social structures did indeed change over time for better in

some cases but for worse in others. In addition they also showed that having a positive deviant within the group (i.e. a clown) helped boost group cohesion while having a negative deviant (i.e. a trouble maker) was more likely to damage cohesion.

Similar findings have also been noted by Palinkas, Gunderson, Johnson and Holland (2000) who note the dangers of clique formation. In a retrospective study of 450 men and women who had wintered-over in Antarctica between 1991 and 1998, they studied the relationship between clique formation and a variety of mood states. They found that crews with more definitive clique structures were more likely to have crewmembers who reported higher levels of anxiety, depression, anger and fatigue.

Why cliques form in the first place is a much deeper question for social psychology, and will be dealt with to a certain degree in Chapter 3. Sandal, Leon and Palinkas (2006) however suggest that in isolated and confined extreme environments, it is often down national or vocational lines and is often the result of suppressed tensions among crewmembers. The formation of cliques may not necessarily be negative however. Recent advancements in social psychology (which will be discussed further in both Chapters 3 and 5) have suggested that positively interdependent subgroups with shared superordinates identities, may be one of the most effective forms of social organisation.

Related to the issue of crew structure is that of optimal crew size. While most space crew sizes to date have been defined by operational requirements, the increased importance of social harmony for extended missions to Mars and beyond may see more emphasis placed on this in the future. Even with these considerations however it is with present technologies inconceivable for large groups of people taking part in long duration space missions. Early studies by Haythorn and colleagues (see Smith & Haythorn, 1972 for an example) investigated optimal size for isolated groups and found that groups of three seemed to do better than groups of two.

Other research seems to indicate that larger groups are more likely to be harmonious however. Dudley-Rowley, Whitney, Bishop, Caldwell, Nolan and Gangale (2002) for example investigated the relationship between crew size and negative behaviour. Their study encompassed numerous polar and space expeditions and indicated that larger crews were more functional than smaller crews in terms of negative or "deviant" behaviour.

In their discussion of related literature Kanas and Manzey (2003) concluded that optimal crew size was around 7, and that odd numbered crews tended to do better than even numbered crews. This they argued was because even numbered crews were more likely to

become deadlocked on group decisions. They also make the point that in larger groups there is also a greater tendency for leader follower relationships to develop. This has obvious advantages in that effective leadership structures are very important for effective group functioning in extreme environment. This issue will be dealt with later in this chapter, where group cohesion will be discussed.

Interpersonal relationships and "group climate" Research into the interpersonal relationships of people in isolated extreme environments, has in the past mostly focussed on the concepts of tension and the general social wellbeing of groups (sometimes referred to as "team" or "group" climate). The next section will be a brief discussion of the work that has been done in this area.

Very little work is to be found in the space psychology literature concerning the actual modelling or understanding of the development and maintenance of positive interpersonal relationships. While there are many references to the word "interpersonal" in the literature, mostly this is used to refer to general social psychological issues in space. Interpersonal psychology as an understanding of dyadic relationships is mostly absent from the space psychology literature.

There are exceptions to this however and a bed rest study by Weiss and Moser (1998) is an example of where dyadic relationship formation in an isolated extreme environment. In their study they observed that the development of a bond between two people in this kind of environment was very important to how well individuals coped with stress. One indication of a bond being formed that they observed was the development of behavioural contagion. By this they meant the partaking in similar activities at similar times. They found that dyads who behaved in this way were far more likely to be able to deal with stress.

Possibly the most advanced means to conceptualise interpersonal relationships in space flight and associated contexts has been proposed by Dion (2004). He recommends using the "Social Relations Model" developed by David Kenny and colleagues (Kenny, 1994). This model looks at the interdependencies of actors and statistically models actor, partner and relationship effects. The advantage of using this kind of model is that it can be used to both monitor the states of specific dyadic relationships as well as to investigate links between certain variables (such as personality types) and positive interpersonal relationships. To date however no data has been collected using this technique, although the related technique of social networks analysis was used in the Johnson, Boster and

Palinkas (2003) study described earlier. In that particular case however they were more interested in social structure rather than specific interpersonal relationships.

The more common form of reporting of interpersonal psychology is that of ratings of tension between crewmembers and how this relates to certain other variables. The relationship between crew tension and time is one example of this and has been reported in numerous studies. Palinkas (2001) for example used anecdotal sources to conclude that as isolation is prolonged there is a relational increase in social tension. Similarly Sandal (2001a) reported a high point of social tension in the final weeks of a 135 day space station simulation in Moscow, culminating in open conflict and the social exclusion of one member of the crew. In this way general aspects of the social/group functioning are often placed under the category of "interpersonal relations".

This kind of "general social wellbeing" has received quite a lot of attention in the literature with numerous studies focused on the idea of "team" or "group climate". An example of this can be seen in a study by Schmidt, Wood and Lugg (2004). They define "team climate" in terms of individual perceptions of a wide range of social factors which relate to the general moral or cohesion of a group. In their study they surveyed 187 Antarctic expeditioners from 19 different groups over a period from 1996 to 2000 and assessed how team climate related to a number of variables. They found that perceptions of effective leadership, more than anything else, predicted high levels of positive "team climate".

A similar study by Kahn and Leon (1994) of four female Antarctic expeditioners, used measures of personality, competitiveness, confidence, communication, stress, mood, coping, and task effectiveness to assess the group climate. Their research however was an assessment of how an all female team would function in an extreme environment rather than seeing how group climate was associated with other variables.

A series of related studies by Marilyn Dudley-Rowley have also focussed on this kind of work, using "deviance" or levels of "off-nominal" behaviour as an indicator of social dysfunction. Dudley-Rowley (1997) defines a methodology for the measurement of the frequency of "off-nominal" acts, which involves the reporting of critical incidents or specific maladaptive behaviours. In this study she found a number of issues which could be counted as "off-nominal" which included neglect of tasks, violations of safety rules, threats and coercion, the expression of mental disorders, challenges to leader authority, claiming of ownership of communal items or spaces, poor communication with outside groups such as

mission control, inappropriate sexual behaviour and advances, poor hygiene, poor planning, accidents caused by human error, insensitivity of expedition leaders and physical or verbal abuse. These behaviours could be as much an outcome of exclusion as a cause of exclusion. In part, the functioning of a group as a whole and the individual-group relationship could be an important aspect of understanding both function and dysfunction.

Using a similar technique Dudley-Rowley, Gushin, and Gorry (1999), then proposed to investigate levels of "off-nominal behaviour" in terms of a general "social states index" during a simulation study of the International Space Station. In this study they proposed using measures of six social indicators. These would include the number of communicative modes, unique communications, efficient communication, cuing behaviours, informal behaviours and number of personal evaluations communicated to one another. In other words Dudley-Rowley et al (1999) were trying to develop a way of assessing group functioning based on levels of different kinds of communication. In this way general group functioning or the "social state" was being defined in terms of effective communication.

Group cohesion   Related to the concept of social wellbeing, social state, and "team" or "group climate" is that of group cohesion. While group cohesion has been dealt with extensively in general social psychology literature, Dion (2004) defines group cohesion in the space flight context as the "social glue" which keeps people together in the face of adversity and represents a form of togetherness. This, he claims, is seen as being very important in numerous contexts in which small groups have to work effectively together, such as military groups, sports teams and even in industry.

While cohesion is seen as necessary for the effective functioning of space crews, Dion, and others (Kanas & Manzey, 2003 for example) point to the link between strong group cohesion and "group think". Janis (1982) proposed that under conditions of high cohesion and isolation from outside input (often from a belief in the group's own superiority), a group may suffer from dysfunctional decision making processes. Another factor of group think is that intragroup differences or disagreements are ignored or denied. Decisions become based on the group's strongly held views rather than evidence presented to them. One of the requirements according to Janis is that the group members have to believe that they are special for some reason and that they are above advice from outside sources. (For an example of "minor group think" developing in a space simulation study, see Rosnet, Cazes & Vinokhodova, 1998). Astronauts could be particularly vulnerable to

this due to their special status and the fact that ground control "don't know what it's like" up in space or "don't understand what's going on". If this kind of extreme group cohesion occurred then it is not difficult to imagine negative consequences following.

Generally speaking in the literature however, group cohesion is considered as an indicator of positive group functioning and numerous studies use the term "cohesion" to represent this. One example of this can be seen in the study by Leon, Kanfer, Hoffman and Dupre (1994) of a mixed Soviet-American group of Artic expeditioners mentioned earlier. Here, like in other studies, group cohesion was used as a positive group outcomes variable and in this particular case was negatively affected by the group interacting with people from villages encountered during the expedition.

In another study by Rosnet, Cazes and Vinokhodova (1998) the cohesion of two group members in a space station simulator was enhanced by the exclusion of third crewmember. In this way the use of the concept of "group cohesion" is generally synonymous with concepts of a group which is close with members highly interdependent on one another. The social networks study by Johnson, Boster and Palinkas (2003) mentioned earlier may give a good indication of what is meant by this. They describe this as a "globally coherent networks" in which all members interact with one another and form a stable whole group rather than splintered subgroups.

Within the space flight and isolated extreme environment psychology literature, one particular issue seems to be related more to group cohesion than any other: leadership. In a study which reanalysed data collected from a number of Shuttle/Mir mission, Kanas and Ritsher (2005) examined the relationship between group cohesion and leadership. They found that effective leadership was related to crew cohesion and interestingly that certain leadership styles were responsible for this. Supportive role leadership (leadership associated with managing the emotional needs of subordinates) was important to group cohesion in both space and mission control crews. Task role leadership (concerned with the fulfilment of mission objectives and taking charge during critical situations) however was only important to cohesion for mission control groups. A follow up study by Kanas et al (2006) of missions to the International Space Station found a similar pattern of results. More support for this can also be seen in the previously mentioned study on "team climate" by Schmidt, Wood and Lugg (2004) who found that perceived leadership effectiveness accounted for 77% of group level variance of "team climate". (Note: cohesion was one of their defining features of "team climate"). Leadership was also considered to be a major

factor in groups which developed "globally coherent networks" in the study by Johnson et al (2003). All this research is interesting as it suggests that leadership is one of the most important factors to consider, when thinking about group dynamics in extreme environments.

Personality and group dynamics Personality psychology has also had an impact on the thinking about how best to achieve positive group functioning in the space flight context. As mentioned earlier in this chapter there has been considerable work done to find what constitutes the "ideal" astronaut. Inevitably a person's interpersonal skills are counted as one of the dimensions to be considered. Indeed the work by Chidester and colleges (Chidester, Helmreich, Gregorich & Geis, 1991; and Gregorich, Helmreich, Wilhelm & Chidester, 1989) mentioned earlier suggests that part of having "the right stuff" was to do with high levels of expressivity on the Personal Characteristics Inventory (PCI): in other words having the ability to socialise successfully with other people. Similar work by Galarza and Holland (1999) on the proficiencies that would be required for extended duration space missions also suggested that team work and group living skills would be of a high priority in future astronaut selection. Recent work by Bishop, Dawson, Rawat, Reynolds, Eggins and Bunzelek (2006) has taken this area further by trying to relate specific aspects of personality with group-based processes, such as ingroup identification and levels of organisational citizenship behaviour. Results from this line of work though are only preliminary however and represents a developing area in space psychology.

This kind of work focuses on the individual and assumes that the way to find the ideal "group of astronauts" is to select a crew of "ideal individuals". This approach is fundamentally limited however as it fails to appreciate the notion that much of social behaviour comes from group-level psychological processes, and/or the interaction of individuals with one another (for a more thorough discussion of this issue see Chapter 3). The work by Haythorn and colleges mentioned earlier (see Smith & Haythorn, 1972 for an example) dealt with this issue to a certain degree by looking at "compatibility" of personalities, but most of the modern work does not take this perspective. Having said this, the relationships found between personality types and positive group functioning are reliable and as such provide an important starting point for achieving social harmony during spaceflight. As personality testing is important for other areas of crew selection, incorporating factors regarding interpersonal skills provides an easy first line of defence.

Compared to managing interpersonal issues that may arise during actual space missions, the selection of people with "the right stuff" is a far more controllable process.

Intergroup processes Understanding intergroup processes in the space flight context has received some attention but represents an underdeveloped area of the space psychology literature. To date most research has described the common intergroup tensions that have been observed either in space or in simulation studies, but generally does not go beyond observation. The kinds of group distinctions that have been observed in the past include mission control versus flight-crew and intracrew groups such as those based on nationality and culture as well as operationally different groups such as those entering or leaving a habitat at different times. While there are numerous ways that people could organise themselves into different social groups (this will be discussed in depth in Chapters 3 & 4), these are the group distinctions from which problems have been observed.

The most common intergroup problem to be observed in the spaceflight context is that of tension or relationship breakdown between mission control and the flight crew. Documentation of this problem dates back to the Apollo missions of the late 1960s, with the most well publicised incident being the breakdown in relations between mission control and the crew of the Skylab IV mission (Harrison & Connors, 1984). In 1974 the flight crew of Skylab (an American space station) shut off all communication with mission control after having strained relations for the first half of the mission. They then went on strike by taking a day off, refusing to perform any of their scheduled duties. While this incident did not result in any physical harm being done, the interdependency of the space crew on mission control meant that such a situation did left the crew open to substantially increased risk. The fact that a loss of a whole day of research was due to social breakdown is also a serious issue due to the extreme expense of conducting research in space.

The Skylab situation was not an isolated incident either, with tension between the flight crew and mission control being an emergent theme in the literature. Palinkas (2001) describes the problem as the "displacement" of problems by the flight crew onto mission control, suggesting that it is a way of coping with problems that they cannot raise with other crewmembers. Kanas, Salnitskiy, Grund, et al (2001) tested this proposition with data from the Shuttle/Mir program and indeed found that tensions among crewmembers were displaced onto mission control. As mentioned earlier in this chapter, Gushin et al (1997) refer to this process as "psychological closing" or a decrease in cooperation and

communication with mission control and it represents a serious intergroup conflict. Further evidence and discussion of this phenomenon can also be seen in Kanas et al (2006), Kozerenko, Gushin, Sled, Efimov, and Pystinnikova (1999), Rosnet, Cazes and Vinokhodova (1998), and Sandal, (2001b).

Another problematic intergroup situation observed in the space flight context is the of the "host-guest problem". Kozerenko et al (1999) describe this as a tension that develops when one group of people have their space invaded by another group, such as by a resupply or visiting crew. Kozerenko et al (1999) note that this problem was first observed when two Russian crews were present on the Mir, basically one crew being the "hosts" and the other the "visitors". The "visitors" had to adapt to the conditions in space and as such required help from their "hosts" whose busy work schedules were then interrupted. This, and the invasion of space, was apparently a source of tension between the two groups. Another example cited by Kozerenko and colleagues regarded a dispute that ignited over the use of a computer by a "visitor" that a member of the primary crew thought of as their own.

The most serious case of the "host-guest problem" developed during the NASA/Mir missions in which the visiting American astronauts had to take a "guest" role while onboard. This was mostly due to the fact that they were isolated by language and the fact that the Russian cosmonauts spent most of their time managing the station. In the first of the missions the Americans were not authorised to be involved with technical operations, but later were given the choice of helping the Russians with their work (to the detriment of NASA's scientific program). In the cases where the Americans did choose to help, the psychological barriers between themselves and the Russians were substantially reduced (Kozerenko et al 1999).

Possibly the most serious case of intergroup relationship breakdown observed has been the situation that arose during the SFINCSS-99 International Space Station simulation, discussed earlier in this chapter (Inoue, Matsuzaki & Ohshima, 2004; Sandal, 2004). The two crews participating in the simulation had a complete relationship breakdown due to the unwanted sexual advances of a member of one crew onto a member of the other. This issue can be partly attributed to cultural differences, but the schism into two groups reveals high levels of intergroup conflict that affected the performance of the group as a whole. The two crews had to be separated by a locked hatch due to the degree of hostility that arose. In this particular case, the ingroup-outgroup effect was observed, but

a deeper understanding of how it had come about was never presented by researchers. At the time no measures of intergroup processes were in place, so it was difficult to really understand what went wrong. One could argue that it is imperative that this kind of process is understood, as if this problem had arisen during a mission to Mars, the consequences could have been disastrous.

Understanding how groups form and how intergroup relations are best managed is still missing for the most part from the space psychology literature. Chapter 3 of this thesis will present an appropriate main stream social psychology theoretical paradigm that deals with these issues and has been alluded to in the work of Dion (2004) and Penwell (1990). Penwell describes parts of "social identity theory" (Tajfel, 1972, Tajfel & Turner, 1979) in the space flight context and suggests why it is important to consider how intergroup conflict can develop from a psychological perspective. Dion on the other hand draws on a related theory of how to prevent intergroup conflict known as the "common ingroup identity" model (Dovidio et al 1997; Gaertner & Dovidio, 2000; Gaertner, Dovidio, Anastasio, Bachman & Rust, 1993). This model suggests that the best way to mitigate against intergroup conflict is to have members of the conflicting groups "recategorise" themselves into a large group that includes members of the other group. To date however, the application of these theories of intergroup conflict to the space flight context has been theoretical only. No actual research to study these issues has been published to date. As noted earlier however, the present thesis will deal with these issues in later chapters and data will be presented.

Small group culture   The final area of social psychology to be explored in the space flight context is that of small group culture. As discussed earlier in this chapter, this is the culture or norms, values, behaviours and beliefs that develop amongst a small group of people. Often these are informed by more "macro cultures" such as nationality, religion or race as well as from individuals' personal backgrounds and the situation or context the group forms and develops in (this will be explored more in later chapters). This area is important because it gives insight into what kinds of behaviours can be expected or are "normative". If a crew develops a "norm" of not reporting safety breaches for example, then intervention would be needed. This is because this particular behaviour, if it is persisted, could jeopardise the success of the mission and safety of the crew. The fact that it had become a "norm" would imply that the behaviour would continue without intervention. In this way group norms represent observable patterns of consistent

behaviour. Other important aspects of small group culture can also be imagined. In Chapter 5 of this thesis, for example, aspects of small group culture relating to tolerance of group member diversity will be introduced.

To date there has not been much work done in this area; however Sarris and colleagues (Sarris, 2006; Sarris & Kirby, 2005) in a number of recent studies of people who had wintered-over in the Antarctic between 1950 and 2000 investigated the idea of "person-culture fit". This notion is taken from organisational psychology literature and describes the degree to which an individual's personal values "fit" with those of a particular organisation. According to Chatman (1991) people who enter an organisation with values that "fit" are better able to adapt to being part of that organisation, are more satisfied with their membership and are more likely to stay longer within it.

Sarris and colleagues adapted this idea for the extreme environment context and did indeed find that those people whose values fit the small group culture they were part of during their time in Antarctica, were more likely to have enjoyed their time, had a stronger desire to return to the Antarctic and had achieved better job outcomes during their expeditions. This particular line of research did not tap into specific aspects of group culture however, but rather on how individuals fit in with the unspecified culture of their groups. Nevertheless these studies were a first step towards understanding the impact of small group culture on mission outcomes and space traveller behaviour. This aspect of space flight psychology represents an important area that needs to be developed in the future research and will be explored empirically in later chapters of the present thesis.

2.2.5 Countermeasures used to combat psychological problems observed in space

So far in this chapter, the different areas of psychology that have been considered in the space psychology literature have been discussed. For many of the problems that have been observed, countermeasures have been proposed. The next section will deal briefly with some of the countermeasures that have been suggested and/or implemented for human space flight. This section will not provide a detailed discussion of countermeasures however, as for almost every paper presented in the space psychology literature, there are usually some countermeasures suggested.

Manzey, Schiewe and Fassbender (1995) provide a detailed account of suggested countermeasures for most psychological problems discussed in the literature. According to Manzey et al (1995) the purpose of employing psychological countermeasures for space

flight is to "provide space crew members with knowledge, attitudes and skills which help to stabilize their mental and emotional state and which help to avoid interpersonal conflicts in order to maintain a high crew performance during the common mission" (p. 339).

Manzey et al (1995) describe four areas of countermeasures that have been used or suggested to date. The first involves "individual-oriented pre-flight countermeasures", which basically encompasses the selection of astronauts as well as basic "psychological" or behavioural training that prepares astronauts for the conditions of space. It also includes training for social competence and stress management.

The second area is "crew-oriented pre-flight countermeasures". This area deals with issues regarding crew functionality, such as; selecting for crews with psychologically compatible members (whether by personality based compatibility measures or through the use of assessment centres as discussed earlier); crew oriented psychological mission preparation, such as team building and the development of shared mission goals (as a crew as opposed to individual or institutional goals), as well as crew coordination skills and the development of crew structure; and finally the development of strategies for dealing with easily anticipated problems, such as the formation of cliques as well as situations involving scapegoating or the alienation of members of the crew.

The third area of countermeasures Manzey et al (1995) discuss regards actual inflight psychological support for space crews. This involves support for the emotional wellbeing of astronauts as well as helping with performance efficiency and prevention of task overload. In order to support flight crews' emotional states they suggest the different kinds of countermeasures; the first being the organisation of entertainment, leisure activities and non formal contact with people on the ground (such as family and friends); the second being the facilitation of regular crew meeting which can help to maintain crew cohesiveness; and the third being ground based monitoring of emotional state and problems that may develop. They suggest this can be done by maintaining regular communications between the crew and the psychological support team.

The fourth kind of psychological countermeasures suggested by Manzey et al (1995) involves an integrated approach to psychological countermeasures. By this they mean an approach which integrates all the areas discussed so far, so that individual and crew training and selection, for example, occurs in such a way that both individual and crew performance is maximised. This is aims to integrate all aspects selection, training and in-mission support, in a complimentary way.

Another summary of countermeasures is presented by Kanas and Manzey (2003). In their chapter on psychological countermeasures they report on seven areas of action. These are (without going into detail); habitability factors (as discussed earlier in this chapter); work design issues; the selection and composition of flight crews; training of flight crews and mission control; monitoring of crews during flight; in-flight psychological support; and finally post-flight psychological support, to help with readjustment. This kind of summary of countermeasures can be found in numerous articles and books on space psychology and generally cover the same areas, with some proposing more specific approaches to the problems outlined in those particular sources. Nevertheless, countermeasures represent the most important aspect of space psychology as it is the actual implementation of knowledge gained through research.

2.3   Summary of Space Psychology Literature, Common Problems and Future directions.

This chapter has outlined a range of different kinds of studies conducted in the field of space flight and extreme environments. The areas covered have included issues relating to: stressors/stress, emotional stability, mood states, psychiatric problems, cognitive function and performance, human factors/habitability, personality and crew selection, interpersonal and social psychological dynamics and finally the kinds of countermeasures that have been employed. These areas represent all the major domains of psychology that have been researched in the context of space flight. The purpose of this chapter was to provide a summary of these areas without going into a thorough critique of the area. In this way a descriptive but very uncritical view of the literature has been presented. Part of the reason for doing this is because there is a consistent pattern of problems and criticisms that apply to much of the work.

Key problems identified by Suedfeld and Weiss, (2000) based on their knowledge of Antarctic research included; sample sizes, difficulties getting participants to complete questionnaires, cultural generalisability and clashes between mission and research goals. Similar problems also plague space research, but there are the additional problems of; expense of research, lack of opportunity, even smaller sample sizes, and a heavy reliance on anecdotal evidence. These problems suggest that the certainty and validity of much of

the knowledge gleaned from research may in fact be questionable. Suedfeld and Weiss argue that at the moment these problems are very difficult to overcome. Where sample sizes are increased, for example by using retrospective studies of numerous expeditions, (such as in Sarris & Kirby, 2005) other problems have emerged, such as a reduction of the reliability of data due to time delay between expedition and data collection (sometimes as long as 50 years!). However while much of the research does have problems, it still represents our best chance of understanding the psychological problems associated with space travel.

The current author, however, would argue that another serious problem, which is not insurmountable, plagues much of the research conducted to date. While there are many exceptions, much of the work does not draw upon mainstream social psychological theory to inform the research. Many of the studies undertaken to date treat psychology within extreme environments as something apart from mainstream psychology. Because of this, ordinary psychological theories are often not used or adapted to understand what is going on in these environments. Instead researchers have had a tendency to start from scratch, creating their own measures and theoretical frameworks. As such they potentially risk missing key insights that mainstream psychology has demonstrated through systematic scientific inquiry. The current approach to space psychology, while it has provided a plethora of knowledge is therefore fundamentally limited. In this sense one area for future development for space psychology is the utilisation of recent mainstream psychological knowledge.

Another area which is currently underdeveloped in the literature is that of the understanding of group-based processes in the context of space flight. As discussed earlier in this chapter some work has been done, but an in-depth understanding of how groups form, how cohesion can be promoted (and prevented from becoming too strong, i.e. leading to "group think"), how conflict can be managed and how small group culture can be shaped to improve mission outcomes, is, in the main, missing from the literature. The present thesis, will attempt to progress this area by applying a main stream social psychological, group process theory to the context of space flight. Even so this thesis is only a preliminary work in this area and there are still many aspects of group processes which will not be covered or need to be further explored.

2.4   Conclusion

To date, there has been much research undertaken to understand the psychological processes relevant to space flight, with much of it being undertaken during spaceflights, in space analogue environments, such as the Antarctic, and in simulated space environments such as SFINCSS-99. This work has been essential in developing ways of understanding how the psychological well being of space crews can be maintained as well as how to improve the chances of mission success. This field of psychology is still however in its infancy and much work is yet to be done. The current chapter has provided a snapshot of all the main domains that have been studied to date. It has been argued that a more integrated group-based social psychological approach to understanding this field has been missing.

In the next chapter of this thesis a social psychological theoretical paradigm which is highly relevant to space psychology is outlined. It is this theoretical approach to understanding group functioning that is then explicitly investigated in the remainder of the thesis. While much of the existing work speaks to phenomena relevant to social psychology (e.g., closing out, intergroup conflict, the important of mission goals, understanding diversity), this work and its links to concepts like social identity, ingroup identification and the group's norms, values and beliefs have not been systematically investigated.

- Chapter 3 -

Understanding the Social 'Group': Social Identity Theory and Self-Categorization Theory

In the last chapter a gap in the space psychology literature was highlighted: that is there is little or no research conducted into the understanding of 'group' (as opposed to 'individual') level processes of human social psychology in the space flight context. The current chapter aims to explore why understanding human social psychology at a group level is important and valuable in predicting human social behaviour in such contexts. The importance of the 'group' is discussed with reference to the historical debate over 'individual' versus 'group' psychology and then a thorough discussion of two of the more influential group-based theories, social identity theory and self categorization theory, is provided.

3.1 An overview of historical tensions between individual and group psychology

The debate as to whether human behaviour can be reduced entirely to 'individual' processes can be traced back to the pre-experimental theorists of the early twentieth century. On one side, theorists such as LeBon, Allport and Taylor considered the behaviour of a group to be nothing more than the sum of the actions of each individual. On the other were Gestaltists like McDougall and others such as Mayo, Asch and Sherif, who believed in processes unique to the group, and that the group was more than just the sum of its parts.

For example, LeBon's work on collective behaviour suggested that when crowds of people acted together, they descended to a less civilised form of behaviour. He did not argue that this was due to 'group' processes, but rather the individual mind taking

advantage of the 'anonymity' that the crowd provided and being influenced through a process of 'contagion' whereby ideas are disseminated through the crowd (Hogg, 1992). In his work group behaviour was simply individuals acting in a similar way. Frederick Taylor also made similar points in his work on 'scientific management'. He argued that as far as productivity was concerned 'individualising' each worker so that they performed their task using the 'one best way' was the best way to maximise productivity. Taylor believed that groups 'undermine accurate cognition and useful action' (Haslam, 2001, p. 26). In this way he did not so much argue that groups were irrelevant, but rather that they were not something that should be encouraged from a productivity point of view.

The point that groups were merely just aggregates of individuals however was most strongly made by Floyd Allport. He argued that 'there is no psychology of groups which is not essentially, and entirely a psychology of individuals' (Allport, 1924, p. 4). Allport was an early experimental social psychologist and his work centred on the principle that understanding the individual was the key to understanding group-based behaviour. The importance of the 'individual' can also be traced back to Münsterburg's 'individual difference paradigm', which saw the measuring of differences between people as a way of finding the 'best person for a job' (Haslam, 2001). His work can be seen to be very influential even today, with much research into human social behaviour being based on individual differences (personality) rather than characteristics of a group or an individual's relationship to a group.

On the other hand a number of early psychologists argued that in order to understand human social behaviour fully, one needed to understand the processes that occurred on a group level: processes that were not reducible to individual functioning. For example William McDougall, in his influential book *The Group Mind* argued that in order to understand individuals and groups, the relationship between the two needed to be taken into account. He also argued that 'the group … is more than the sum of the individuals, has its own life, proceeding according to laws of group life, which are not the laws of individual life' (McDougall, 1921, p. 13). McDougall's perspective is that of a Gestaltian: that is the belief that a whole can be more than simply the sum of its parts. So in some ways the debate is philosophical in nature rather than simply psychological. On one had there is the reductionist perspective which suggests if we reduce something to its base processes, we can induce the higher order processes from these. The alternate position suggests that processes occur which are independent of the processes at the lower level.

This position that the 'group' could not be ignored in social psychology was taken up by influential researchers such as Elton Mayo, who's work in the Hawthorn studies, lead to the conclusion that group processes rather than characteristics of the individuals or working procedures per se, were producing changes in workplace performance. Mayo recognised that group norms could be detrimental to group functioning (e.g., social loafing, poor performance) but also that they could serve to foster higher group performance. Further work by Solomon Asch also supported the notion that group membership could have a direct impact on individual outcomes. In his famous line studies, Asch (1952) showed that peoples' perception of the length of lines could be altered by the opinions of others. Here he demonstrated that what the 'group' thought about a problem influenced the cognition of the individual.

The later half of the 20th century saw a growing body of evidence in favour of group-based processes impacting upon individual cognition and behaviour. Despite this however the 'individual' still dominates in areas such as organisational psychology (Haslam, 2001). As pointed out in the previous chapter, the 'individual' also dominates in space psychology. This may have occurred in part due to the 'individualistic' culture of the western countries where much of the research has taken place, or may simply be due to the notion that programs targeted towards the 'individual' are easier to comprehend and require less abstraction. It is much easier to simply believe that if we find the right person for the job (or space mission), then everything else will fall into place. This position however is problematic, as a growing body of evidence suggests that group processes and group dynamics can contribute considerably to the variation in human social behaviour.

One of the more influential theories, arguing for a more direct consideration of the role of the group in human psychological functioning, is social identity theory (Tajfel, 1972, Tajfel & Turner, 1979), which arose from a series of studies which were conducted in order to understand how being a member of a group could lead to discrimination and prejudice. Social identity theory (SIT) developed into a much broader theory however, with a range of predictions regarding how the nature of intergroup relations could affect group behaviour. In particular the focus was on low status disadvantaged groups and the conditions under which they would accept or challenge the high status dominant group.

SIT also introduced the idea of a social identity, that is a part of one's self concept which is concerned with the membership of a specific social group. Following on from the work on SIT, self-categorization theory (SCT) was developed by John Turner and

colleagues (Turner, Hogg, Oakes, Reicher & Wetherell, 1987), as a way of understanding the processes by which people come to identify with a particular group. These two theories together have often been referred to as the 'social identity perspective' (Turner & Reynolds, 2001), and have been expanded on and backed up by three decades of research. These theories form the core framework of this thesis and for this reason are outlined in more detail in the remained of this chapter.

3.2   An overview of Social Identity Theory

Social identity theory arose originally from a group of experiments done in the 1970s by Henri Tajfel and colleagues (Tajfel, 1972; Tajfel, Billig, Bundy, & Flament 1971; Tajfel & Turner, 1979). The original goal of this experimental program was to understand why and how intergroup discrimination occurs. These experiments used what has come to be known as the minimal group paradigm, which will be explained in more depth shortly. The SIT approach to discrimination attempted to incorporate what was happening at an individual level with what was happening on a 'social' level (in terms of social structure and social change).

A core aspect of SIT is the recognition that there is a psychological relationship between the individual and their group memberships. Tajfel (1978) linked the individual self-concept and group behaviour through the notion of social identity, described as "that part of the individual's self-concept which derives from his knowledge of his membership of a social group (or groups) together with the value and emotional significance attached to that group membership" (p. 63).

Tajfel and colleagues examined ingroup favouritism and outgroup discrimination for groups that were minimal in the sense that the 'meaningfulness' of the groupings was minimised. This was done by removing as much social meaning as possible from the social context and adding social information until discrimination appeared. The first step of the process was to categorise participants on the basis of an arbitrary preference, for example, painters Klee or Kandinsky. No other meaning was provided and it was assumed that these groups were not associated with any 'real world' previous strongly held identities, histories or conflicts.

It was found that when placed into these 'minimal groups', however, participants would actually discriminate against members of an outgroup in a task which involved awarding points that represented money to other participants. What Tajfel and colleagues

found most interesting was that participants did use the minimal group memberships as a cue for awarding the points and were willing to allocate points in a way that maximised the difference between their own group and the contrasting group (i.e., Klee versus Kandinsky). This strategy meant the ingroup received less profit than it otherwise could have. In other words, it was the difference (or distinctiveness) in allocations between groups that was important to participants rather than a pure profit motive. It was argued that in the minimal group studies, the only way to distinguish one's group from another in a positive way was to award group members more money than outgroup members. In addition to this, it was found that social categorisation was required to get these effects, not just perceptions of similarity between individuals (Tajfel, 1972).

From these initial minimal group studies came the broader more detailed social identity theory. Essential to Tajfel and Turner's theory, are two fundamental elements (Tajfel & Turner, 1979). These were how the motivation of a person to obtain a positive social identity interacted with a) specific status relations within a society and b) whether the orientation to the problems were responded to as an 'individual' or as a 'group member'. In other words, the way in which one's own group compared to others on relevant dimensions as well as the degree to which there was a belief in collective or individual strategies to bring about a more positive comparison were central to social identity theory.

It was argued that comparison between groups was key to predicting behaviour. Specifically it was thought that four aspects of intergroup relations were important. These were the status differential, the legitimacy of that differential, the stability of the differential and the permeability of boundaries between groups (whether it was possible to move from one group to another). It was argued within social identity theory that individuals had three behavioural choices which would further their goal of achieving a positive social identity – social mobility, social creativity or social competition.

Social mobility would be pursued when an individual's current group was of a low status and the boundaries between their own group and the higher status group were permeable. This behavioural strategy might also be pursued if a person was in a higher status group and strongly believed that the status differential was illegitimate and stable. Under these conditions, he or she would feel psychologically connected to the disadvantaged group (Reynolds & Turner 2001).

Social creativity can be defined as a way of redefining the comparative context in such a way as to legitimise a higher status position of a group. This strategy might be

pursued in situations where lower status group members perceive the status differential as stable but illegitimate. In this kind of situation, the lower status group redefines what the key elements of comparison are in such a way as to make their own group higher status. Conversely a higher status group might use social creativity to reinforce their position when the status differential is unstable and illegitimate (i.e. they try and induce stability by finding a new way to justify their position).

Finally social identity posits that social conflict will occur when group boundaries are perceived as impermeable and status differentials viewed as unstable and/or illegitimate. Reynolds and Turner (2001) describe this as where group members of subordinate and dominant groups engage in competition with one another on dimensions that are valued by both groups. In order for this to occur there must be shared agreement between members of the low status group that there is potential for change. With this comes higher identification by individuals in the lower status group and correspondingly the ability of that group to act in a unified manner to achieve their collective goal.

The extent to which a person thinks of themselves as either an individual or as a group member was thought to lie on an 'interpersonal-intergroup continuum'. At one end of this continuum is the personal self, at the other the social self. The personal self could be thought of as containing attributes which describe the individual compared to other individuals, while the social self could be thought of as the self as interchangeable with other members of a social category or group. The personal self was thought to apply for interpersonal social interactions while the social self was more likely with intergroup interactions. This interpersonal-intergroup continuum was theorised to coincide with a continuum of interpersonal-intergroup behaviour, whereby at the personal end behaviour is appropriate to interpersonal relationships and at the social end it is appropriate to intergroup relationships.

Another two continua were also thought to be related to these processes. The first is that as a person's self-definition moved from interpersonal to intergroup their perceptions of members of a relevant outgroup would move from being heterogenous to homogenous (later work suggested that this also occurred for perceptions of relevant ingroups as well; Oakes, Haslam, Morrison & Grace, 1995). The second was that behaviour towards members of an outgroup (or ingroup) would also become more uniform as a person moved towards the social end of the interpersonal-intergroup continuum.

SIT was also developed as a social system model, designed to understand the behaviour of groups within society. A series of predictions about group and individual behaviour based on a number of relevant social factors were made. It was thought that the extent to which a person identified at either a group level or a personal level would motivate people to work collectively to change or maintain a status quo (depending on the status of their group), move as an individual from a low status group to a high status group or alternatively redefine what is important so that one's group is evaluated more positively (Haslam, 2001). In this way social identity theory is about intergroup behaviour and can be used to understand social systems. For a detailed description of this model see Haslam, (2001, p 38).

3.3 An overview of Self Categorization Theory

From social identity theory rose self categorization theory (Turner, Hogg, Oakes, Reicher & Wetherell, 1987). While interrelated, these two theories do not describe exactly the same areas. SIT is predominately interested in social structure and while social identities were described as being important, the psychological mechanism that underpinned shifts from personal to social identity were unspecified. In order to understand how people come to identify with certain groups Turner and colleagues (Turner et al. 1987) developed self-categorisation theory. This theory was developed to compliment rather than replace social identity theory (Turner & Reynolds, 2001).

Self-categorisation theory is primarily concerned with the process of psychological group membership – how it is that people come to identify and 'categorise' themselves and others as group members. A person may have numerous 'self categorisations' that can become relevant in a given situation. Under certain conditions they can define themselves as distinct and unique individuals in terms of their personal identity (the "I "and "me") or as group members who share common goals, interests and values with others in terms of their social identity (the "we" and "us"). The process that accounts for which self-categorization or identity will become salient in a given context will be discussed in more detail later.

It is thought that a salient social identity allows for individuals to come together as a single group with shared goals, values, behaviours and beliefs. These shared goals, values, behaviours and beliefs are what fundamentally define the identity of a group and arise out of a dynamic process of interaction amongst members (Haslam, 2001; Postmes & Jetten, 2006). When a self-categorisation is made in terms of one's group membership, the self is

seen as interchangeable with other members of a particular category (Turner et al. 1987; Turner, Oakes, Haslam, & McGarty, 1994). Turner (1987) refers to this process as 'depersonalisation'. When a person thinks about him or herself in terms of a social identity, they see themselves in terms of the characteristics that define that group rather than the personal attributes that define him or herself as an individual. In this way, when a person's social identity is salient the group goals, norms, values and beliefs become their own and shape attitudes, behaviour and cognition. If we take an example of a football player (McGarty, 1999), without having knowledge of the player's group membership, it becomes impossible for team members or spectators to predict which direction they will kick the ball. It is group attributes that allow us to predict the player's behaviour rather than individual characteristics. This process is therefore seen as an enrichment of identity rather than a loss of personal identity.

In order to understand SCT, one must first understand what is meant by categorisation. A categorisation can be thought of as a cognitive process in which an aggregate of stimuli are grouped together so that they become functionally interchangeable with one another. It is important to note that this is not the same as stimuli being similar to each other. When categorisation occurs a 'wholeness' is implied which removes the individual distinctiveness of a stimuli. In order for social or self categorisations to occur, a stimuli (i.e. a person) must have 'fit' with a particular category. 'Fit' is described as "the degree to which a social categorization matches subjectively relevant features of reality – so that the category appears to be a sensible way of organising and making sense of the social stimuli" (Haslam, 2001, p. 50). Fit comprises of two components, comparative fit and normative fit. As well as this there must also be perceiver readiness to make a categorisation.

'Fit' is made up of two components, comparative and normative fit. Comparative fit describes how appropriate a categorisation is based on the meta-contrast principle which can be defined as "in a particular context, stimuli will be categorised as the same when the average differences perceived between them (intraclass differences) are less than the differences between them and other stimuli (interclass differences)" (Reynolds & Turner, 2001 p. 169). This means that stimuli can be grouped (or categorised) together when they are closer to each other than they are to other stimuli. Turner et al (1994) go on to say that the principle of comparative fit 'defines fit in terms of the emergence of a focal category

into distinct groups' (p. 455). In other words comparative fit is about a mechanism for allowing categories (not just social ones) to emerge from a given group of stimuli.

Normative fit, on the other hand, describes the appropriateness of a category in terms of its meaningfulness to other situational factors. Essential to normative fit is that the stimuli to be categorised meet the 'normative' expectations regarding that category (Turner et al, 1994). By this it is meant that the ways in which the stimuli are being differentiated from other stimuli in comparative terms must fit in with the expectations regarding that category, particularly in regards to the direction of similarities and differences. Take the example of a collection of people that could be separated into two groups based on the meta contrast principle. Whether or not we categorise each as pro and anti abortion, will depend on whether the dimension that they have been contrasted on relates to opinion on abortion. Furthermore the differences must go in the direction expected. A study by Oakes, Turner and Haslam (1991) demonstrated this point by showing that a participant's self category as either an 'Arts' or 'Science' student became most salient when witnessing a group discussion (between other arts and science students) which allowed for both comparative and normative fit of these categories. In terms of normative fit, if students expressed views that were incongruent with the stereotypes of arts and science students (i.e. arts students' opinions were more scientific than the science students, and visa versa), then the likelihood of the emergence of the categories "arts" and "science" was decreased. In other words in order for the two groups of students to be categorised as arts and science students, the differences between them needed to conform with pre-existing expectations about the categories in question.

In order for a person to apply principles of normative fit however, there must be 'perceiver readiness'. This concept describes how ready a person is to make a categorisation based on their existing thoughts, ideas and knowledge which they have acquired through previous experience of the world and through culture and other processes (Oakes, 1987). In other words, in order to make a social categorisation it is necessary to first have an existing system of meaning that contains that category.

It is important at this point to introduce the concept of salience. Salience can be thought of as the dominance of a particular self-categorisation above other potential self-categorisations. The salience of a self-categorisation is thought to be directly related to both the social context an individual finds him or herself in ('fit') and their perceiver readiness to make certain self-categorisations (Turner, 1987). In other words people will

categorise themselves according to what is happening in their social environment and in the way that best fits with their previous experience of the world. In this way, a person's salient social identities will fluctuate in accordance with changes in their social environment. It is also thought that as one self-categorization becomes more salient other self-categories become less salient (Turner et al., 1994; Haslam, 2001). So, it is possible for a person to have different social identities, with conflicting features (such as goals or values). This is because as one identity (along with all its associated features) becomes salient, another (possibly conflicting) identity recedes, therefore preventing the two cognitive identity systems from operating concurrently. It is also the case that under-conditions where the conflict between identities can be resolved and aligned stronger identification may be expected (Turner, Reynolds, Haslam & Veenstra, 2006).

Turner et al (1994), however, stress the point that self-categories are not thought of as being permanent cognitive structures. Instead it is argued that they are generated when a person is within a particular context and that 'all cognitive resources – long-term knowledge, implicit theories, cultural beliefs, social representations, and so forth – are recruited, used and deployed when necessary to create the needed self category' (p. 459). In other words self-categories (and categorisations regarding others) are generated through a process of self-categorisation, rather than simply being 'activated'.

It is argued that when a collection of individuals self-categorise themselves together within a group it allows them to come together as a single group with shared goals, norms, values and beliefs. McGarty (1999) describes this as a normative framework as "some set of standards that are explicitly endorsed or implicitly accepted by a perceiver which the perceiver uses as a basis for making assertions or developing beliefs about truth" (p. 253). By using a shared cognitive system, individuals are able to make comparisons between each other and with other outside groups. It also means that because others are expected to interpret their situation in the same way as oneself, others become a valuable source of influence in shaping views about social reality (Turner, 1991). An assessment that others are "like" us at a given point in time, means that ingroup members can be persuasive and processes of mutual influence amongst group members can flourish. Furthermore, those that are considered more prototypical of the group should have most impact (i.e., leaders – see Haslam, 2001; Turner, 1987, 2005; Turner & Haslam, 2001).

Once self categorization occurs at a group level, SCT predicts a variety of changes to occur in terms of peoples' perceptions, cognitive processes and behaviour. Haslam

(2001) summarises these in the following way. He suggests that when people share a self-categorization, they have an increase in their perceived similarity, trust for one another, ability (and desire) to communicate effectively with each other, and ability (and desire) to co-operate and act collectively. It is a shared social identity that is argued to make group life possible. Indeed a body of research has been generated which demonstrates clearly the benefits of ingroup identification to group performance and functioning. Amongst the findings is evidence that ingroup identification promotes higher levels of organisational citizenship behaviour (behaviour which serves collective needs without serving individual needs) (Ouwerkerk, Ellemers, & de Gilder, 1999; van Knippenberg, 2000); a greater willingness work towards achieving collective goals (Ellemers, de Gilder, & van den Heuvel, 1998; Tyler, 1999; Tyler & Blader, 2000); stronger likelihood of engaging in collective action (Kelly & Kelly, 1994; Veenstra & Haslam, 2000), and higher levels of group productivity (James & Greenberg, 1989; Worchel, Rothgerber, Day, Hart, & Butemeyer, 1998). Taken together these and other findings suggest effective team or group functioning is in part attributable to that group's ability to come together and develop a shared social identity, that members internalise and identify with.

3.4   Summary of chapter

To summarise social identity theory and self categorization theory provide an analysis that recognises that there is a personal self as well as a social or collective self. It is the existence and benefits of a salient social identity amongst group members that is argued to be particularly relevant to group functioning. It is argued in this thesis that these same social identity processes are also relevant to the productivity of the group and overall mission success as well as other issues identified in the ICE literature including avoidance of alienation, the minimisation of inter(sub)-group conflict, and managing diversity. It is the case though that these group-level factors have not been considered within the space flight and related ICE environments. In line with the aims of this thesis outlined in Chapter 1, there is a gap in the intersection between the social psychology and space/ICE literatures. The remaining chapters of this thesis investigate the relevance and usefulness of the social identity perspective in understanding group functioning in the space flight domain.

- Chapter 4 -

Social Groups, Social Identities and Group Functioning in the Space Flight Context.

In the last chapter the mainstream social psychological theories of social identity theory and self-categorization theory were introduced. The basic principles of these theories were outlined to enable an understanding of human social behaviour within mainstream social psychology. The present chapter will expand on this and apply this knowledge to the space flight context. In this way an initial picture of group functioning in ICE environments will be described and explored from the "social identity" perspective. This chapter is intended to be exploratory in nature and included within this is an initial field study. This study was designed to investigate some basic predictions about social psychological functioning in an ICE environment, in particular, whether similar measures could be used to assess such processes. This chapter then concludes with a discussion of these findings and a decision for the remainder of the thesis to focus on two of the main findings and investigate these factors in more detail in the rest of the thesis.

4.1 Applying the Social Identity Perspective to the Space Flight and Related Environment Context

4.1.1 Social problems in space and other extreme environments

In Chapter 2, reference was made to a significant body of literature within the domain of space psychology that described the kinds of social problems that have been observed in space. Examples included; intergroup tension between space flight crews and mission control, tension between 'hosts' and 'guests', tension between people from different cultures, issues of diversity, problems involving the scapegoating of individuals, the formation of cliques, the impact of leadership on group functioning and issues of group

cohesion and its relationship to 'group think'. The first part of this chapter will discuss some of these issues, but this time from the 'social identity perspective'.

Possibly the most common group-related issue or problem identified in the ICE literature has been conflict between the flight or expedition group and some external group such as mission control. The most famous example of this was the 1972 Skylab IV incident described in Chapter 2, however other less extreme examples were also presented. Gushin et al (1997), Harrison and Connors (1994), Kanas, Salnitskiy, Grund, et al. (2001), Kanas et al (2006), Kozerenko et al (1999), Palinkas (2001), Rosnet, Cazes, and Vinokhodova (1998) and Sandal (2001b) all describe in one form or another hostility between a crew and an outside group. Within the Russian literature this has been referred to as 'psychological closing' where the group becomes 'closed off' from outside influence (Kozerenko et al, 1999). In the western literature this same process has been described in terms of 'displacement', where negative affect is displaced onto an external group.

From a 'social identity perspective' this problem reflects the emergence of an ingroup versus outgroup ("us" versus "them") intergroup categorization process. Rather than forming self-other categorical judgments were oneself and others are perceived as individuals or as members of different sub-group within a higher-order ingroup ("the mission"), a more conflictual stance emerges and come to define group relations. Indeed, Penwell (1990) describes in an extreme environment context the way that groups can develop incompatible goals and how it is through the process of identification that social conflict can emerge.

How and why conflict develops between the two groups is another matter all together. According to SIT, conflict and prejudice is not inevitable when people categorise into separate groups (Tajfel, 1972, Tajfel & Turner, 1979). It is the potential conflict between the identities or the purposes of the groups which lead to animosity and hostility. Tajfel claims that the principal interest of a group member is to see their group as positively distinct from others. In many contexts this does not lead to conflict, hostility, competition or prejudice. However, when others (e.g., leaders, high-status group members) are not seen to share one's own interests and goals and do not seem to reflect one's own feelings and experiences then disidentification can occur. Also where there is an experience of intergroup threat then conflict is more likely.

Within the extreme environment context, there are two external sources that have often been observed to become "outgroup"; where there has been a shift away from these

sources and a severing of the psychological connections and processes of psychological identification: mission control and friends and family. Interestingly Harrison and Connors (1984) have made the observation that it is mission control, rather than friends/family that are more likely to become a target of hostility. Kanas and Manzey (2003), highlight this process of "us" and "them" in their observations that astronauts often think that those on the ground "don't know what it's like" up in space. It is also the case that mission control, often is in the role of "boss" or "mission leaders" and needs to place certain demands on the crew. Given that processes of genuine influence and persuasion and perceived authority and legitimacy all flow from a shared social identity (Turner, 1991, 2005) then these relationships have to be managed very carefully. Below a model is described where the emphasis is on developing and maintaining a superordinate higher-order ingroup while acknowledging the importance of the roles of different individuals and sub-groups.

There have also been other intergroup conflicts in ICE environments that can be explained using social identification processes. Kozerenko et al (1999) and others describe the "host guest" problem where there is social divide between the people who have been present within a habitat for a long period and those who have just arrived, or are only there temporarily. This phenomenon was observed often when there were newcomers to the space station, but was particularly common when cultural/nationality differences were present. Kozerenko and colleagues describe a series of incidents that occurred during NASA/Mir missions in which Americans were 'guests' onboard Russian mission. Once again it could be observed that the crew was divided into two social groups, with categorisation occurring based on national identity and length of tenure at the space station. In terms of the categorisation process it seems clear as to why these groups would form, with the most obvious differences being language, cultural norms and operational duties. In addition to this, the existing crews had probably already developed a shared group identity; one which the 'guests' were not members of. It is interesting to note however that conflict between these groups did not always occur and Kozerenko and colleagues observed that during the latter missions when the Americans were allowed to become more involved with the operations of the space station, they became more integrated into the group. In other words, if the 'guests' were given the opportunity to behave in the same way as the 'hosts' and be able to contribute to the achievement of the 'hosts' goals then a foundation for a shared group identity was created. From this sense of shared identity, improved crew relations were observed.

The most extreme ingroup-outgroup incident reported in the space psychology literature was that which occurred during SFINCSS-99 (Inoue et al. 2004; Sandal, 2004). As described in Chapter 2, this incident involved two groups within a spaceflight simulator developing a relationship that was so conflictual they had to be physically separated from one another. At one point in the simulation the crew comprised of a Russian group and a group comprised of people of varying nationalities. Within the habitat the two crews were already separated into two different sections. This, as well as differences in operational duties and cultural differences, could have acted as the basis for categorisation to occur into the two groups. This in and of itself would have been unlikely to cause conflict between the two groups. Conflict did not develop until after an incident of perceived sexual harassment of one of the members of the international group by one of the Russians. In this case, when the members of the international group perceived a threat against an ingroup member, feelings of hostility towards the Russian crewmembers developed. The hostility between the two groups became so heightened that the hatch between their two sections of the habitat was sealed closed and one of the members of the international group actually left the simulation. If this conflict had occurred on a real space flight, it would have seriously jeopardised the mission.

Many of the other social psychological issues that have been observed in extreme environments can also be related to identity processes. For example problems arising from cultural differences and diversity can be conceptualised in terms of group norms and expectations regarding behaviours. These behavioural expectations can also be related to whether an individual is seen as a legitimate group member. If a person's behaviour deviates too much from what others view as 'normative', they may be 'outgrouped' as in the situation described by Rosnet et al (1998). This process of alienation or scapegoating is a form of intragroup behaviour which is particularly dangerous during space missions and will be explored further in later chapters.

Conformity with behavioural expectations or how 'prototypical' a person is has also been related to leadership effectiveness (Platow & van Knippenberg 2001). This line of research suggests that a leader's influence on other group members will be related to how much they embody the norms, values and beliefs of the group (Turner & Haslam, 2001). In this way, leadership is not just about an individual having the "right stuff" but also about being the right person in the right group at the right time. If this is the case, as is suggested by a growing body of literature, then a group's identity is directly related to leadership

processes and effectiveness. The person who is best able to reflect and embody the norm, values and beliefs of the group will be the most influential.

Group cohesion is also directly related to processes of ingroup identification (Hogg, 1992). The importance of group cohesion is highlighted by Dion (2004) where he describes it as "the social glue that binds members of a group and keeps them together in the face of internal or external threats" (p. C39). Here and in the wider literature on group cohesion, it is described as an essential component of effective group functioning. As discussed in Chapter 2, there is also evidence that too much group cohesion can lead to 'group think'. Indeed there is discussion of this occurring during space missions and has often been sighted as the cause of disputes between mission control and the flight crew (Dion, 2004, Kanas & Manzey, 2003, and Rosnet et al 1998). As discussed earlier however it may not have been the level of cohesion per se in these circumstances that led to hostility, but rather the psychological connections within and between groups. Understanding and working effectively with the psychological group memberships and groups relations that will develop in these settings is fundamental to mission success. For example, a detailed and systematic analysis of psychological group memberships and the way these can oscillate and change as a function of current experiences can inform planning and issue-management during missions. The next part of this chapter will explore what these theories suggest the "right kind of groups" for space missions would look like.

4.1.2 The "Right Group"

If we recognise that people will make sense of their experiences in relation to others and that oneself and others can be categorised as individuals, members of the same group or members of opposing groups, then it becomes imperative that during space missions, we develop structures, conventions, understandings and practices that are going to maximise the emergence of certain types of groups rather then others.

Perhaps the first thing to consider when figuring out what the "right group" might look like, is to understand when an aggregate of individuals actually become a group. So far we mostly have discussed groups in terms of members' levels of identification with a group, or the categorisation of others into groups. It should be noted however that there are other ways of conceptualising this which do not contradict the social identity approach. One way of doing this, as discussed by Lickel, Hamilton, Wieczorkowska, Lewis, Sherman, and Uhles (2000), is to consider the concept of "entitativity". They describe this

as the degree to which a group can be perceived as a coherent entity. They found that people perceive groups as entitative when they are important to and are valued by group members (identification), the members have common goals, there is common fate between members, and there is a degree of similarity between members (this can be thought of in similar terms to normative and comparative fit). Within the space environment common fate is likely to be shared amongst crewmembers; however common goals and similarity cannot be assured (as discussed with reference to crew diversity). This leaves identification as an important component of how strongly a group holds together.

As discussed earlier if people identify with a group, there are a number of outcomes that directly relate to group functionality. If a person identifies strongly with a group this is seen as an indication that they have internalised the group's goals, values, behaviours and beliefs. The benefits of 'ingroup identification' are numerous and have been detailed by many studies over the last 20 years. Benefits include: increased group productivity (Worchel, Rothgerber, Day, Hart, & Butemeyer, 1998); higher levels of co-operation (Kramer, 1993); improved communication (Postmes, Tanis & de Wit, 2001); increased trust (Kramer, Brewer & Hanna, 1996); more prosocial and voluntary behaviour (Ouwerkerk, Ellemers , & de Gilder, 1999); increased liking and respect for others in the group (Terry & Callan, 1998); and an increase in the willingness to contribute to collective goals (Ellemers, de Gilder & van den Heuvel, 1998). From these benefits it is clear that strong group identification is essential to the success of human space missions.

Ingroup identification is not enough however to guarantee social harmony and mission success, what characterises a group can also play an important role. These group characteristics can be conceptualised in terms of "group culture" which encompasses the group's behavioural norms as well as its underlying values, beliefs and attitudes. Terry, Hogg and White (1999) describe how a person's behaviour is heavily influenced by how they think other group members would behave in a similar situation. These behaviours can be described as 'norms' and once they are established within a group, become a powerful guiding force behind individual behaviour. It is not difficult to imagine that within the context of a space flight, certain behavioural norms would be more constructive than others. For example the adherence to safety protocols versus the over-consumption of alcohol.

A group's culture can be considered to be deeper than specific behaviours however, reflecting also the underlying attitudes, values and beliefs. For example if a space crew

believe that some drinking is acceptable while on duty, a pilot may be more inclined to actually drink, before performing a potentially dangerous space manoeuvre. On a more abstract level, we can consider a value such as forgiveness; where group members may be more forgiving of minor transgressions. This would probably be a constructive characteristic of a group's culture, as it may serve to prevent certain interpersonal conflicts. In this way a group's culture, or what makes that group who it is, will have a large influence on the successfulness of that group. For this reason it is essential to take group culture into consideration when considering group dynamics in extreme environments. This issue will be discussed in more depth in later chapters of this thesis.

As discussed earlier, the relationships between groups and subgroups can have a strong impact on mission success. Groups with competing goals would most likely impede a mission and as discussed by Palinkas, Gunderson, Johnson and Holland (2000) and Johnson, Boster and Palinkas, (2003), cliques that do not cooperate with one another would most certainly be undesirable. In this way it is not just a matter of having the "right group" but also to have the "right groups". In other words it is important that the subgroups are compatible with one another.

Haslam, Eggins and Reynolds (2003) describe a form of social organisation in which subgroups can exist in such a way as to allow for harmonious relations. In their work on the ASPIRe model (Actualising Social and Personal Identity Resources), they outline how in order for subgroups to work effectively with one another they have to go through a process of building a collective superordinate identity which includes and values all subgroups. This process involves people developing or reaffirming their own subgroup identity, followed by the coming together of members of all relevant subgroups in order to build a collective and organic superordinate identity of which all subgroups play a vital role. By doing this, members of other subgroups can be considered as group members and in turn will be treated as such. Without going into detail here, this allows for the subgroups to work effectively with one another while preserving their identities as distinct entities. In this way it may be possible to engineer the relationships between subgroups in order to ensure their compatibility. Having the "right groups" may be in part something that can be developed using techniques such as this.

From these points we can see that having the "Right Groups" in space missions is likely to be a product of having groups which are psychologically real (entitative), have members who identify strongly with them, have group cultures which are conducive to

mission success and have relationships between subgroups which are constructive with this process involving the development and maintenance of a higher order "mission" superordinate identity.

It appears then that much of the current work in the ICE environment has observed and recognised that group processes and intergroup relations can have an impact on mission outcomes. Certain terminology has been developed to describe important aspects of this process such as "closing off" and the host-guest problem. The social identity perspective and other related work in social psychology complements such material but also provides a more systematic analysis of the underlying psychological processes. It is through understanding these processes that it becomes possible to prescribe the type of structures, processes and conventions that may need to be in place to work with human psychological functioning and maximise mission outcomes. Although there have been previous points of cross-over between social psychology work on social identity and group dynamics in ICE environments it is necessary to investigate social identity processes in ICE environments more explicitly and directly. It is also necessary to determine whether the same processes can be assessed as straightforwardly in such environments.

4.1.3   Self Categorisation in an Isolated Extreme Environment: Initial Predictions.

How might these ideas about self-other categorization processes translate to the ICE environment? A central part of self categorisation theory is that people interpret their social environment using principles of normative and comparative fit, and by drawing on their past experiences (perceiver readiness) categorise themselves and others into social groups (Turner, Hogg, Oakes, Reicher & Wetherell, 1987). In this way, the salience of social categories is fundamentally linked with what is happening in a person's social environment. One could imagine that given the geographic and social isolation as well as a set of very clear tasks and goals that a share "ingroup" membership may be likely to develop and stay relatively constant for the individual group members. Because the social environment is not in flux people's salient self-categorizations also may stay reasonable constant.

More specifically, limited variation in the social environment may limit the number of social identities people use. In other words, in space flight-like environments, people may draw on a smaller range of personal and social identities than they otherwise would in a normal environment. This could be conceptualised as a positive relationship between the

amount of change there is in the social environment with the number of social identities a person uses

In addition, it is predicted that the social categories people employ would be related to the functional groups present (e.g., geologists, biologists, engineers). Indeed this assumption has been made in previous work such as an unpublished study by Eggins, Reynolds, and Dawson. This assumption is based on the idea that categorisations are used to make sense of the world and in isolated extreme environments, some of the most meaningful groups would be those based on functional aspects of a mission. We could also predict that there would be categorisations based on other obvious distinctions such as nationality, gender and possibly friendship groups. However, at this point only generalised predictions can be made and the specific groups which emerge in an isolated environment will be explored experimentally in this chapter.

Apart from the differences related to the social environment, it would be expected that social psychological processes would otherwise function in the same way in isolated extreme environments as they do in normal environments. In other words we would expect relationships between social psychological variables and other patterns that have been observed in countless mainstream social psychological studies to be the same in isolated extreme environments. As stated earlier in this chapter, the identification with an ingroup has been associated with group cohesion and improved group functioning. This issue is also investigated to see how identification processes relate to key aspects of group functioning. These included, aspects of group culture (such as conformity and acceptance of diversity), affect towards ingroups and outgroups, group polarisation, self-esteem and stress.

From these initial predictions and general areas for investigation, an initial field study was devised with these issues in mind. It was designed as a starting point for future exploration of social identity issues in isolated extreme environments. The rest of this chapter will be devoted to this study and its implications will then be discussed.

4.2   Study 1: The Arkaroola Field Study

4.2.1   Overview

This experiment constituted an initial study, utilising the paradigm of the "social identity perspective", to investigate the social psychological functioning of a small group of

people in an isolated environment. In this way the study represents a preliminary explorative study which was designed to investigate the use of social identity concepts in an extreme environment. Due to its explorative nature, this study was not designed with strict hypotheses to be tested, but rather to take measurements of a number of key constructs.

4.2.2 Key Areas Investigated

1. *Social Environment Flux*: The first issue to be investigated was the amount of change there was in the expeditioners' social environment. It was thought that the isolated environment of the expedition may present a social context with little change. This level of change can be thought of as "social environment flux". The link between changes in the social environment and the salience of a variety of social identities was investigated.

2. *The Emergence of Social Identities*: In this part of the study, a qualitative investigation was undertaken to measure the kinds of social identities that would emerge over the course of the expedition and the extent to which these identities were shared amongst crewmembers. In this way it was thought that an understanding of the kinds of social categorisations people were using could be developed. It was assumed during mission planning that the important social groups would be primarily associated with aspects of mission functionality (for example, subgroups based on research teams like "the biology team" or the "geology team"). In addition to this it was believed that the nature of the expedition would lead to the emergence of a whole "expedition group" shared identity.

3. *Aspects of group functioning*. This section of the study was concerned with measuring a number of key aspects of group functioning. Based on past research from "normal" environment and laboratory studies, it was expected that ingroup identification would be related to positive group functionality and visa versa. The constructs investigated included positive emotions towards both ingroup members and outgroup members, group cohesion, conformity to group norms, the group's tolerance for diversity, different forms of stress and self esteem. This part of the study was also intended as a preliminary exploration of the relationships between variables and as such no formal hypotheses are presented. How these findings fit with past research will be discussed latter in this chapter.

4.2.3   The Expedition

The study was conducted during the Mars Society's "Expedition Two" which is part of a greater research program with 16 planned expeditions over as many years (i.e. one per year). The goal of this research program is to conduct critical research necessary for the preparation of a human mission to Mars. Different areas of research make up the program and include such scientific disciplines as Engineering, Geology, Biology and Human factors (which includes human physiological and psychological health and well-being). The expedition ran for 26 days in August 2004 and took place in an isolated region of the Northern Flinders Rangers in South Australia, known as Arkaroola.

Figure 4.1. Expedition Two Crewmembers, Week 3

4.2.4   Methodology

Participants

Twenty five people participated in this study, 10 women and 15 men. The entire expedition group consisted of 26 people however (including the experimenter). All crewmembers were adults who had applied to participate in the expedition (except for two girls aged 13 and 16 who accompanied their parents on the expedition) and had gone

through a selection processes based on the research they intended to conduct or the technical skills they could provide. Of the 26 people only 6 were not directly involved in a research program (two of whom were the children previously mentioned).

Duration of stay on the expedition varied from 5 days to 26 days with participants leaving and arriving each week. Only four people (including the experimenter) were present for the entire expedition while the majority of crewmembers (15) were present for two weeks or longer. In the first week there were 14 crew members, in the second week there were 17, in the third week there were 13 and there were 7 crewmembers during the final week of the expedition. On two occasions during the expedition the crew was divided into a home and away team. The first away mission was conducted during the second week of the expedition with 9 people spending 4 days away while 8 remained behind. The second away mission took place during the third week, with 5 people away for 2 days and 8 people remaining at the base.

Materials

A daily questionnaire was completed by the participants consisting of 26 questions covering a number of qualitative and quantitative domains.

The main qualitative measure employed in the questionnaire was a novel attempt to gauge which meaningful social identities people used in a given day. It asked participants to simply make a list of which groups they could identify themselves as being a member of. It was a self generated list without a fixed length, so that participants could write down as many or as few social groups as they liked. The list allowed for a qualitative picture of the 'social map' to be developed which described the social categories the crewmembers perceived. In this way it was used to address the issue of which social identities would emerge during the course of the expedition. In addition to this, the number of identities that a person recorded for a given day was taken as a measure of the variety of social identities employed by that person. This variable was referred to as "number of social identities".

The next part of the questionnaire consisted of quantitative measures of a range of different variables. These included measures concerned with how much change people perceived in their social environment, how much pressure there was to conform with group norms, how strongly people identified with their group, how positively they felt towards their ingroup, how positively they felt towards a nominated outgroup, how different they perceived their own group to be from the nominated outgroup, how cohesive they perceived

their group to be, the degree to which the group embraced the diversity of its members, measures of personal and collective self esteem and measures of stress relating to social factors, goal/work related factors and general stress.

Social Environment Flux (SEF) was quantified by way of six Likert scale measures and one ratio measure. The Likert scale items were designed to measure the degree of variation in a participant's social environment on a given day. As the concepts being measured were thought to be difficult for a person to count, scale measurements were used rather than ratio measures. Seven point Likert scales were employed which ranged from 1 to 7, with 1 indicating "few" or a "small number" and 7 indicating "many" or a "large number". The aspects of SEF measured in this way included the range of; different tasks performed, different social roles undertaken, people who were physically present, goals pursued, different groups the participant observed interacting with one another, and information received from people not physically present. In addition to these, the participant was asked to provide an exact number of people that they had come into contact with on that day. The idea of quantifying the amount of change in a person's social environment was entirely novel and as such; none of the measures used here had been trialled before.

During the remainder of the questionnaire, participants were asked to think about different aspects of group functioning. They were instructed to refer to the group they had nominated as "most important" in the first part of the questionnaire. In addition to this they were asked to nominate a group they did not feel part of. Measurements of group functioning were taken by asking participants the degree to which they agreed with a series of statements. They responded using Likert scales ranging from 1 to 7, with 1 representing "do not agree at all" and 7 representing "agree completely".

The first aspect of group functioning they were asked to consider was how much pressure they felt to conform to the norms of their group. This was measured with two statements: "In our group, it is important for every one to do what is right by our group" and "When I do things I keep in mind what other members of my group would do".

The next variables of group functioning to be measured were; how positively the participants felt towards their own group and then about a nominated outgroup. The statements used were: "Over the course of today I felt very positively towards my group" and "Today I felt very positively towards the other group". In addition to this they were asked how different the two groups were with the reverse coded statement "My group and

the other group are quite similar to each other". This was taken as a measure of group polarisation.

After this they were asked a question regarding the diversity norm of the group. This was done using the statement "To what degree do you think your group is generally open to new ideas about how to do things".

Next the degree of ingroup identification felt towards their group was measured using the two statements "I feel strong ties with members of my group" and "I identify with other members of my group". These measures have been used extensively in the past and were obtained from Doosje, Ellemers & Spears (1995).

Similarly the two measures of group cohesion were obtained from Stokes (1983) and have also been used reliably in past research. These measures used the statements "I would be delighted if the opportunity arose, at a later date, to undertake activities with the people who are in my group" and "Compared to other groups like mine, I believe that our group works very well together".

Four items were used to assess the participants' personal and collective self esteem. These were adapted from Rosenberg's (1962) Self-Esteem Scale (the original items were only concerned with personal self esteem). The items presented to participants were: "On the whole I am satisfied with myself", "I feel I do not have much to be proud of" (reverse scored), "Our group has much to be proud of" and "Other groups don't think that our group is any good" (reverse scored).

The final three items in the questionnaire were used to measure stress levels in the participants. Firstly stress related to goals and work being done was measured with "Today I felt a large amount of stress, which was directly related to achieving my group's goals". Next social stress was measured with the reverse coded item "Working with other members of my group did not feel stressful at all". The last item measured general stress levels with "Overall today was a very stressful day".

The questionnaire then thanked participants for their time and effort.

Design and Analyses

As outlined earlier, this study was exploratory in nature and as such did not have a strict experimental design or specific hypotheses. The first issue, "social environment flux", was investigated by seeing how the different aspects of SEF correlated with the number of social identities that a person generated on a given day. The second issue, "the

emergence of social identities" was investigated by qualitatively assessing the identities that people recorded. The third issue, "aspects of group functioning" was analysed using a correlational approach. This approach was flawed however as it made the assumption of independence of scores, where non-independence existed. It was utilised despite this for two reasons; firstly it is consistent with the methodology traditionally used in extreme environment research and secondly because it could be used as a rough guide to the nature of the relationships. Because of these shortcomings further multilevel linear modelling (MLM) was conducted to more accurately assess the relationships. In this way direct comparisons could also be made between the traditional correlational approach and the newer, MLM.

Procedure

The questionnaire was completed by participants at the end of each work day, usually just before or after dinner. Once the participants became accustomed to the questionnaires, it usually took them between 10 and 20 minutes to complete. Questionnaires were collected in locked boxes which were not opened until after the expedition, preserving individual confidentiality and addressing concerns regarding self-disclosure about group interactions while the expedition was ongoing. The questionnaires were also handled and analysed in such a way as to protect the confidentiality and anonymity of all participants post expedition, as far as possible.

Figure 4.2. Expedition Two Crewmembers complete psychological questionnaires.

4.2.5 Results

The nature of the data collected in this study has meant that the results of the standard statistical techniques employed must be interpreted with caution. The assumption of independence which is required for correlational analysis has been violated. This is because on any given day participants interact with one another and the variables that are being studied concern these social interactions: what one participant reports, in part, is dependent on what another reports (Kenny, Mannetti, Pierro, Livi & Kashy, 2002). In addition to this if all the data were to be analysed simultaneously, then non independence would be rife within individuals, as what a participant reported on one day would most likely be related to what they reported on a different day. Correlational analyses have been conducted however to give us an "idea" of what is happening with the data. In order to make full use of all of the study's participants, analyses have been conducted separately for a number of different days. A more appropriate form of analysis to use with this kind of data is multilevel linear modelling (Kenny et al, 2002), which was used to confirm the results found using traditional correlational analysis. This method provides us with a useful way of ascertaining relationships between variables when non independence is a problem.

Social Environment Flux

In order to make use of data from all of the participants, analyses were conducted separately for 4 different days, one from each week of the expedition. The dates used were the 5th, 11th, 19th and 25th of August 2004. These dates were chosen as they represented the maximum sample size for each week.

The most reliable scale for SEF was developed from 5 of the 7 original items. It was found that for 3 of the 4 dates, scale reliability was highest without the items regarding "SEF (information)" and "SEF (total number of people encountered)" so these two items were dropped from the scale. Cronbach's Alphas were generally high for each of the days and can be seen in Table 4.1.

Table 4.1. *Scale reliability for Social Environment Flux.*

Date, August 2004	Number of Items	Cronbach's Alpha
5th (week 1)	5	.69
11th (week2)	5	.86
19th (week 3)	5	.82
25th (week4)	5	.94

From *Figure* 4.3, we can see how the amount of change in the social environment fluctuated over time. As can be seen from the graph, mean level of SEF were around the midpoint of the scale and seemed to decrease slightly over time.
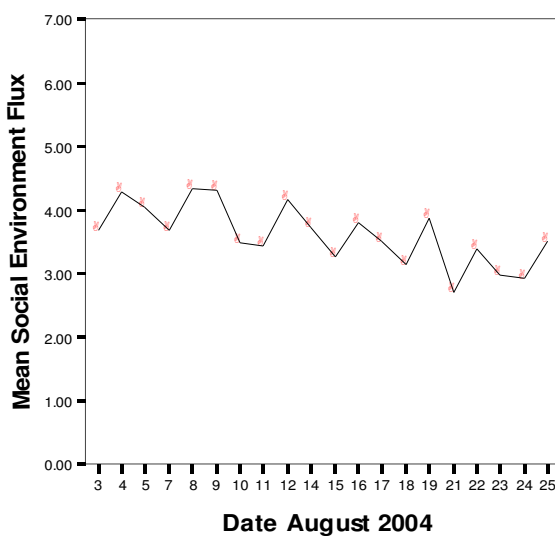
Figure 4.3. Mean Social Environment Flux over time.

In order to assess the relationship between SEF and social identification process a correlational analysis was conducted between SEF and the measure assessing the number of social identities. Once again this analysis was conducted for each of the four weeks, using the same dates as before. Additionally, however, the analysis was conducted combining data from each of the four days.

The results from these correlations can be seen in Table 4.2. The correlations for the individual days range from -.09 to .75 with two of the four correlations showing a marginally significant positive relationship. Where the data was combined the overall correlations was statistically significant and of moderate size at $r = .40$, $p < .01$. These data though must be interpreted with extreme caution as within-subject non-independence and within day non independence would mean that this correlation is possible inflated.

Table 4.2. *Correlations between "Social Environment Flux" and "number of social identities"*

Date, August 2004	Number of Participants	*R*	*p*
5th (week 1)	11	-.09	.799
11th (week2)	16	.36	.173
19th (week 3)	12	.52	.082
25th (week4)	6	.75	.086
combined data (all four days)	45	.40**	.007

** indicates correlation is significant at p < .01.

The Emergence of Social Identities

The emergence of shared social identities was monitored by seeing how many people on a given day identified themselves as being a member of a particular group. This was sampled from the entire data set by examining the data from two days from each of the four weeks of the expedition.

The main shared identity to emerge was that of "Expedition Two crew". In addition an 'away team' and 'base team' shared identity emerged during the two occasions when the crew was divided into two groups for long distance multi-day traverses. The vast majority of social groups that people identified, however, were not shared between people. In other words, people felt like they were a member of a particular group, but nobody else identified

that group as being important, even other members of that category. Examples of groups that were only psychologically meaningful to one person were: the SEMS people (a particular research group), the beer drinking group; young people and the Defender/Destroyer group (a group that used a particular vehicle for a day mission).

From Table 4.3 it can be seen that the predominant group identity, i.e., the "Expedition Two crew", was not entirely shared by all crewmembers and at one point was only shared by 2 out of 14 people. The lowest points of shared "expedition" identity came during the two multi-day away missions (12th and 16th of August). These days saw a corresponding increase in the sharedness (how many people shared that identity) of the 'away team' and 'base team' identities. The mean sharedness for the "Expedition Two crew" group identity was 48.25%. There, however, were numerous identities that were shared by two or three people. Examples of these included; men, women, the 'flight' group and a few others.

Table 4.3. *The Emergence of Shared Social Identities*

	Week 1		Week 2		Week 3		Week 4	
	3[rd]Aug	5[th]Aug	9[th]Aug	12[th]Aug	16[th]Aug	19[th]Aug	23[rd]Aug	25[th]Aug
Number Participants	12	11	15	14	12	12	6	6
Number of SI shared by 4 or more people	**1**	**2**	**3**	**2**	**0**	**2**	**1**	**1**
Number of SI shared by 3 people	1	0	2	4	2	1	0	0
Number of SI shared by 2 people	5	3	5	4	3	4	1	1
Number of SI not shared	35	27	39	24	38	25	16	21
Proportion of People who shared a "Whole Expedition" Identity	**8/12** **67%**	**6/11** **55%**	**5/15** **33%**	**2/14** **14%**	**3/12** **25%**	**5/12** **42%**	**5/6** **83%**	**4/6** **67%**

*SI = social identity

While many of the categories that emerged were related to functional work-based groups, none of these showed a high degree of sharedness. Categories such as geologist, biologist, SEMS team, of which there were numerous members and would have traditionally been considered to be the important subgroups of the mission, were not

identified by crewmembers as being important. In this way the groups which had been thought to be important during mission planning, did not emerge as subgroups.

Aspects of group functioning

As with Social Environment Flux, scales were developed for a number of the group functioning variables using data from the four dates of the 5th, 11th, 19th and 25th of August 2004. The number of participants for each of the dates respectively were $N=11$, $N=16$, $N=12$ and $N=6$.

The first scale developed was for pressure to conform to group norms (Conform). The two items were found to work very well as a scale for two of the four days (with Cronbach's Alphas $\alpha > .9$) but not for the first date and only moderately well for the second. It was decided however that due to the high reliability for the later days that the items would be used as a single scale. The respective Cronbach's Alphas for each of the dates were: $\alpha = .43$, $\alpha = .75$, $\alpha = .94$, and $\alpha = .95$ respectively.

The next scale developed was for ingroup identification "Identification". This proved to be a reliable scale for the first three dates, but could not be calculated for the forth date as the small sample ($N=6$) had zero variance for the 1st "Identification" item. The scale was considered reliable none the less with Cronbach's Alphas of $\alpha = .92$, $\alpha = .95$, and $\alpha = .99$ for the first three dates.

A two item scale for group cohesion "Cohesion" was developed which also showed a high degree of reliability. (Cronbach's Alphas of $\alpha = .83$, $\alpha = .91$, $\alpha = .93$, and $\alpha = .94$ for each of the respective dates).

An attempt to create a scale for "personal self-esteem" from two items failed due to low Cronbach's Alphas. While the scale showed high reliability for the third and forth dates (Cronbach's Alphas both of $\alpha = .94$), the reliability for the first and second dates was low (Cronbach's Alphas of $\alpha = .50$ and $\alpha = .24$ respectively). It was decided that the first item ("On the whole I am satisfied with myself") better reflected the concept of personal self esteem, so the second item ("I feel I don't have much to be proud of" reverse coded) was dropped from the analyses.

The attempt to create a scale for "collective self-esteem" from two items also failed. For the 5th of August a negative Cronbach's Alpha resulted and for the 25th of August an Alpha could not be calculated due to lack of variance. For the other two dates (the 11th and 19th of August), reliability was not high ($\alpha = .64$ and $\alpha = .32$ Cronbach's Alphas

respectively). The first item ("our group has much to be proud of") was thought to be more representative of collective self-esteem than the second item ("other groups don't think our group is very good" reverse coded) so the second item was dropped from the analyses.

A combined scale for stress was not developed as it was decided that we were primarily interested in general stress levels "stress". The other two items, "today I felt a large amount of stress, which was directly related to achieving my groups goals" and "working with other members of my group did not feel stressful at all" reverse coded", were dropped from the analysis.

In order to assess the relationships between each of the group functioning variables, correlational analyses were conducted for each of the four dates (5th, 11th, 19th and 25th of August). These correlations can be seen in Tables 4.4a, 4.4b, 4.4c and 4.4d.

Table 4.4a. *Correlations between group functioning variables, 5th of August 2004. (N=11)*

Group Functioning Variable	1.	2.	3.	4.	5.	6.	7.	8.	9	10.
1. Identification	-									
2. Cohesion	.79**	-								
3. Conform	.08	.30	-							
4. Positive affect to ingroup	.69*	.27	-.18	-						
5. Positive affect to outgroup	-.06	.10	.02	-.11	-					
6. Polarisation	-.06	-.37	-.77**	.35	.09	-				
7. Diversity norm	.72*	.26	.04	.82**	-.20	.20	-			
8. Personal self-esteem	.46	.81**	.29	-.11	.50	-.40	-.05	-		
9. Collective self esteem	.05	.46	.16	-.02	.38	-.28	-.40	.47	-	
10. stress	.07	-.22	-.33	.43	.00	.26	.22	-.44	.12	-

* indicates correlation is significant at $p < .05$. ** indicates correlation is significant at $p < .01$.

Table 4.4b. *Correlations between group functioning variables, 11th of August 2004. (N=16)*

Group Functioning Variable	1.	2.	3.	4.	5.	6.	7.	8.	9	10.
1. Identification	-									
2. Cohesion	.79**	-								
3. Conform	.54*	.53*	-							
4. Positive affect to ingroup	.71**	.76**	.36	-						
5. Positive affect to outgroup	.23	.42	-.44	.41	-					
6. Polarisation	.20	.16	-.34	.30	.53	-				
7. Diversity norm	.51*	.58*	.26	.33	.30	.19	-			
8. Personal self-esteem	.38	.76**	.34	.52*	.61*	.14	.36	-		
9. Collective self esteem	.90**	.92**	.47	.84**	.35	.16	.54*	.57*	-	
10. stress	-.38	-.63**	.10	-.55*	-.91**	-.51	-.46	-.76**	-.53*	-

* indicates correlation is significant at $p < .05$. ** indicates correlation is significant at $p < .01$.

Table 4.4c. *Correlations between group functioning variables, 19th of August 2004. (N=12)*

Group Functioning Variable	1.	2.	3.	4.	5.	6.	7.	8.	9	10.
1. Identification	-									
2. Cohesion	.97**	-								
3. Conform	.82**	.85**	-							
4. Positive affect to ingroup	.96**	.91**	.78**	-						
5. Positive affect to outgroup	-.02	.00	.00	-.10	-					
6. Polarisation	.22	.20	.01	.06	.52	-				
7. Diversity norm	.70*	.76**	.88**	.73**	.12	.00	-			
8. Personal self-esteem	.74**	.82**	.85**	.78**	.00	-.15	.87**	-		
9. Collective self esteem	.86**	.84**	.85**	.92**	-.08	.04	.86**	.81**	-	
10. stress	-.32	-.20	-.12	-.44	.28	.24	-.10	-.26	-.40	-

* indicates correlation is significant at *p* <.05. ** indicates correlation is significant at *p* < .01.

Table 4.4d. *Correlations between group functioning variables, 25th of August 2004. (N=6)*

Group Functioning Variable	1.	2.	3.	4.	5.	6.	7.	8.	9	10.
1. Identification	-									
2. Cohesion	.87	-								
3. Conform	.86	.89*	-							
4. Positive affect to ingroup	.85	.99**	.87*	-						
5. Positive affect to outgroup	.85	.99**	-.02	.11	-					
6. Polarisation	.87	.89	-.38	-.39	.87	-				
7. Diversity norm	080	.88	.91*	.76	.29	-.05	-			
8. Personal self-esteem	.54	.84	.88*	.86*	-.15	-.55	.79	-		
9. Collective self esteem	.54	.53	.88*	.60	-.35	-.55	.79	.81*	-	
10. stress	.69	.27	.53	.29	.03	-.03	.43	.09	.47	-

* indicates correlation is significant at *p* <.05. ** indicates correlation is significant at *p* < .01.

From Table 4.4e the pattern of consistent correlations across the four dates can be seen. Of particular note are the consistent relationships found between "Identification" and the variables "Cohesion", "Positive affect to ingroup" and "Diversity norm". In addition to this "Cohesion" was also consistently related to "Conform", "Positive affect to ingroup" and "Personal self-esteem". "Personal self-esteem" was also found to be consistently

related to "Positive affect to ingroup" and "Collective self-esteem". Final correlation coefficients are not reported here as the varying results from each of the days and the small sample sizes suggest that we have not accurately measured the strength of these relationships. As this study is exploratory in nature it was deemed sufficient at this point to simply point out the existence of the relationships.

Table 4.4e. *Pattern of consistent significant correlations across dates between group functioning variables*

Group Functioning Variable	1.	2.	3.	4.	5.	6.	7.	8.	9	10.
1. Identification	-									
2. Cohesion	***	-								
3. Conform	**	***	-							
4. Positive affect to ingroup	***	***	**	-						
5. Positive affect to outgroup		*			-					
6. Polarisation			-*			-				
7. Diversity norm	***	**	**	**			-			
8. Personal self-esteem	*	***	**	***	*		*	-		
9. Collective self esteem	**	**	**	**			**		***-	
10. stress		-*		-*	-*			-*	-*	-

* indicates significant positive correlation for one of the four days, ** indicates significant positive correlation for two of the four days, *** indicates significant positive correlation for three of the four days. – indicates correlation is negative. 95% Confidence level used.

Multilevel Analysis of Data

Multilevel Linear Modelling (MLM) is a powerful tool for analysing data like that collected in this study. (For thorough discussions of MLM see either Tabachnick & Fidell (2006) or Hox (2002). MLM allows us to develop predictive models, similar to a regression model, but takes into account nested aspects of the data. In this way it does not require assumptions regarding independence. In the data from the present study, we have multiple responses from individuals and data from numerous interacting individuals on any given day. This leaves us with two forms of non-independence, both of which are not a problem if we use MLM. We also do not have data from every individual for every day, but fortunately MLM also does not require a complete data set like other methods such as

repeated measures ANOVA. In this way MLM provides an excellent data analysis technique for the kind of data commonly collected in extreme environment research.

In the present study MLM was used to investigate a number of the relationships that have just been reported using traditional analyses. In this way it hopes to confirm the relationships with a more robust statistical technique. SPSS version 14.0 was used to conduct the analysis using the "Mixed Models" function. In addition to this results were verified using MLwiN version 1.1. The MLwiN results are only reported where they are incongruent with the SPSS results.

Chi squared tests were conducted between *-2 Restricted Log Likelihood* scores to determine model improvement, using a 95% confidence level.

The first relationships examined using MLM were between "Cohesion" and a number of covariates. Data was grouped by individual, "Cohesion" was treated as the dependent variable and a number of models were constructed to predict it using "Identification" and "Conform" as covariates, both as fixed and random effects. The model used an unstructured covariance matrix.

Cohesion – Identification An initial intercept only model was constructed, which suggested that 46.9% of the variance in "Cohesion" came from differences between individuals. This was determined by the intra class correlation which was calculated using

$$\rho = s_{bg}^2 / (s_{bg}^2 + s_{wg}^2)$$

Where

s_{bg}^2 = The between groups (individuals) variance

s_{wg}^2 = The within group variance (residual)

So

$\rho = .46 / (.52 + .46)$

$= .469$

Next a fixed effect for the covariate "Identification" was added to the model. This model was a significant improvement over the intercept only model with $\chi^2(1, N = 214) = 507.5 - 313.8 = 193.7, p < .05$.

Following this, "Identification" was added as a random effect. This too produced a significant improvement in model with $\chi^2(2, N = 214) = 313.8 - 305.4 = 8.4, p < .05$.

This model can be described on one level, with the following equation [1]

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

Y = the dependent variable

X = the predictor variable

β_{0j} = the intercept (this may vary between groups)

β_{1j} = the slope (this may vary between groups)

e_{ij} = the error

i = the case

j = the group (in this case the person)

Remember that in this particular analysis the groups are actually individuals, with the cases being single responses from an individual, i.e. cases are grouped by the individual people.

So in this instance

$$Cohesion_{ij} = \beta_{0j} + \beta_{1j}Identification_{ij} + e_{ij}$$

With

$$\beta_{0j} = 2.68, p < .001$$
$$\beta_{1j} = 0.58, p < .001$$

As there was also a random effect for "Identification" it is important to describe the way these parameters vary for individuals. In this case the covariance around the intercept (β_{0j}) was significantly different from zero with $\tau_{00} = 0.95$ (0.56), $p < .05$. The covariance

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[1] One advantage of MLM is that at this point in the analysis we could add a second level predictor to the model. This has not been done in the present study but could be of particular use in extreme environment research. For example a personality variable could be used as a predictor for the relationship between two covariates. In this way we may be able to investigate the way that aspects of an individual may impact upon that individual's pattern of responses

around the slope coefficient (β_{1j}) was not significantly different from zero however with τ_{11} = .023 (0.015), $p > .05$. This suggests that while mean levels of cohesion varied between individuals, the relationship between "Identification" and "Cohesion" was similar across individuals. It is also important to report here the covariance between the slopes for individuals and the means for individuals, which in this case was τ_{10} = -.14 (0.09), $p > .05$. This suggests that slopes do not vary as a function of mean levels of "Cohesion".

The residual variance of this model can then be used to determine the proportion of variability within individuals that is explained by this model. This is done by subtracting the residual variance of this final model from the residual variance of the "intercept only" model and dividing by the residual variance of the "intercept only" model. In this case

Effect Size　　$\acute{\eta}^2$ = (.52 - .19)/ .52

　　　　　　　　= .634

So in this case 63.4% of the variability of "Cohesion" within individuals can be explained by "Identification". This relationship was such that for every increase of 1 point of "Identification" there was on average an increase of 0.58 in "Cohesion".

Cohesion – Conformity　　　The same procedure was then followed to determine how "Conform" predicted "Cohesion". In this case the first "null" model was the same "intercept only" model reported in the "Cohesion – Identification" analysis. The next stage was to add "Conform" as a fixed effect. In this case the model was a significant improvement over the intercept only model with χ^2(1, N = 214) = 507.5 – 488.5 = 19, $p < .05$.

Following this, "Conform" was added as a random effect. This however did not produce a significant improvement in model with χ^2(2, N = 214) = 488.5 – 487.4 = 1.1, $p > .05$. This suggests that a "fixed effect" model is sufficient for predicting "Cohesion" from "Conform". As with the previously reported analysis, this fixed effect model can be described on one level, with the following equation

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

$$Cohesion_{ij} = \beta_{0j} + \beta_{1j}Conform_{ij} + e_{ij}$$

And

$$\beta_{0j} = 3.78 \ (0.42)$$
$$\beta_{1j} = 0.38 \ (0.07)$$

As this was a "fixed effects" only model it is appropriate to simply report the *t statistic* rather than $\acute{\eta}^2$. In this case for β_{1j} , $t(125) = 5.28$, $p < .001$. This confirms that "Conform" is a significant predictor of "Cohesion". These results suggest that for every increase of 1 point in "Conform" there will be a corresponding increase in "Cohesion" of 0.38.

Cohesion – Conform and Identification   In order to ascertain if both "Conform" and "Identification" could be used in the same model to predict "Cohesion", "Conform" was added as a fixed effect to the random effects model developed for "Cohesion – Identification". This did not however produce an improvement in model, (in fact *-2 Restricted Log Likelihood* increased from 305.4 to 307.20). Within this model the effects for "Identification" remained significant while the fixed effect for "Conform" did not. This suggests that "Conform" was redundant and not necessary in the prediction of "Cohesion".

Personal Self Esteem – Cohesion   How group cohesion could be used to predict personal self esteem was the next relationship to be investigated using MLM. The "intercept only" model was developed as before and in this case, between individual (groups) variability was able to account for 27.2% of the total variance of "Personal self esteem".

A "fixed effects" model was then developed by adding "Cohesion" as a covariate. This model proved to be a significant improvement over the "intercept only" model with $\chi^2(1, N = 214) = 703.1 - 642.2 = 60.9$, $p < .05$. However when "Cohesion" was added as a random effect, this did not produce a significant improvement in model ($\chi^2(2, N = 214) =$

642.2 - 637.1 = 5.1, $p > .05$. This suggested that a "fixed effects" model was sufficient to explain the effect of "Cohesion" on "Personal self esteem". This model can be summarised as

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

$$Personal\ self\ esteem_{ij} = \beta_{0j} + \beta_{1j}Cohesion_{ij} + e_{ij}$$

And

$$\beta_{0j} = 1.54\ (0.54)$$
$$\beta_{1j} = 0.71\ (0.09)$$

Once again as this was a "fixed effects" only model the *t statistic* rather than η^2. is reported. In this case for β_{1j} , $t(127) = 8.0$, $p < .001$. This suggests a reasonably strong relationship between group cohesion and personal self esteem, such that for every increase of 1 for "Cohesion" there would be a corresponding increase of 0.71 in "Personal self esteem".

Identification – Diversity Norm   The next relationship to be investigated was how a diversity norm could predict ingroup identification. The results presented here were from MLwiN rather than SPSS as the random effects model failed to converge using SPSS but did using MLwiN. To begin with an intercept only model was constructed which indicated that 47.1% of the variance in "Identification" could be explained by differences between individuals.

Next, "Diversity Norm" was added to the model as a fixed effect. This model was a significant improvement over the intercept only model with $\chi^2(1, N = 206) = 598.7 – 540.4 = 58.3$, $p < .05$.

After this, a random component for "Diversity Norm" was added to the model. This also proved to be a significant improvement of model with $\chi^2(2, N = 206) = 540.4 – 488.5 = 51.9$. This model can be described as follows

$$Identification_{ij} = \beta_{0j} + \beta_{1j}Diversity\ Norm_{ij} + e_{ij}$$

Where

$\beta_{0j} = 3.24, p < .001$

$\beta_{1j} = 0.40, p < .001$

As in the "Cohesion – Identification" model, it is important to describe the covariance of these parameters. Significant variation was found for the intercept with $\tau_{00} = 7.19$ (3.15), $p < .05$. This was also the case for the covariance of the slope ($\tau_{11} = 0.25$ (0.11), $p < .05$) and also for the covariance between the slope and the mean ($\tau_{01} = -1.30$ (0.57), $p < .05$). These results suggest that both the mean levels of "Identification" and the relationship between "Identification" and "Diversity Norm", varied between individuals. In addition to this it was apparent that as "Diversity Norm" increased, its relationship with "Identification" became less pronounced.

Once again the residual variance of this model can then be used to determine the proportion of variability within individuals that is explained by this model.

Effect Size $\acute{\eta}^2 = (.85 - .42)/ .85$

     $= .505$

So in this case 50.5% of the variability of "Identification" within individuals can be explained by their group's "Diversity Norm".

This random effects model for "Identification – Diversity Norm" suggests that increases in a group's "Diversity Norm" will lead to increased levels of identification with that group, but that this increase becomes weaker as the "Diversity Norm" increases. It should also be noted at this point that we cannot be as confident in the results of this analysis as we are for the previous ones where convergence was achieved in both SPSS and MLwiN.

Stress – Positive affect towards outgroup

How affect towards a salient outgroup predicts stress levels was the next relationship to be investigated using MLM. As before, an initial intercept only model was

constructed. This model suggested that 35.9% of the variance of stress levels could be attributed to individual differences.

Next "Positive affect towards outgroup" (paffout) was added as a fixed effect to the model. This model showed significant improvement over the "intercept only" model with $\chi^2(1, N = 214) = 760.5 - 713.3 = 47.2, p < .05$. A random effect for "paffout" was then added to the model but this did not produce a significant improvement ($\chi^2(2, N = 214) = 713.3 - 710.3 = 3, p > .05$). As such the simpler "fixed effects" only model was used. This model can be summarised as follows

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

$$Stress_{ij} = \beta_{0j} + \beta_{1j}paffout_{ij} + e_{ij}$$

And

$\beta_{0j} = 3.84\ (0.47)$
$\beta_{1j} = -0.29\ (0.08)$

Again as this was a fixed effects only model it is appropriate to simply report the *t statistic* rather than $\acute{\eta}^2$. In this case for β_{1j}, $t(196) = -3.78, p < .001$. This confirms that "Positive affect towards outgroup" is a significant predictor of "Stress". These results suggest that for every increase of 1 point in "paffout" there will be a corresponding decrease in "Stress" of 0.29.

Number of Social Identities – Social Environment Flux

The last relationship to be investigated using MLM, was how the amount of change in the social environment predicted the number of social identities that people employed. In this case however the variable of "Number of Social Identities" was problematic in terms of the normality of its distribution. This was corrected by taking the log (to base 10) of "Number of Social Identities"; this new variable will be referred to as "logNSI". This analysis also proved problematic in that results differed when conducted in SPSS and

MLwiN. Using both software packages random effects models failed to converge, however in MLwiN a fixed effect model was significantly better than the "intercept only" model, where as in SPSS the "fixed effects" model was not. It is unclear as to why these differences occurred but for the purposes of this study both results will be presented.

The "intercept only" model in both analyses showed a large amount of variability based on individuals with SPSS reporting 69.7% of the variance in "logNSI" being attributable to differences between individuals.

The differences in analyses emerged when a fixed effect for "SEF" was added to the model. In SPSS, this did not produce significant model improvement with $\chi^2(1, N = 214) = 235.1 - 233.0 = 2.1$, $p > .05$, however in MLwiN, the "fixed effects" model was significantly better with $\chi^2(1, N = 212) = 232.4 - 224.7 = 7.7$, $p < .05$. The MLwiN model can be described as

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

$$logNSI_{ij} = \beta_{0j} + \beta_{1j}SEF_{ij} + e_{ij}$$

And

$$\beta_{0j} = 0.883 \ (0.133)$$
$$\beta_{1j} = 0.074 \ (0.026)$$

Unfortunately MLwiN does not provide the *t statistic* for this model so instead 95% confidence intervals around β_{1j} are reported. In this case they are (0.031, 0.117) for lower and upper bound respectively. As zero does not fall between these confidence intervals we can take the β_{1j} coefficient as significant. These results suggest that an increase of 1 point in "Social Environment Flux" will lead to a corresponding increase of 0.074 in the log (to base 10) of "Number of Social Identities". So according to this model there is an exponential increase in "Number of Social Identities" for every increase in "Social Environment Flux". This result must be interpreted with caution however as this model was not significantly different from the "intercept only" model when SPSS was used which

may mean that differences between individuals may be enough to explain the variation in "Number of Social Identities".

4.2.6 *Discussion*

This study was a preliminary investigation into how the social identity perspective could be applied to a space flight analogue environment. From this study some interesting and informative observations have arisen. The findings of this first study will be discussed with reference to the three areas investigated; social environment flux, the emergence of social identities and links between social identification aspects of group functioning. After this, the limitations and benefits of this study will be discussed and then from the findings of this study, future directions for the remainder of the thesis will be proposed.

Social Environment Flux

The investigation in this field study, of the dynamics of the social environment and how this impacted on social psychological functioning as assessed by key constructs used within the social identity perspective was a unique and original attempt to study the link between social environment and social psychological processes. The results found in this study covered general measurement of change in the social environment and the relationship between this change and the reporting of meaningful social identities

It was anticipated, that the isolated extreme environment examined here would be similar to the space flight environment in that the social environment would be relatively stable (in terms of people present and roles and activities undertaken). The findings of this study do not confirm this expectation. Generally people rated Social Environment Flux (SEF) around the midpoint of the scale, with only a slight decrease over time. This suggests that people perceived the amount of change in their social environment to be at least moderate. This could mean that they were using the expedition as a reference point, or that they actually perceived their social environment to be as dynamic as what they were accustomed to in their normal pre-expedition life. If the second explanation is correct, then it is possible that a space flight environment would also be more socially dynamic than was hypothesised. However there were more people present during this expedition (group size ranged from 5 to 17 people) than are typically present during space missions. This may mean that there was higher SEF in this group, than would be found in a space environment (as there were more people present). The evidence of this study does not support this idea

however as even when the expedition was split into 'home' and 'away' teams of much smaller sizes there was no corresponding drop in SEF ratings.

It was predicted that in this study we would find a positive linear relationship between SEF and the number (or variety) of social identities that people used. When traditional correlational analysis was conducted, there was some evidence for this relationship but there are problems with this type of analysis being used on the data collected in the field. Only when data was combined from four different days was a significant positive correlation found. As stated earlier problems of non-independence mean that this result must be interpreted with caution. Because of this, the relationship was investigated using MLM. The results of this analysis were also problematic with one statistical package finding a weak exponential relationship and the other finding no relationship. As MLM was a more robust and appropriate statistical technique to use in this circumstance we can be more confident in the results produced. In combination these results reveal that there is not a strong positive relationship demonstrated between SEF and the salience of social identities.

There are a number of possible explanations for this lack of relationship. The first relates to possible methodological artefacts. Problems relating to the measurement of SEF have already been discussed, but it is also possible that measurement of social identity activation could also be improved. To the author's knowledge, no other researchers have tried to measure social identity activation by asking people to report which groups were important to them. This method assumes that a social identity is something a person can reliably report but it may be that in many cases it is difficult to pin down such processes with labels. In this way we may not have been receiving an accurate count of the social identities people were using. The second possible explanation, as discussed earlier, is that the relationship is only present when there is an extremely stable social environment and that this was not the case in the current study with changes in the make-up of the group across time. A further explanation, relates to the idea that the salience of certain identities is not purely an outcome of environmental factors. Remember that social identities become activated through both 'fit' and 'perceiver readiness'. In other words, the unique way of understanding and interpreting the world that each crewmember brings to the environment, in and of itself creates a certain level of flux in the social environment. In the absence of the development of a shared social orientation to that environment there will be higher levels of variability in the way people make sense of that environment. In this way even a

small number of people may be enough to have a highly dynamic social environment. There does not seem to be anything inherent in the structure around those involved in ICE-type environments per se that rules-in or rules-out certain types of psychological responses. It is interesting to note that with the introduction of "away" and "home" teams, there did seem to be more consensus in people's reporting of important group memberships. Such structural divisions, like those reported in the space psychology emerging between mission control and astronauts, did seem to come to play an important role in people's self-other categorisation processes.

To summarise the findings regarding SEF: no clear evidence has been found from this study for the idea that an isolated extreme environment would have a stable social "psychological" environment. In addition to this, there was only very weak evidence for any relationship between the amount of change in the social environment and the number of social identities that people use. It is possible that these findings were limited by issue with the methods used to assess such factors, but it is also possible that the social environment of isolated extreme environments may in fact be quite dynamic. If this is the case we would expect people to utilise social identities in space flight environments in much the same way as they do in normal environments.

The Emergence of Social Identities

This study utilised an original methodology to map out social identity use and group membership in an isolated group of people. It was designed to investigate the emergence of shared social identities and in the main was successful in doing so. The kinds of identities that emerged and the degree to which those identities were shared did not however conform with expectations. It was thought that due to the nature of the isolated environment, clear shared identities would emerge at a superordinate group level, a subgroup level or both levels.

A whole group identity of "Expedition Two crew" did emerge but this was not shared by all crew members, (at one point it was only shared by 2 out of 14 people). While this does suggest that a shared group identity may emerge, it cannot be assumed that it will. What's more it cannot be assumed that all crewmembers will be included within this group. Apart from when the crew separated into an 'away team' and 'base team' no clear shared subgroup identities emerged. This is very surprising as at one point the crew size was 17 people, and subgrouping would usually be expected to emerge in a group of this size. This

is not to say that people did not associate with one another, but rather that those people who did spend time with each other may have developed certain interpersonal relationships rather than meaningful group-based identities.

Any lack of shared whole group and subgroup identities could have implications for group functioning. This is because (as discussed earlier) groups that have strong ingroup identification and have a strong shared ingroup identity enjoy the benefits of increased group productivity, higher levels of co-operation, improved communication, increased trust, more prosocial and voluntary behaviour, increased liking and respect for one another and an increase in desire to contribute to collective goals. These advantages would be very important to group functioning on any space flight so finding a way to encourage the emergence of shared ingroup identities would be imperative. How to do this is an issue that will be discussed in more detail later in the thesis.

From the data collected it was clear that the vast majority of social identities people had active were not shared by others. This suggests that the cognitive framework people used to make sense of their social environment was very different for different people. This different way of thinking about the world, could be considered as a very fundamental form of diversity. This could have serious implications for group functioning, as diverse groups tend to behave differently to homogenous groups (Chatman, Polzer, Barsade, & Neale, 1998). This issue of diversity will be dealt with in much greater detail in the next chapter of this thesis. The point being made here is simply that we may have observed a very fundamental form of diversity in this study even though this study was not designed to measure diversity.

Another surprising finding from this study was the lack of emerging identities that conform with the preconceptions of mission planners. During preparations for "Expedition Two" there was often reference to 'the biology group' 'the geology group' 'the engineering group' 'the SEMS team' and 'mission support' (the people supporting other people's research). These groups were also assumed for a study which ran parallel with the present one, which measured levels of ingroup identification with specific groups (Eggins, Reynolds, & Dawson, unpublished study). This has implications for this work and other work which assumes which groups people will identify with. The current study suggests that in the absence of any structures that seek to develop or encourage certain group-based categorizations there can be diversity in the way people make sense of their experiences.

One potential limitation of this technique, as discussed earlier, is that people may not be consciously aware of the social identities they have salient and may not label them the way people were asked to do in this study. If this is the case then people may be identifying with the same shared groups, without labelling them the same way as each other. Although in the context of this study, this may only hold true for subgroups as the 'whole expedition group' identity was easy to identify from the labels provided by the participants. Having said that however, people may have been functioning with a 'whole expedition group' identity of which they were not consciously aware. If this is the case, then it would be more appropriate to do the reverse of what was done in this study and instead do what is commonly done in identity research: That is, to suggest a group that the researcher believes is appropriate and then to ask the participant how strongly they identify with that group. Both techniques have their merits however and the purpose of the current study was to create a map of the social identities people used. In that regard this section of the study was successful.

Aspects of Group Functioning

This study also measured a number of social psychological variables related to group functioning. It was anticipated that relationships which exist in normal environments would also be found in isolated extreme environments. The principal relationship investigated in this way was the link between ingroup identification and group cohesion. As this study was exploratory in nature, a number of other variables relating to group functioning were also measured. Results by and large confirmed expectations, and a number of other interesting observations were made. The relationships observed and analysed using MLM will be discussed in turn.

This study found strong evidence for a positive linear relationship between ingroup identification and group cohesion. This evidence came from both the flawed correlational analysis and the more robust MLM. Both techniques found a positive linear relationship. This confirms the link described in self categorisation theory (Hogg, 1992; Turner et al., 1987). This means that in isolated extreme environments, like normal environments, strong group cohesion is related to group members identifying with their group. In other words it is the internalisation of what it means to be a group member and the embracing of that identity, which leads to the group developing cohesion. This cohesion, as discussed by Dion (2004), is in turn what binds the group together. The results found in this part of the

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study are not surprising, but they do support the notion that groups function in a similar way in extreme environments as they do in normal environments.

One of the relationships observed in this study was the positive relationship between conformity and group cohesion. Hogg (1992) discusses this relationship suggesting that cohesive groups are more likely to have conformity amongst members. Support for this was found in this study, however using MLM an attempt was made to predict cohesion from both conformity and ingroup identification. Ingroup identification, however, proved to be a much stronger predictor of group cohesion (cohesion was not a significant predictor in this model). It appears that it is through ingroup identification that both cohesion and conformity emerge. Consistent with much writing within the social identity perspective, when people identify with a group they are more likely to act in line (conform with) the norms, values and beliefs that define the group (see Haslam, 2004 for a more detailed discussion).

It was also found that ingroup identification was related to acceptance of diversity within these isolated and extreme groups. Consistent across both correlational analysis and MLM, the extent to which a group embraced diversity was related to the degree to which people identified with that group. What was particularly interesting was the strength of this relationship, with the diversity norm accounting for 50.5% of the variance within individuals for ingroup identification. This is particularly interesting as it suggests that people are far more likely to identify with their group if that group accommodates the differences amongst individuals and sub-groups. This relationship has previously been found in SIT literature, with van Knippenberg, Haslam, and Platow (2004) finding that ingroup identification was stronger in groups that valued diversity. The existence of this relationship in this study is important however as it may be a key to encouraging stronger ingroup identification in groups in isolated extreme environments. For this reason this issue will be explored in much greater depth in the next chapter and in the rest of the thesis.

Another variable that was found in this study to be related to group cohesion was personal self-esteem. Abrams and Hogg (1988), describes how being a member of a cohesive group leads to increased positive personal self-esteem. The present study does suggest that when people were in a cohesive group, they felt better about themselves personally. This can be taken as one of the advantages of having cohesive groups during space missions, as positive self esteem is indicative of good mental health and well-being

(see Baumeister, Campbell, Krueger, & Vohs, 2003 for a thorough discussion of the benefits and pitfalls of high self-esteem).

The final relationship of interest that was observed in this study concerned the relationship between stress and positive feelings towards a relevant outgroup. In this study a negative relationship was found between these two variables. This is of particular interest as it implies that conflict between subgroups could be major contributor to stress within these types of groups. This is of particular note considering the findings of Kahn and Leon (1994) who found that pro-social behaviour was one of the most important mechanisms a group of Antarctic expeditioners used to cope with stress. Social conflict both in Kahn and Leon's study and as shown in the present study would therefore be related to higher stress levels. This link between social conflict and stress highlights the importance of maintaining positive intergroup relations during extreme environment expeditions. As discussed in Chapter 2, the space flight environment is already a very stressful place and every effort must be made to reduce possible stressors.

One way of building and maintaining positive relationships has already been discussed in this chapter. The ASPIRe model (Haslam et al., 2003) proposes a technique of utilising existing subgroup identities to build a collective or superordinate group identity that values people from all subgroups. The results from the current study suggest that by employing a technique such as this, it may be possible to reduce crew stress by reducing social tensions amongst the crew.

Limitations of this study

There were a number of limitations observed with this study but it was also exploratory and sought to investigate the links between key social psychological variables and factors that have been identified as being important in ICE-type groups. Some of the methodological limitations have already been touched upon.

As discussed earlier there were a number of flaws in the tools used to measure the constructs of interest in this study. Some of the constructs being measured in this study had never been measured before and as such novel techniques had to be developed. The two constructs which were most problematic in this regard were SEF and social identity salience. Future attention will need to be given to these dimensions.

Another methodological problem that this study suffered from, regarded sample size. Suedfeld and Weiss, (2000) described how small samples and the use of limited non-

random samples posed methodological problems for extreme environment psychology research. The present study has not been able to overcome these issues and as such, falls into the same trap. The small sample size used has meant that some of the statistical tests used must be interpreted with caution (although this was overcome using MLM). Also as only one group of people were examined, it is possible that the results are not generalisable to other small groups. As gaining access to isolated small groups is very difficult, this study was not unique in this regard and similar research in this area will continue to suffer from these problems.

The second area of limitation of this study related to how generalisable these results are to other extreme environments, particularly space flight environments. The environment observed in this study was like a space environment in many ways; the people were geographically isolated, many of the activities that were undertaken were designed to replicate activities that would performed on the Martian surface, and the people all had scientific backgrounds and were engaged in scientific field work (like astronauts). However there were a number of key differences; the mission duration was relatively short (between one and four weeks), the crew size at times was much larger than most space crews, people arrived and left the environment more frequently than would be expected on real space missions (especially long duration missions), the crewmembers were not confined to a small space, there was not the same level of physical danger, and there was not as much riding on the success of the mission. For these reasons this environment was not an ideal analogue of the space environment. However for the purposes of the first study of this thesis, it was deemed to be sufficient. As already discussed, access to real space environments or high fidelity analogues is exceptionally difficult and as such was not possible for the purposes of the current study. This limitation was overcome for the purpose of a study described later in the thesis which observed a group wintering over in Antarctica.

Despite the limitations of this study however, as an initial investigation of how SIT and SCT can be used to understand group processes in a space analogue environment, this study has been somewhat successful. Possibly the most important benefit has been to shed light on which areas of social psychological functioning are best investigated in the remainder of the thesis. In particular to continue to explore the relationships between social identity processes and group functioning but perhaps also to explore these relationships between ingroup identification and diversity in more detail. Given that the groups likely to

travel in space will be diverse in a demographic sense but also in terms of the individual specialisations and skills, the question of how best to manage this diversity to maximise the success of the groups becomes a critical question. This question is also one that is currently a research focus in social and organisational psychology more generally.

On the basis of the findings of this study it is proposed that two of the other issues that arose from this study will be investigated. As already discussed, the link between ingroup identification and a pro-diversity norm, has potential implications for how group functioning in a space environment could be managed. This is fundamentally an issue of group culture and there may potentially be various aspects of this which may be of interest to space psychology. As such the issue of group culture will be explored in much greater depth in the following chapters.

The other issue to arise was the importance of harmonious relations between subgroups. This issue has previously been discussed with reference to crewmembers being able to cooperate and work effectively together, but evidence from this study suggests that there is also its impact on stress to consider. How then to manage the diversity in subgroups, becomes an important issue to space psychology. For this reason, this issue will also be investigated in more depth in future chapters.

4.3   Conclusion

This chapter was an attempt to address two challenges that face the space psychology literature. The first was to apply a mainstream psychological theory to the field and the second was to apply the framework of social identity theory and self-categorisation theory to the space flight context. These theories allowed us to conceptualise social psychological issues in this context at a 'group' level, rather than just focusing on what happens in terms of individual psychology.

Data collected during this study found support for the application of these theories to this context, by highlighting issues that would be important for mission success. This included the need for the promotion of a shared social identity amongst crewmembers. It was argued here that the emergence of such an identity cannot be assumed and that the benefits of such a shared identity would be essential for the success of any human mission to Mars. It was also argued that such a shared identity should have a culture which values the diversity of members. In addition, this study highlighted the importance of intergroup relations

between mission subgroups; as a break down in these relations could be a serious source of mission stress. From these issues, a future direction for the thesis has been outlined and will be pursued in the proceeding chapters.

- Chapter 5 -

Identity and Diversity: How group identity can be used to realise the benefits of group heterogeneity.

In the last chapter a number of important and related themes were suggested to be important to group functioning in isolated confined extreme environments. One important relationship that was observed was the link between ingroup identification and the extent to which a group valued the diversity of its members. It was also found that disharmony between subgroups was a major source of stress for crewmembers. These two observations have important implications for how we consider diversity in extreme environments and also how a group's culture or identity can be used to improve group functioning.

In the current chapter, issues of diversity will be explored in much greater depth. As outlined in previous chapters, the topic of diversity is one that has been discussed at length in the space psychology literature. It has also however been investigated in great depth in the context of organisational psychology. For this reason, the current chapter will draw on this vast body of literature to outline what is currently known about the impact of diversity on group functioning.

After this, the importance of group identity and its relationship to diversity norms within groups and group functioning will be discussed. In recent times a body of literature, based on social identity theory and self categorisation theory, has developed that explores the importance of identity processes to how diversity is both interpreted and reacted to in group contexts. This work is relevant both to diversity amongst individuals within a group as well as the emergence of certain sub-group differences within a higher-order ingroup (e.g., "away and "base" teams within an expedition group). For this reason it can be used to understand how positive social relations can be developed and maintained in the context of

both individual diversity and subgroup diversity. The current chapter will therefore outline the direction for the remainder of the thesis.

5.1 Diversity in Space

As outlined in Chapter 2, much attention has been paid to how crew diversity impacts on group functioning in space and polar missions. This diversity has been suggested as a root cause of social disharmony, but also as one of the more positive developments in recent space exploration, particularly as the level of international cooperation has increased and equal opportunities for women have begun to be realised. In this way the space psychology literature sees the increase in crew heterogeneity as a two edged sword. This view of diversity is shared by the organisational psychology literature.

Kanas and Manzey (2003) summarise the observations that have been made in space psychology relating to crew heterogeneity and highlight some of the important changes that have occurred over the past forty years regarding crew diversity. They describe how originally space crew consisted entirely of white males from military backgrounds who were from a single nation. More recently however this has changed, with increased international cooperation and the realisation of equal opportunities for women in space. They suggest that inevitably, future space missions will be more heterogeneous in terms of gender, nationality, age, experience, skills set and background, and importantly in terms of language.

Much of the extreme environment work on diversity is focused on demographic diversity. The characteristics of difference described by Kanas and Manzey (2003) are almost all demographic, and this pattern can be seen in other work such as that of Benson (1996), Gushin, Kolinitchenko, Efimov and Davis (1996), Kanas et al (2000), Leon, Kanfer, Hoffman and Dupre (1994), Leon and Sandal (2003), and Ritsher (2005). All of these researchers focus on heterogeneity in terms of characteristics such as gender, nationality, language and cultural background. They do not discuss crew heterogeneity in its more abstract form, i.e. where a potentially limitless number of characteristics could be used to differentiate between people. This issue of demographics vs. more abstract forms of diversity will be discussed further in this chapter, but in this way this research is somewhat limited in scope. It is worth noting however that in a review of organisational psychology literature relating to diversity, William and O'Reilly (1998) suggest that

demographic heterogeneity can be one of the most influential forms diversity in terms of its impact on group functioning.

National and Cultural Diversity

As stated, diversity relating to nationality has been one of the most common sources of difference studied in the extreme environment context. As international cooperation in space has increased, so too has the diversity of crews in terms of nationality (Kanas & Manzey, 2003). This form of crew heterogeneity naturally is directly related to diversity in culture and also in many cases language. There have been numerous forms of social dysfunction which have been observed and attributed to this heterogeneity. For example in the observations made during the Russian simulation SFINCSS-99, cultural differences were thought to have been one of the major sources of the conflict that developed (Inoue, Matsuzaki & Ohshima, 2004; Sandal, 2004). Linguistic differences have also been observed to be a major barrier to effective social interactions during Russian-American missions to the Mir space station (Benson, 1996; Kanas et al., 2000).

Other studies, such as by Ritsher (2005), have focused on what differences exist between space farers from different nationalities. In her study she observed that there were eight major differences between Russians and Americans. These differences included; central values, subjective perceptions of wellbeing, levels of emotional expressivity, tolerance of lack of personal space, personality profiles, perceptions of gender roles, attitudes towards working relationships and a bias of people from English speaking backgrounds to not be multilingual. Ritsher's work has highlighted the differences that exist between astronauts and cosmonauts without examining the underlying social psychological process related to these differences or the consequences they may have on crew functionality.

There are a number of the studies however that do deal with the consequences of having space crews made up of individuals from different nationalities. Benson (1996), for example, quotes American astronaut Norm Thagard who, after spending 115 days aboard the Mir Space station with an otherwise all Russian crew, said that his cultural and linguistic differences were a major source of social isolation. In this way, cultural diversity has been linked with, if not, deliberate social ostracism, then, at least, social isolation. This of course could have serious consequences for long duration space missions, as it may

threaten the psychological health of a crewmember, and also impede the crew's ability to function effectively as a unified team.

Social isolation is not the only potential drawback of multinational/multicultural space crews; Kring (2001) conducted a review of the literature pertaining to multicultural issues in space and concluded that cultural diversity impacted on ten different aspects of crew functionality. These included the ability of crewmembers to communicate effectively with one another, shared thinking and decision making styles, ability to use the same technological interfaces, difficulties with interpersonal interactions, differences in work, management, and leadership styles, differences in approach to personal hygiene and clothing, differences in how food is prepared and meals are conducted, differences in religion and holidays, different approaches to recreation, and finally, different preferences towards habitat aesthetics. Kring suggests that these ten areas of difference have the potential to impact negatively on crew functionality and recommends a training program designed to deal with each point of difference. Through this training, Kring hopes that crewmembers can become aware of their differences and then move towards having agreed behaviours that are acceptable to all members. While not describing it as such, in social identity terms, this approach is about forming a new crew identity with behavioural norms that are acceptable to all members.

Kring's approach to understanding the impacts of nationality/cultural diversity is focused on specific aspects of group functionality rather than the social psychological process that are occurring. While his work gives us an understanding of what specific problems might arise, he does not draw upon an understanding of the psychological processes that underpin these difficulties. For this reason there may be problems with his approach to solving these problems. This is because his approach may not take into account the attachment that crewmembers have towards their existing national and cultural identities; they may not be willing to compromise these identities and as such their associated behaviours. They may believe that their own behaviours are the "right" way to behave. This point will be explored in more detail later in this chapter with reference to the ASPIRe model (Haslam et al., 2003).

Most of the observations relating to national, cultural and linguistic diversity, which are discussed in the extreme environment literature, focus on the problems associated with these kinds of heterogeneity. The benefits of having people from varying national and cultural backgrounds are not discussed in depth. Possibly one of the most important

benefits of course it that by conducting multinational expeditions, international cooperation can mean greater resources and also a wider range of technical expertise being made available. The International Space Station is a good example of this, where what can be achieved by many nations is more than what could be achieved by a single nation alone. In addition to this, international cooperation in space may encourage international cooperation back on Earth. This is in stark contrast to the polarising effect of the space race between the former USSR and the USA, where one nation's space exploration was seen as a threat to the other nation. In this way having multinational crews may be an important way of forging international links back on Earth.

Gender Diversity

The other form of diversity that is discussed at length in the extreme environment literature concerns mixed gendered crews. Whilst national/cultural and linguistic heterogeneity has been commonly associated with crew dysfunction, the same cannot be said of gender diversity. Leon and Sandal (2003) reported a study of three mixed or all female polar expeditions, which found that the presence of women added an additional layer of social support to crewmembers. This idea of female crewmembers improving the climate of social support is also backed up by Kahn and Leon (1994), who found that a female crew performed well during an Antarctic expedition in part due to the social support they provided each other (although this may be seen as evidence for homogenous all female crews). In the context of mixed gendered crews, Gushin et al.(1996) reported that the sole female, during the space station simulation EXEMSI, was not involved in any of the reported interpersonal conflicts and that she acted as a peacemaker. It is difficult to generalise from these sorts of studies, however, as they are of only a small number of groups, and there have been other cases were mixed gendered crews have had problems.

The conflict that arose during SFINCSS-99 (Inoue et al., 2004; Sandal, 2004) was thought to have arisen from an unwanted sexual advance made by a Russian male on a Canadian female. It was thought to be an intercultural misunderstanding, but would probably not have happened had the crew not been mixed gendered. This incident is an example of one of the potential pitfalls of having a mixed gendered crew, that is, it opens up the possibility of social conflicts that arise from sexual relations. Without going into detail here (as this point was covered in Chapter 2), having mix gendered crew adds an extra dimension of social relationships, that does not exist (to the same extent) in single sex

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crews. In this way it adds one more facet of crew relations that needs to be effectively managed in order to maintain harmony within a crew.

The realisation of equal opportunities for men and women in today's western societies means that having mixed gendered crews will almost certainly continue into the future. For this reason, it is one form of diversity that needs to be addressed in future research. While there has been some work done in this area, far more is needed in the future. At this point in time it is not clear as to why mixed gendered crews sometimes perform effectively and sometimes do not. It is possible that gender stereotypes play an important role, in which case issues of identity may be important in managing gender heterogeneity in space crews.

In general, issues of diversity in space have been oriented around what problems arise from crew heterogeneity. In this way it is assumed that diversity is a potentially negative social force rather than a positive one. The research seems to have been conducted to look for problems rather than investigating potential benefits. This may be because where problems have arisen, it sometimes makes sense to the researcher (and to the astronauts/cosmonauts) to consider the most obvious social categories as the cause. In this way, problems arising from diversity may simply be a manifestation of poor subgroup relations. In other words, it may be the orientation of the observers which has lead to observations of diversity being a problem for space crews as opposed to other causes. It should be noted however that Kanas and Manzey (2003) make the general comment that crew heterogeneity may help to overcome the monotony of long duration space missions. They argue that different points of view could produce a positive interpersonal environment. They frame this however in terms of overcoming the negative impacts of diversity. In this way, they too start with the assumption that diversity is inherently negative.

Possibly the most important limitation of the literature relating to diversity in space is its lack of grounding in more general psychological theory. As already discussed, it is focused on the specific problems that have been observed rather than the underlying psychological processes. It is also limited in that in the main it does not consider diversity beyond demographics. Because of these limitations, no comprehensive plans have been suggested that would allow the problems associated with diversity to be dealt with, but also, more importantly, how to use the diversity that exists within space crews to be taken advantage of and used as a positive force. In order for progress to be made in this area, a

greater understanding of the underlying psychological processes must be developed. To do this, it is argued, the broader psychological literature, particularly from organisational psychology, must be considered. If this is done successfully it may allow future mission planners to realise the full potential of their heterogeneous crews.

5.2   Diversity in Organisations

As in the realm of space psychology; there has been a growing interest in diversity in the business world and because of this: in organisational psychology. While crew heterogeneity has been increasing in space missions over the last few decades, so to has the demographic diversity in modern workforces. With this increase in demographic diversity, many questions have been asked as to what potential benefits and problems might arise from this diversity. Williams and O'Reilly (1998) in their comprehensive review of diversity literature, describe how in today's day and age, a modern company can expect to have an extremely heterogeneous workforce, in terms of gender, race, cultural background, age, experience, tenure and the qualifications of employees. This increase in heterogeneity they say has brought about a mixture of benefits and costs to organisational functioning.

More attention is paid to what is meant by diversity in the organisational psychology literature than in the space psychology literature. Janssens and Steyaert (2003),, for example, discuss in depth how some researchers have favoured narrow definitions of diversity while others have favoured broader definitions. Those favouring a more narrow definition believe that it is only useful to describe specific cultural categories such as race and gender, while those favouring a broader definition believe that it is important to consider the vast range of ways that people can be differentiated from one another.

One approach to defining diversity in organisations is somewhat similar to that taken by Kring (2001) and Ritsher (2005) in the space psychology domain. McGrath, Berdahl and Arrow (1995) for example set out five different forms of diversity that are important to work groups. These are demographics (age, sex, race, etc); task-related knowledge skills and abilities; values, beliefs, attitudes, personality, cognitive and behavioural styles; and status and position within in the organisation. Like Kring and Ritsher, McGrath and colleagues consider what aspects of diversity they think may cause problems, rather than consider what is happening psychologically.

Williams and O'Reilly (1998), in their definition, take a more psychologically-driven approach which is in essence based on SIT and SCT. They suggest that as there are a potentially limitless ways that people can be differentiated, what becomes important is the way in which people are differentiated in practice. In this way, it is the categorisations that people make about themselves and others which determine what aspects of diversity are important. From this, diversity becomes a socially constructed concept which is inherently imbedded in the social context and history of the groups in question. Williams and O'Reilly go on to say that as categories like age, gender, race, culture, organisational tenure, education and organisational role are often quite visible, they will often act as a basis for categorisation. In other words, defining diversity in terms of demographics is useful as these are often the most important ways that people are differentiated from one another.

Another distinction that has arisen is that of social category diversity versus informational diversity (for a thorough discussion see van Knippenberg & Haslam, 2003; van Knippenberg, Haslam, & Platow, 2004; and Williams & O'Reilly, 1998;). The first is concerned with diversity related to social categorisations, as just discussed, and the second is concerned with diversity regarding information. This distinction is an important one to make as it relates to two quite different psychological processes and from these different impacts on group functioning.

A considerable amount of work has been conducted that has investigated the impacts of diversity on group performance. To review all of it here is beyond the scope of this chapter however, but some of the key findings do need to be highlighted. Perhaps one of the most important things to consider is that the literature has yielded a complex picture of how diversity impacts upon group functionality (van Knippenberg & Haslam, 2003). The general consensus however is that there are both advantages and disadvantages of work group/organisational diversity. Williams and O'Reilly (1998) discuss these advantages and disadvantages, in reference to social categorisation (and similarity/attraction) and to informational diversity and in doing so, link these advantages and disadvantages to their underling psychological processes.

Williams and O'Reilly (1998) suggest that the negative outcomes of diversity in work groups, comes from two social psychological processes. The first, as discussed, is based in the paradigm of social categorisation and the second is from the perspective of the similarity/attraction paradigm (this distinction is also made by Janssens & Steyaert, 2003,

but they refer to the later in terms of homophily). The present chapter will deal with the later approach first as it has in many ways been superseded by the former in more recent developments in organisational psychology.

The idea of similarity/attraction is based on work by Bryne and his colleagues (see Bryne, Clore & Worchel, 1966; and Byrne & Griffitt 1973) who found that people had a tendency to like and feel stronger interpersonal attraction towards people who where similar to themselves. This and other work lead to the development of a paradigm which suggested that the tendency of people to be more attracted to others who are similar to themselves leads to some serious problems for the functioning of heterogeneous groups (Williams & O'Reilly, 1998). They cite evidence that it can lead to poorer communication and less group cohesion. This literature suggests that people have a psychological tendency to want to interact and work effectively with similar others, and that in heterogeneous groups people are less motivated to work effectively with one another.

With the development of SIT and SCT, it became apparent however that similarity in and of itself was not enough to drive serious prejudicial behaviour (Tajfel, 1972). Tajfel and colleagues in their minimal group studies found that categorisation was required before negative behaviour was expressed towards people who were different. In this way, work on similarity may have inadvertently been investigating attraction to ingroup members versus outgroup members. Either way the predictions of both paradigms lead to the same conclusions.

According to SIT and SCT, under certain conditions the categorisation of other people into an outgroup can lead to prejudice (Reynolds, Turner & Haslam, 2000). While this is not an inevitable consequence of categorisation, in teams where people may be categorised into separate groups, serious problems may arise. Williams and O'Reilly argue that when people perceive diversity in their work group, this diversity acts as the basis for categorisation. In this way, they suggest that in diverse groups people are categorised into separate groups rather than into the same ingroup. They argue that this leads to breakdowns in trust, communication, cooperation, liking for team members, group cohesion and also to higher levels of conflict. In other words, Williams and O'Reilly argue that it is the process of categorisation into separate groups within a team, which leads to a break down in group functioning in heterogeneous groups.

It should be noted however that Williams and O'Reilly make a common misinterpretation of the SIT, SCT and the minimal group studies. They take theses theories

to mean that categorisation inevitably leads to prejudice and ingroup favouritism, where in actual fact Tajfel and colleages (Tajfel, 1972; Tajfel, Billig, Bundy, & Flament, 1971) argued that people are motivated to see their own group (which they identify with) as being positively distinct from other groups and that this sometimes leads to prejudice and ingroup favouritism. This means that prejudice and ingroup favouritism only occur where there is a benefit to the identity of the ingroup. In many circumstance helping an outgroup can in fact boost the positive image and prestige of the ingroup. Williams and O'Reilly are right to point out this issue because even though prejudice and ingroup favouritism are not inevitable outcomes of ingroup-outgroup categorisation, it is a necessary precondition for it to occur. This therefore makes it relevant to understanding the psychological processes of how group heterogeneity can lead to group dysfunction.

Essentially what is argued by Williams and O'Reilly and also by others (e.g., Chatman & Flynn, 2001; Chatman, Polzer, Barsade & Neale, 1998; Polzer, Swann & Milton, 2003; Schneider & Northcraft, 1999; van Knippenberg & Haslam, 2003; van Knippenberg, Haslam, & Platow, 2004; van Knippenberg & Schippers, 2007) is that problems associated with work group heterogeneity stem from the intergroup processes associated with social categorisation. Chatman and Flynn (2001),for example, present a study in which demographic diversity is shown to impair the ability of work teams to develop group norms that promote helping behaviour. They argue that as the team members do not categorise themselves together as a group, it prevents them from developing a shared identity and from this shared behaviours (such as cooperative behaviours). In this way, diversity, as a means of differentiating between people, is seen as detrimental to effective group functioning as it encourages "outgrouping".

As mentioned earlier, diversity is not viewed as a purely negative force in the organisational psychology literature. It is commonly accepted that diversity in work groups is important to promoting creativity, innovation and better decision making (Janssens & Steyaert, 2003; Milliken & Martins, 1996) and also to preventing group think (Janis, 1982). It is thought that with diversity comes different skills, wider knowledge, different ways of thinking and also a greater likelihood that traditional ways of doing things will be challenged. In order to make sense of this psychologically a number of researchers have drawn upon the information/decision making paradigm (van Knippenberg & Haslam, 2003; van Knippenberg & Schippers 2007, Williams & O'Reilly, 1998)

This paradigm is based on work such as Gruenfeld, Mannix, Williams and Neale (1996), and investigates how informational or task related diversity impacts upon performance. In that particular study it was demonstrated that people had a tendency to share and draw upon information which was already shared by other group members. In other words in homogenous groups, people were motivated to continue a consensus. In diverse groups however this was not always possible so group members were forced to explore different alternatives, and because of this were exposed to a wider variety of information.

According to van Knippenberg and Haslam (2003), this has a number of important consequences for group functioning. They suggest that heterogeneous groups are more likely to have a broad and distinct range of skills, abilities and information that are nonredundant; and also to have a greater variety of perspectives and opinions. Because of this, they argue, heterogeneous groups have a greater ability to bring task related skills, information and expertise to bear on a given task or problem. They go on to say that as heterogeneous groups have a greater need to reconcile different viewpoints they are required to process task-related information in greater depth and as such improve their ability to solve similar problems in the future. In this way the information/decision making perspective argues that diversity is important to group functioning as it leads to wider information sharing and from this, better decision making.

Williams and O'Reilly (1998) point out however that this kind of diversity will only be beneficial where it is related to information. So if we take the example of a group of people who all are homogenous in terms of education, workplace experience and skills, but are heterogeneous in terms of gender and race, then we may not see the benefits of informational diversity, but may still suffer the consequences of social category diversity.

Williams and O'Reilly (1998) summarise the advantages and disadvantages of diversity in organisations in a model which incorporates the perspectives of social categorisation, similarity/attraction and information/decision making. They conclude that the performance of diverse groups is often affected negatively by the categorisation of team members into outgroups or through a lack of perceptions of similarity amongst team members. They argue that this impacts upon a team's ability to trust, cooperate and communicate effectively with one another, while at the same time preventing them from forming a cohesive group. On the other hand they argue, by way of the information/decision making perspective, that by having greater informational/task related

diversity, groups are able to work more effectively through better decision making processes and greater information sharing. Essentially Williams and O'Reilly are saying that there are two forms of diversity, one of which is detrimental to group functioning and one of which is beneficial. The first being social category diversity, and the second being skill/informational diversity. In this way they have differentiated between a positive form of diversity and a negative form.

The relationship between diversity and group functioning may be more complex and difficult to summarise in one model however. One of the nuances of SIT and SCT that Williams and O'Reilly (1998) do not take full account of in their model is the importance of the content of an identity (or the meaning behind an identity), to how diversity is interpreted within a group. The next section of this chapter will demonstrate how these identity processes can actually turn around the negative aspects of social category diversity.

5.3   Diversity and Identity

In the last section, the idea that diversity is problematic in organisations as it leads to exclusive categorisation between team members was presented. This interpretation of the social identity perspective is flawed however. It assumes that any kind of difference will inevitably lead to categorisation into separate groups, and that this categorisation will inevitably lead to a breakdown in team cohesiveness. This is not necessarily the case, however, and evidence will now be presented which will explain how when a more expansive understanding of identity processes is made, it can be seen that diversity itself can be the foundation of an effective group or team identity.

Work by Jetten and colleagues (see Hornsey & Jetten, 2004; Hornsey, Jetten, McAuliffe, & Hogg, 2006; and Jetten, Postmes & McAuliffe, 2006), provides crucial insight into how the content of an identity can influence group members attitudes towards individual difference. Their work investigates how differences between individualistic and collectivist cultures can be explained using the social identity perspective.

There is growing evidence that there is a difference between western and eastern cultures regarding how people conceptualise the self. It has been observed that people in western countries tend to think of themselves more in terms of individual characteristics; where as people in eastern countries tend to view themselves more in terms of their social relationships and group memberships (Markus & Kitayama, 1991). What is interesting

here, is that within western countries the group "values" the individual, where as in collectivist countries, the group is seen as being more important than the individual.

Jetten and colleagues have investigated how the paradox within individualistic societies can be explained. That is, how a group identity can exist if it by definition places more emphasis and value on individual or personal identity, than on social identity. Also, if categorisation is purely based on perceptions of similarity, then it would seem reasonable to suggest that where the differences of individuals are highlighted, people are less likely to categorise at the group level. The content of an individualistic social identity should, by definition, undermine the salience of that identity. This however is apparently not the case, and evidence has shown that being different can actually be prototypical. Jetten, Postmes and McAuliffe (2002) demonstrated that people were more likely to behave in an individualistic manner when they identified strongly towards an individualistic group. In other words, in an individualistic culture (such as American), a person can be seen as more of a group member if they behave in such a way that demonstrates their own uniqueness and distinctiveness. This example demonstrates how being prototypical can actually be more about acting in accordance with the group's behavioural expectations, rather than being similar to other group members (Rink & Ellemers, 2007a); and that these behavioural expectations can include demonstrations of distinctiveness. It is this possibility of a broader or more abstract definition of what it means to be a group member that allows for the possibility of diversity and distinctiveness to be the foundation of a social identity.

Rink and Ellemers (2007b) described a study which demonstrated that as long as people behaved in accordance with expectations, their group could function effectively together. They found that people had initial expectations of behavioural similarity amongst team members and that if a person behaved differently (i.e. violated behavioural expectations), members would then show less commitment towards the group. But they also demonstrated that if these expectations were changed so that they expected the other person to behave in a different way to themselves, then they would continue to show commitment to the group. In this way they argue that it is behavioural norm violation which causes the fragmentation of a group into different categories when there is diversity. The answer to this they suggest is to have behavioural norms which are abstract and inclusive enough to include all the possible behaviours of group members. It should be noted however that Rink and Ellemers (both 2007a & 2007b), discuss diversity in terms of task related diversity (or informational, in terms of Williams & O'Reilly, 1998), rather than

social category diversity. Because of this they do not extend this hypothesis to social category diversity, so leave open the possibility that this strategy will not work for demographically diverse groups.

Rink and Ellemers (2007a) however also stress that categorisation of oneself (and others) does not just rest on perceptions of similarity but can also arise from a sense that they are reliant on other people to achieve a collective goal. In this way, if a person needs to work together with another who is demographically different from him or herself, as long as they are working together towards a common goal and they are aware and accepting (have an expectation) of that difference they should be able to function effectively as a team. This leaves open the possibility that demographic (and social category) diversity can be incorporated into a team/organisational identity.

Van Knippenberg and Haslam (2003) take this point to the next level by suggesting that not only can diversity amongst team members be accepted, but that it can also be seen as an asset. In this way, diversity can be incorporated into the content of a social identity. This is the idea that what makes the group positive and distinct from other groups (and as such central to the group's identity), is the heterogeneity within it. In other words the group defines itself by the way it values the diversity of its members. Van Knippenberg and Haslam (2003) argue that by incorporating this "value in diversity" into its identity, a group can also demonstrate to individual members that they are valued for "who they are" as an individual as well as "who they are" as a group member. This in turn can lead to an increase in identification with the group.

Following on from this, van Knippenberg, Haslam and Platow (2004) found further support for this notion. They discovered that people in both a laboratory and workplace environment showed higher levels of ingroup identification with their workgroup, when that group valued the diversity of its members. Importantly they also found the reverse; that is that when diversity was not valued, people identified more strongly with homogenous groups. This study provides crucial information as it suggests that the impact of diversity is derived from how a group values diversity. This study is also interesting as it does not rely on task related diversity (as done in Rink & Ellemers, 2007b), but on gender diversity, which according to Williams and O'Reilly (1998) should be associated with disunity within the group and a lack of ingroup identification.

Taken together the work of Jetten and colleagues, Rink and Ellemers, and van Knippenberg and colleagues, suggest that diversity can be utilised as a source of common

ingroup identity, which in turn can allow for effective group functioning. They all argue that the psychological mechanisms of group formation and identity are flexible enough to allow for a common identity which incorporates the diversity of group members. This is in stark contrast to the argument made by Williams and O'Reilly (1998) which suggests that social category diversity can only lead to division and a lack of ingroup identification. There are two key ways in which Jetten and colleagues, Rink and Ellemers, and van Knippenberg and colleagues, are more consistent with the social identity perspective. The first is that by valuing the diversity of group members, a group can see itself as being positively distinct from other groups. The second way is that by appreciating individuals for who they are, people can embrace both their own personal identity as well as be included within the identity of their group (Tyler & Blader 2000). Both these factors allow for strong identification with a diverse group and by doing so overcome the unity in diversity paradox.

Chatman, Polzer, Barsade and Neale (1998) present a related although contradictory argument to the one just discussed. They described a study which investigated how demographic diversity interacted with an organisation's culture. This study highlighted the importance of culture (and group identity) to the impact of diversity and on the surface the results seem to contradict the notion that diversity can be used as a basis for a common ingroup identity. They found that people in organisations with collectivist cultures (rather than individualistic as suggested by Jetten and colleagues) were able to function more effectively than those with individualistic cultures, in the context of demographic diversity. They argued that in organisations with collectivist cultures there was a more real and active social identity for people to identify with, where as in individualistic organisations people were more focused on differences between individuals and so therefore were more likely to categorise based on those differences. In essence this is consistent with the common ingroup identity model (Dovidio et al 1997; Gaertner & Dovidio, 200; Gaertner, Dovidio, Anastasio, Bachman & Rust, 1993). This approach suggests that the way to avoid conflict is to have everybody recategorise into a common ingroup. There are problems however with this approach, which will be discussed shortly.

In order to come to terms with the apparent contradiction between Chatman et al (1998) and Jetten and colleagues, it is important to differentiate between a group with an individualistic culture and one which has a "value in diversity" culture. While an individualistic culture celebrates and draws attention to individuals, it does not necessarily

define itself by the differences between these individuals. On the other hand, when a group has a "value in diversity" norm or culture (as suggested by van Knippenberg and colleagues) the differences between individuals are a key component of that identity. In this way a group which values the diversity of its members may actually be better adapted to dealing with that diversity than one which is simply individualistic. For this reason it is possible that the individualistic groups in Chatman et al (1998)'s study may not have been groups which valued the diversity of their members, but simply groups which focused on individuals.

A second problem with Chatman et al (1998)'s study is that it suggests that the way to deal with diversity is through something akin to the common ingroup identity model (see Gaertner et al., 1993). This approach argues that the best way to deal with differences between individuals (and subgroups) is to have all those involved recategorise themselves into a common ingroup. This approach is potentially flawed however as it assumes that people will be more than happy to replace an existing valued identity with a new one. It is not difficult to imagine circumstances where people are unwilling to assume an imposed organisational identity, but would instead continue to identify with the subgroup (or social category) that was previously important to their own self definition. In this way, while Chatman et al (1998) found that communalistic organisations were more cohesive and functioned more effectively than individualistic organisations, they may not have found the best way to deal with diversity in organisations. This is because this approach denies the importance of existing personal and social identities.

Haslam et al.(2003) challenge the notion that an organisation with a common ingroup identity, with an "all-consuming monolithic team or organisational identity" (p. 100), is the most effective form of social organisation. They instead describe the ASPIRe model (Actualising Social and Personal Identity Resources) (see also Eggins, O'Brien, Reynolds, Haslam & Crocker, 2007; Eggins, Reynolds & Haslam 2003; O'Brien et al 2004 and Reynolds, Eggins & Haslam, in press), which suggests that organisations are more effective when they value all of their component subgroups and individual members. This model is foundered on the social identity perspective and suggests that in any organisation there is going to be diversity of individuals and subgroups (in the more abstract form), and that in order to make full use of its people, an organisation's identity must incorporate this diversity. Their work rests on the notion of "organic pluralism", which suggests that a social identity can consist of different components which organically contribute to the

functionality of the whole. They argue that people will have a certain degree of attachment to their existing personal and subgroup identities and that in order for them to identify with a higher order social group it must be "self-defining" and "self-relevant".

It should be noted that the idea of an "organic" superordinate identity is different from having two identities which are salient simultaneously (personal or subgroup at the same time as organisational). According to SIT and SCT, there is a "functional antagonism" between identities so that as one becomes more salient others become less salient. ASPIRe gets around this as the subgroup or personal identities actually become part of the organisational identity, which allows for the different levels of categorisation to be salient simultaneously. In other words the process of ASPIRe allows for the merging of identities into an organic whole.

The ASPIRe model suggests that it is ineffective to ignore the "social reality" or existing categorisations that people rely on to understand their lives at work and that imposing different social categories on people may not be the most effective strategy. Instead it argues that social categories are actually a resource that can be utilised to build an effective organisational identity.

Haslam et al (2003) present a technique which enables the development of an effective organic superordinate identity, which incorporates subgroup and personal identities. This process consists of four phases. The first phase involves ascertaining which personal and subgroup identities people actually use within the context of their organisation (Ascertaining Identity Resources - AIRing). The second phase involves "sub-casing", where people within subgroups are brought together so that they can form a consensus about who they are as a subgroup and what their goals are. Both the first and second phases are conducted with reference to the existing non-organic superordinate identity, so that the subgroup and personal identities can be viewed in relation to the superordinate. In the third phase selected members of all the different subgroups come together to define the superordinate identity (this is referred to as "super-casing"). In this phase, the superordinate identity is redeveloped so that it incorporates and values each of the subgroups. The final phase ("ORGanizing") involves strategic planning and organic goal setting, where members of the different subgroups come together to plan the future action of the organisation in such a way that subgroup and organisational goals can be fulfilled. In this way the goals of the subgroups and the organisation as a whole are congruent and

interdependent with one another. This is allows for the full realisation of the organic superordinate identity.

One of the advantages of the ASPIRe model is that it not only allows for diversity at the individual level, but also at the subgroup level. As discussed in the last chapter and earlier in this chapter; one of the largest sources of stress in space missions is conflict between subgroups. If the ASPIRe model is utilised successfully, then subgroups should become interdependent on one another, and integrated into the same organic identity. This is designed to stop members of one subgroup viewing members of other subgroups as outgroup members. As such they will be motivated to act cooperatively and avoid conflict with members of other subgroups. In this way ASPIRe promotes the development of a "value in diversity" higher-order norm or culture, which accommodates the diversity of individuals and subgroups.

At this point it is important to draw attention back to the space flight training program suggested by Kring (2001) which was described earlier in this chapter. Kring proposed that problematic diversity could be dealt with by providing astronauts and cosmonauts with training in which they all came together to identify which divergent behaviours caused problems. He argued that by identifying these behaviours the crew could come up with a new set of acceptable behaviours that everybody agreed upon. From the point of view of ASPIRe Kring's approach is essentially about creating a new identity. While it makes sense to bring everybody together to forge a crew identity, according to ASPIRe it would also be important for the new crew identity to build on existing understandings, experiences and ways of operating. In this way, Kring's training program would have some success, but could be improved upon through the use of ASPIRe.

Taken together, the work on ASPIRe, combined with that of Jetten and colleagues, Rink and Ellemers, and van Knippenberg and colleagues, suggests that if diversity is incorporated into the identity of a group, then it can act to boost organisational identification and improve organisational functioning. This work suggests that whether we consider diversity at a subgroup or individual level, the key is to have an overarching superordinate identity which values and includes diversity within its self definition. In other words, the key to turning social category diversity into an advantage rather than a disadvantage (as suggested by Williams & O'Reilly, 1998), is through the development of an organisational identity, which is organically plural, and has a culture which values diversity amongst its members.

More work in this area is still needed however, with only the first implementations of the ASPIRe model being undertaken recently (for an example see Eggins, Reynolds, Cresswell & Reid, 2007). There is also evidence from the workplace that a "climate for diversity" can improve organisational functioning. Hicks-Clarke and Iles (2000) for example in a survey of a broad range of large organisations found that if they had a "climate for diversity" this was far more likely to lead to positive organisational outcomes, such as increased positive attitudes towards the organisation. It is sufficient to say that there is strong theoretical evidence and growing evidence from the workplace that organisations are better able to utilise the diversity of their workforce if they have an identity that incorporates the heterogeneity of its members and has a culture that values diversity.

5.4   Conclusion

This chapter has outlined the importance of work on diversity in both workplace and extreme environments. Much of the work in both these domains has presented diversity as a "two edged sword". On one hand it allows for the realisation of equal opportunities for members of a broad range of demographic groups (in space and in the workplace), while allowing for increased international cooperation in space exploration. It is also thought to allow for greater creativity and better decision making and help to prevent dysfunctional "group think". On the other hand, it is associated with team fragmentation and a break down in group cohesiveness in both space and the workplace. This has been thought to happen because diversity causes people to categorise each other into separate groups, which then prevents them from functioning together effectively as a team.

More recent developments in organisational psychology which are based in the social identity perspective, dispute that this kind of divisive categorisation is a necessary outcome of a focus on diversity. It has been argued that this typically negative aspect of diversity can in fact be turned into a way of effectively unifying a group of people. This can be done through the creation of a common ingroup which organically incorporates the diversity of all individuals and subgroups within it. This enables people to hold onto and maintain existing valued personal and social identities, while also allowing them to take pride in there group. It has been argued in this chapter that if this can be done successfully, then a group can make full use of the benefits of its diversity, without it inevitably causing division.

As demographic diversity in space crews is almost certain to continue into the future, it is of the utmost importance that this form of diversity as well as other possible bases for difference and diversity that can emerge through group interaction can effectively be managed. The research presented in this chapter has provided a way to take advantage of the psychological processes involved in categorisation and identification, so that they can be used to realise the full benefits of having a heterogeneous crew. If these psychological processes are taken advantage of, then they have the potential to turn a potential drawback of crew diversity, into the basis of a strong crew identity.

In the chapters that follow, how a pro-diversity identity/culture or group norm impacts on group functioning will be investigated. This will be done in both the context of two extreme environment field studies and two laboratory experiments. These studies will provide further evidence for how a "value in diversity" identity may be the key to managing crew heterogeneity in future space missions.

- Chapter 6 -

Demonstrating the Benefits of Group Identification and Pro-Diversity Norms in the Field and Laboratory

6.1   Introduction

In the previous chapter, the issue of how diversity impacts upon group psychological processes was investigated. Importantly, that chapter highlighted how an understanding of identification processes could be used to take full advantage of diversity and to avoid its divisive potential. The ideas presented were based on work in mainstream social psychology and organisational psychology, which suggested that the best way to deal with diversity was for a group to develop a norm (or culture) which values the diversity of its members. Evidence was presented that this creates a more inclusive group environment and can act as foundation for strong group identification. In the context of group functioning in space, these two factors are essential to mission success. The present chapter will explore these issues in greater depth through three empirical studies. The first of these studies was a field study and the second two were conducted in the laboratory. The purpose of these studies was to investigate the impact of diversity and diversity culture on group dynamics in contexts broadly considered to have similarities to isolated confined extreme environments.

This chapter utilises data from both the field and the laboratory. Both were used to enable a deeper understanding of core theoretical points and then to assess these same factors in more naturalistic settings. When conducting research designed to inform an understanding of ICE environments, this issue is especially important as part of what is being studied is the effect of the environment on psychological processes. In this way, field studies are important for exploring the usefulness of certain measures and their interrelationships with other variables as well as their explanatory power. It could be

argued at one level that all the work of the thesis and especially the research outlined in Chapter 7 concern the degree to which core social psychological variables that explain group functioning can be measured and are important to the ICE literature.

One of the drawbacks of field studies however is the difficulties in actually conducting the research. As discussed in earlier chapters, getting research access to people living in space is exceptionally difficult. The extreme cost of sending people into space means that every minute of an astronaut or cosmonaut's time is very valuable. Because of this only those people directly involved in the space programs tend to conduct any actual psychological research in space. This means that most research has to be conducted using analogue environments and space simulation studies. These localities however, also have high research costs and are also difficult to access. Environments such as Antarctic research stations, submarines, and other space analogues often have restricted access to their personnel and research that is conducted is typically determined and managed by specific governing organisations. Possibly the most important restrictions though are simply that there are not that many people in these environments, these people are usually isolated and they are often highly engaged with their own work. This results in most research in this area suffering from; small sample sizes, difficulties getting participants to complete questionnaires, cultural generalisability and clashes between mission and research goals (Suedfeld & Weiss, 2000).

Laboratory studies have their own advantages and disadvantages. They have advantages such as greater experimental control, greater flexibility in sampling and disadvantages such as a lack of ecological validity as already discussed. In terms of sampling much larger samples can be obtained (the only limitation is the resources available to the research) and it is also possible to sample in such a way as to have independent data (a key flaw of much of the highly ecologically valid work). Other advantages of laboratory studies include increased cooperation and monitoring of participants, and the ability to have more time consuming and expansive questionnaires. By manipulating specific independent variables in experiments, the effects of these changes can be directly observed. In field studies we only have the opportunity to observe the variations that take place in our sample. If we take one measurement at one point in time of a group based measure, this severely limits the variability in our data.

These points when taken together suggest that in order to conduct effective research in extreme environment psychology, it is important to use both field and laboratory studies.

If results from both types converge, this leaves the research in a far more defensible position. The downside of this is that a number of studies need to be conducted in order to find a convergence of results. One laboratory study or one field study is simply not enough. For this reason, the present chapter describes three studies (one field and two laboratory) to investigate the impacts of diversity and diversity culture on group functioning. The chapter that follows this one, then outlines a further field study that follows on from the findings of the current chapter.

The three studies described in this chapter, at their core investigate the issues raised in the previous chapter. The key factors investigated are identification with a relevant ingroup, the extent to which that relevant group values diversity, the level of perceived diversity in that group and various aspects of group functioning. Group functioning is considered to be an outcome variable related to the first three and in this chapter encompasses elements such as the alienation of sub-groups and individuals, the cohesiveness of the group, pro-social behaviour within the group and in one of the three studies, the performance of the group on a specified task.

There are key predictions, which arise from the research discussed in the previous chapter that are common amongst the three studies. Primarily it is expected that high levels of identification will be associated with better group functioning. Secondly it is predicted that a pro-diversity culture, will result in better group functioning. Furthermore it is expected that the actual diversity within the group will have an impact on these relationships. Specifically, where there is actual diversity in the group, a pro-diversity norm compared to an pro-uniformity norm will lead to stronger group identification and more positive group outcomes. This prediction is important because in space analogue environments and space endeavours themselves, groups often are highly diverse (in terms of gender, nationality, specialist skills and roles).

The studies described in this chapter, and also the study described in Chapter 7, all investigate the same core theoretical questions. Because of this these two chapters will not examine the theoretical implications of the findings in detail. Instead these chapters will provide a description of the research process and results and leave the main theoretical discussion of these findings to Chapter 8. This is done to avoid the repetition of a similar discussion of the result in relation to theory from each study.

6.2   Study 2: The Mona Lisa and Leonardo, Utah Field Study

This first study described in this chapter was undertaken as part of the Mona Lisa and Leonardo project. This comprised of two scientific space simulation missions to the Mars Desert Research Station (MDRS) in Utah. The first team was all male and the second was all female. Both crews spent two weeks each at the simulation site. The MDRS is a purpose built simulated Mars simulation base in the Utah desert. It is geographically isolated in an area that has been suggested to be geologically similar to Mars and the station itself is cramped and confined like a real space station. The research conducted on these two missions, was of a similar nature to research that would be conducted during a real mission to Mars, such as Biology, Geology, Engineering and Human Factors. In addition some of the activities undertaken outside the habitat were done using prototype space suits in a simulated extreme low pressure atmosphere.

This station provides an excellent location for undertaking space analogue (particularly Mars analogue) psychological research. There are a few features however which are not analogous, such as the lack of real danger, lack of the extreme isolation of space, and in the case of these two missions, the duration of time the crews spent together in isolation. Despite this, these missions provided a rare and excellent opportunity to study group processes in a space analogue environment. What's more, one of the stated goals of these missions, was to investigate group processes during a simulated Mars mission (see Monalisa Leonardo MDRS Project, n.d., for a full account of the missions), so these samples provided an even rarer example of an alignment between research goal and mission goals.

The predictions made for this study conform with those stated earlier. Stated as formal hypotheses they are:

H1. Ingroup identification will be important in explaining group functioning in this ICE environment.

H2. Where there is perceptions of actual diversity there will be more negative group functioning.

H3. The presence of a pro-diversity group norm within the expedition group will be associated with higher ingroup identification and better group functioning

6.2.1 Method

Participants   The participants of this study were from two expedition teams to the Mars Desert Research Station (MDRS). The first team consisted of 6 males with an age range of 28 to 51 years (mean of 32.0). The second team was made up of 6 females with an age range of 24 to 52 years (mean of 34.2). All participants were present at the MDRS for two weeks and were engaged in the Mars expedition simulations for that entire time.

Materials and Procedure   Participants completed the questionnaire for this study towards the end of the expeditions using a laptop computer. Before doing so however they gave their informed consent to participate in the study by reading and completing a consent form. The questionnaire used in this study was in the form of an Excel file and took around 10 minutes to complete. Individual ID codes are used to enable only the participant and the experimenter access to responses and all data was kept in a secure location.

The questionnaire consisted of thirty six items, however only twenty eight of the items were used in this study. The key variables measured in this questionnaire were, "Ingroup Identification", "Perceived Diversity", "Pro-Diversity Norm", and two variables associated with effective group functioning. The first was a general group functioning measure which considered factors such as the degree to which people viewed their group as a unified entity, the level of interaction between members, and how much members shared each others' goals. The second measure of group functionality was to do with alienation or fragmentation of the group. These are referred to as "Group Functioning" and "Alienation" respectively.

Four sub-dimensions of Alienation were measured; these were alienation of an individual, where the target of the alienation was the self ("individual/self"); alienation of an individual, where the target of the alienation was another person ("individual/other"); alienation of a subgroup, where the target of the alienation was the person's own subgroup ("subgroup/self"); and alienation of a subgroup, where the target of the alienation was another person's subgroup ("subgroup/other").

Five sub-dimensions of Group Functioning were measured; these included, the importance of the group to its members; the amount of interaction amongst group members;

the extent to which group members had common goals; the extent to which group members shared common outcomes; and how similar group members were to each other.

Each variable was measured using 7 point Likert scales; where participants rated the extent to which they agreed or disagreed with a statement, with a rating of 1 indicating that they strongly agreed and a rating of 7 indicating that they strongly disagreed with the statement. The items used for each variable can be seen in Table 6.1.

Table 6.1. *Variables and Items used in Study Two*

Variable	Item
Identification	- *"I see myself as a member of the expedition team"*
	- *"I am pleased to be a member of the expedition team"*
	- *"I feel strong ties with members of the expedition team"*
	- *"I identify with other members of the expedition team"*
	(Items adapted from Doosje, Ellemers & Spears (1995))
Perceived Diversity	- *"Most people on this expedition share the same kinds of opinions about important issues"* (reverse coded)
	- *"The people on this expedition all have similar values"* (reverse coded)
	- *"Compared to other groups that I have been a member of, this expedition group seems very diverse"*
	- *"There are important differences between people that could affect the mission overall"*
Pro-Diversity Norm	- *"Our expedition group values the differences that each individual brings to the group"*
	- *"Different points of view are readily accepted within this expedition group"*
	- *"On this mission it feels as if people are encouraged to think and act in a similar way"* (reverse coded)
	- *"In this expedition group we are encouraged to voice opinions even if they generate much debate and disagreement"*
Alienation – Individual/Self	- *"I feel like I don't get along with other people on this expedition"*
	- *"Other people on this expedition are closer to each other than they are to me"*
Alienation – Individual/Other	- *"I think there is at least one person from this expedition who doesn't get along with the others"*
	- *"There is one person from this expedition who doesn't seem very close to anybody"*
Alienation – Subgroup/Self	- *"I am part of a subgroup within the expedition that does not get along with the others"*

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Alienation – Subgroup/Self (cont)	- *"It feels like I am in a subgroup, which is not very close to the other crewmembers"*
Alienation – Subgroup/Other	- *"Some people from this expedition are part of a subgroup, which doesn't get along with everybody else"* - *"There is a subgroup within this expedition, which is not very close to the other crewmembers"*
General Functioning	- *"Compared to other groups that I have known about, the expedition group is very much a 'group'"* - *"The people on this expedition would best be described as being part of a group rather than just a collection of individuals"* - *"If I compared different groups, I would rate the members of this expedition very highly on how much they fit with my conception of what it means to be a group"*
Group Functioning – Importance	- *"The expedition group is very important to all its members"*
Group Functioning – Interaction	- *"Compared to other groups, there is a high degree of interaction between members of this expedition"*
Group Functioning – Common Goals	- *"The people on this expedition all share common goals"*
Group Functioning – Common Outcomes	- *"In this expedition group, all members either succeed or fail together, whereas in other groups, individual members may succeed or fail independently of the other members"*
Group Functioning – Similarity	- *"There is a high degree of similarity between members of this expedition"*

Design and Analysis   This study was designed to test the relationships between the key variables outlined earlier. This was done by conducting correlational analyses between the key variables. In addition to this, comparisons between the two expedition groups were conducted for each of the key variables together in a MANOVA. There were not any specific hypotheses regarding how the two groups would compare to one another however; this part of the analysis was purely exploratory in nature.

As with the first study of the thesis described in Chapter 4, this sample had high levels of non-independence. Unlike that sample however, data in this study was only collected once from each individual. This meant that Multilevel Linear Modelling could not be used as an analysis technique for overcoming non-independence.

6.2.2   Results

   Scale Reliability   Scales were constructed for each of the variables measured. The four items relating to ingroup identification did not form a scale, however when the second item was dropped, a reliable scale was formed, with a Cronbach's Alpha of $\alpha = .72$. Perceived diversity items 1, 2 and 3 were found to form a very reliable scale with a Cronbach's Alpha of $\alpha = .86$. The four items relating to the diversity norm, also did not form a scale so only items 1 and 2 were used (Cronbach's Alpha of $\alpha = .75$). A reliable scale for general alienation was constructed using all alienation measures except subgroup/self item 1 and subgroup/other item 2. This scale had a Cronbach's alpha of $\alpha = .88$. The only alienation subscale which was found to be reliable was for individual/other which had a Cronbach's Alpha of $\alpha = .90$. Because of this, analyses were conducted for the other kinds of alienation using the singular alienation items. The three general group functioning items did form a scale with a Cronbach's Alpha of $\alpha = .80$; however an additional group functioning scale, which consisted of each of the separate dimensions of group functioning, was not used as it proved to be very unreliability (Cronbach's Alpha of $\alpha = .39$). A summary of scale reliability can be seen in Table 6.2.

Table 6.2. *Scale reliability*

Variable	Number of Items	Cronbach's Alpha
Identification	3	.73
Perceived Diversity	3	.86
Pro-Diversity Norm	2	.75
Alienation - General	6	.88
Alienation – Individual/Other	2	.90
Group Functioning	3	.80

   In order to test if there were any general differences between the two expedition groups, a MANOVA was conducted using all the key variables. A significant multivariate effect was not found however with Wilk's $\Lambda = .29$, $F(1, 6) = 2.95$, $p > .05$. A significant difference was found between the two groups regarding their diversity norm however, with the female group showing a more pro-diversity norm than the male group ($F(1,10) = 8.45$, $p < .05$. No other significant differences were found between the two groups. The results of these tests as well as mean scores can be seen in Table 6.3.

Table 6.3. *Mean scores and MANOVA results*

Variable	Male Crew Mean (n=6)	Female Crew Mean (n=6)	Overall Mean (n=12)	*p*
Identification	1.3 (0.4)	1.4 (0.3)	1.4 (0.4)	*p* > .05
Perceived Diversity	4.7 (0.4)	5.1 (0.8)	4.9 (0.6)	*p* > .05
Pro-Diversity Norm	1.8 (0.3)	1.3 (0.4)	1.5 (0.5)	*p* < .05
Alienation - General	4.8 (0.4)	4.5 (0.6)	4.7 (0.5)	*p* > .05
Group Functioning	1.5 (0.6)	1.6 (0.8)	1.5 (0.7)	*p* > .05

After this, correlation analysis was conducted in order to measure the relationships between the key variables. Data from both expedition groups was combined in order to maximise sample size. The correlations between variables can be seen in Table 6.4. Given that none of the measures are strongly correlated suggests these are different measures. Results suggested no significant correlations at the 95% confidence level, however a marginally significant negative correlation was found between identification with the expedition group and general alienation. Given the small size of this sample this result can be taken as indicative of the relationship between identification and this key group functioning variable. In addition all other correlations tended in the predicted directions, which provides further support for our hypotheses and the associated social identity framework. By looking simply at the correlation coefficients, identification with the expedition group was negatively associated with diversity, but positively associated with both a pro-diversity norm and group functioning. The pro-diversity norm was also associated with slightly better group functioning and alienation and negatively associated with perceptions of diversity.

Table 6.4. *Correlations between key variables*

Variable	1.	2.	3.	4.	5.
1. Identification	1				
2. Perceived Diversity	-.17	1			
3. Pro-Diversity Norm	.37	-.43	1		
4. Alienation - General	-.56[†]	.28	-.24	1	
5. Group Functioning	-.01	.34	-.01	-.11	1

[†] *indicates correlation is significant at p < .06*

In order to investigate Alienation further, correlation analyses were conducted between the Alienation subscales and Identification, Perceived Diversity, Pro-Diversity Norm and Group Functioning. The results of this analysis can be seen in Table 6.5. These results indicate that there may indeed be a negative relationship between the different forms of alienation and group identification, with three of the seven Alienation subscales indicating a significant negative correlation and a forth item showing a marginally significant negative relationship. In addition to this two of the Alienation subscales relating to the alienation of subgroups were negatively correlated with having a pro-diversity group norm which indicates that the more there is a pro-diversity norm the less likely there is alienation of subgroups.

Looking only at the correlation coefficients even more evidence can be seen for the impact of both ingroup identification and having a pro-diversity culture. Given the small sample size (n=12) it is important not to discount these non-significant results. Interestingly the correlations almost all tend in the predicted directions. Group identification appeared negatively related to individual alienation and in all but two cases negatively related to subgroup alienation. Interestingly having a pro-diversity group norm was invariably related to lower levels of perceived alienation. General group function also seemed (to a lesser extent) to be negatively related to perceptions of alienation. From these results it appears that social psychological aspects of group identification, diversity and group outcomes can be reliably measured in the space analogue environment. Also the relationship between variables in the expected directions further highlights the importance of identification and group norms.

Table 6.5. *Correlations between key variables and Alienation subscales*

Alienation Subscale Type and Target	Identification	Perceived Diversity	Pro-Diversity Norm	Group Functioning
Individual of self item 1	-.61*	.06	-.48	-.31
Individual of self item 2	-.36	.40	-.10	.05
Individual of other (combined)	-.60*	.24	-.16	-.10
Subgroup of self item 1	.12	.43	-.68*	-.04
Subgroup of self item 2	-.61*	.06	-.48	-.31
Subgroup of other item 1	-.51[††]	.25	-.17	-.11
Subgroup of other item 2	.18	.40	-.68*	.03

* indicates correlation is significant at p <.05, [††] indicates correlation is significant at p < .10

6.2.3 Discussion

This study found some evidence to support the proposed hypotheses. In support of the first hypothesis, ingroup identification was shown to be meaningfully related to alienation (a key indicator of dysfunctional group dynamics). Likewise in support of the second hypothesis, while not significant, higher perceived diversity seemed to be associated with higher levels of alienation. Results also provided some support for the third hypothesis that a pro-diversity group norm is associated with both higher ingroup identification and better group functioning (in this case lower alienation).

Work on the social identity perspective (Tajfel, 1972; Tajfel, Billig, Bundy, & Flament et al., 1971; Tajfel & Turner, 1979, Turner et al., 1987) has provided strong theoretical support for the positive link between ingroup identification and group functionality. This work demonstrates these same factors can be measured in space analogue environments and are related in the same way as the social identity perspective would predict. In addition, this study has also further demonstrated the link between a diversity culture and increased ingroup identification (Haslam, Eggins and Reynolds 2003; Tyler & Blader, 2002; van Knippenberg and Haslam, 2003; van Knippenberg, Haslam and Platow, 2004) and the benefit this can have on group functionality. Together these results support the core aim of this thesis to investigate the applicability of this approach in the space analogue and ICE environments. It is fair to say that this theoretical perspective and

the broader contribution of social psychology has not been fully integrated with the space human factors literature.

Another notable observation of this study was the difference found between the male and the female crew in regards to their diversity culture; with the female crew having a more pro-diversity culture than the male crew. This difference may be difficult to interpret with the nature of the samples and the fact that both groups were assessed as being reasonably accepting of diversity amongst individual members (rated above the mid point in terms of having a pro-diversity norm). Given larger cell sizes it would have been informative to examine for each group separately, the relationship between the norm of the group and successful group functioning.

A key limitation of this study was the size of the sample. With only 12 participants it made it difficult to get statistically significant results and those results that are significant may be the outcome of only a few responses. In addition as the data came from a group of interacting individuals, non-independence of the data points raises questions over the validity of the tests used. Furthermore, due to the exploratory nature of this study, the results of the correlation analyses were not adjusted for multiple correlations. This may mean that there has been an inflated likelihood of "type II" errors occurring. Recognising these points however, this study has provided a rare and unique opportunity to observe social psychological processes in a space analogue environment.

The work in this naturalistic setting confirms that the social psychological variables of interest in this thesis are relevant to space analogue/isolated confined extreme environments. Also this work suggests a complex interplay between group identification, a pro-diversity group norm and group functioning. It is these relationships that will be explored in more detail in the remainder of this chapter. In particular these relationships are examined in the laboratory before returning to a more naturalistic setting in the research reported in chapter 7.

6.3   Study 3: Diversity in the Laboratory

This study was designed to investigate the same issues as the previous study, but this time in a controlled laboratory setting. The intention was to create a group setting in the context of an isolated, extreme environment scenario, in which group diversity and the group norm or culture could be manipulated. By using a computer program that was specifically designed for this study, it was hoped that an immersive scenario could be

created, in which realistic group processes could be observed. As this was a laboratory study, a much larger sample could be utilised than in the previous study and more conventional statistical techniques could be used to explore the relationships of interest. The two central variables under investigation where the group norms (pro-diversity or pro-uniformity) and the existence of explicit diversity within the group on a dimensions relevant to the group task (homogeneous or heterogenous).

The following predictions were made in this study:

H1: Ingroup identification will be higher under conditions in which there is a "value in diversity" group norm.

H2: Group functioning will be best when there is there a "value in diversity" norm and lowest when there is there is a "value in homogeneity norm". This will be assessed using a range of measures of different aspects of group functioning.

H3. The existence of diversity within the group will interact with the norm manipulation to affect group functioning. More specifically, diversity in the group will have the most negative impact in groups that do not value diversity.

6.3.1   Method

Participants   As part of a course requirement 74 first year psychology students from the Australian National University participated in this experiment.   Of these participants 34 were male and 40 were female with ages ranging from 17 to 40 years with a mean of 19.7 years. Between three and five participants took part in the study during each testing session and all were led to believe that they were interacting with four other participants besides themselves.

Design   This study followed a 2(Group Diversity, present or absent) X 2(Diversity Norm, pro or anti diversity) independent factors design. ANOVA analyses were conducted for each of the dependent variables in turn to test the hypotheses. The first independent variable was the manipulation of actual diversity within the group and the second was the manipulation of the group's culture; in this case the extent to which they

had a pro-diversity norm or not. The four dependent variables were "Alienation", "Identification", "General Group Functioning" and the score on the Survival in an Extreme Winter Environment task ("SEWE score").

Materials and Procedure   Participants completed this exercise on a computer, using a program written for the purposes of this experiment. The program was written using Macromedia Authorware version 7.01. The program consisted of a linear progression through screens which provided the participants with information and asked them to make responses to questions. In this way participants worked their way through the experiment by reading information, clicking "continue" once the information had been read, and making selections when presented with multiple options. The content of this program and the procedure of the experiment will now be discussed in more detail.

When the participants arrived for the experiment they were led to believe that they were in a group of five people. Where one or more participants did not turn up a confederate was used in order to lead the other participants to believe that they were still in a group of five people. Once each participant had been given a short explanation about the experiment and provided their informed consent (by signing a form), they were led to individual cubicles where they could not hear or see the other participants. They were told at this point that their only means of communication with the other participants would be by way of unidirectional email. In the cubicle they had a computer terminal with which they completed the experiment.

Before entering the cubical the experimenter set the program up for the appropriate experimental condition. Participants were randomly assigned to these conditions. Once seated the computer program welcomed the participants and gave them a more detailed account of what they would be doing in the study. They were then asked to enter their own unique codename. This was a name that they were led to believe would identify themselves to the other group members. In reality, the computers from the different participants were not connected. This was done so that they were led to think that they had an identity within the group, but were able to remain anonymous from their co-participants. They were then allocated a colour, which would be associated with their name. The participant's colour was always blue. After this they were told what the other group members' codenames and colours were. All participants received the same information at this point (i.e. they were all

told their team members were called "Corsica", "retrocious", "Crusty Burger" and "muppet").

After this, participants were told that they would need to do a thinking style task, and that this would be used to characterise their group. They were told that this method was based on Gorham, Kissinger, & Lichstien (1991)'s, Inductive/Deductive Thinking Style Scale (IDTSS). In actual fact this scale was completely made up and simply used as a way of leading participants into thinking that they shared a social category with their fellow participants.

Participants were then told that they had to wait for their other team members to complete that part of the study and for the data to be analysed, so that scores for the whole group could be presented. During this time they were given the opportunity to play a rudimentary computer game of "snake". This was designed to give the illusion of multiple interacting team members. After a few minutes their game was interrupted and they were told that all data had been collected and analysed.

Participants were then presented with a "double bell curve", which was explained to show the supposed distribution of people as either "deductive" or "inductive" thinkers. In this way it was made explicit that there were two "types of people". It was also explained that the closer a person was to the peak of the distribution the more similar they were to other people of that thinking style. They were then presented with the scores for each of their supposed team members. It was at this point that the manipulation of "Diversity" was introduced. In all conditions, the participant and three of the other team members were presented as being very similar to one another, with scores around the centre of the "inductive thinker" distribution. In the conditions where there was meant to be genuine diversity of views, one team member was shown to be away from the other team members, with a score which was almost but not quite in the "deductive thinker" distribution. The other condition showed all group members clustered together on the distribution. The distribution presented to participants in the conditions with diversity can be seen in *Figure 6.1*. An explanation was presented with the figure which informed participant in the diversity conditions that while their group was made up of inductive thinkers, there was one member whose thinking style was different to the rest. In the no diversity conditions, participants were told that they were all inductive thinkers. After this, participants in all conditions were told about some advantages and disadvantages of being an inductive thinker.
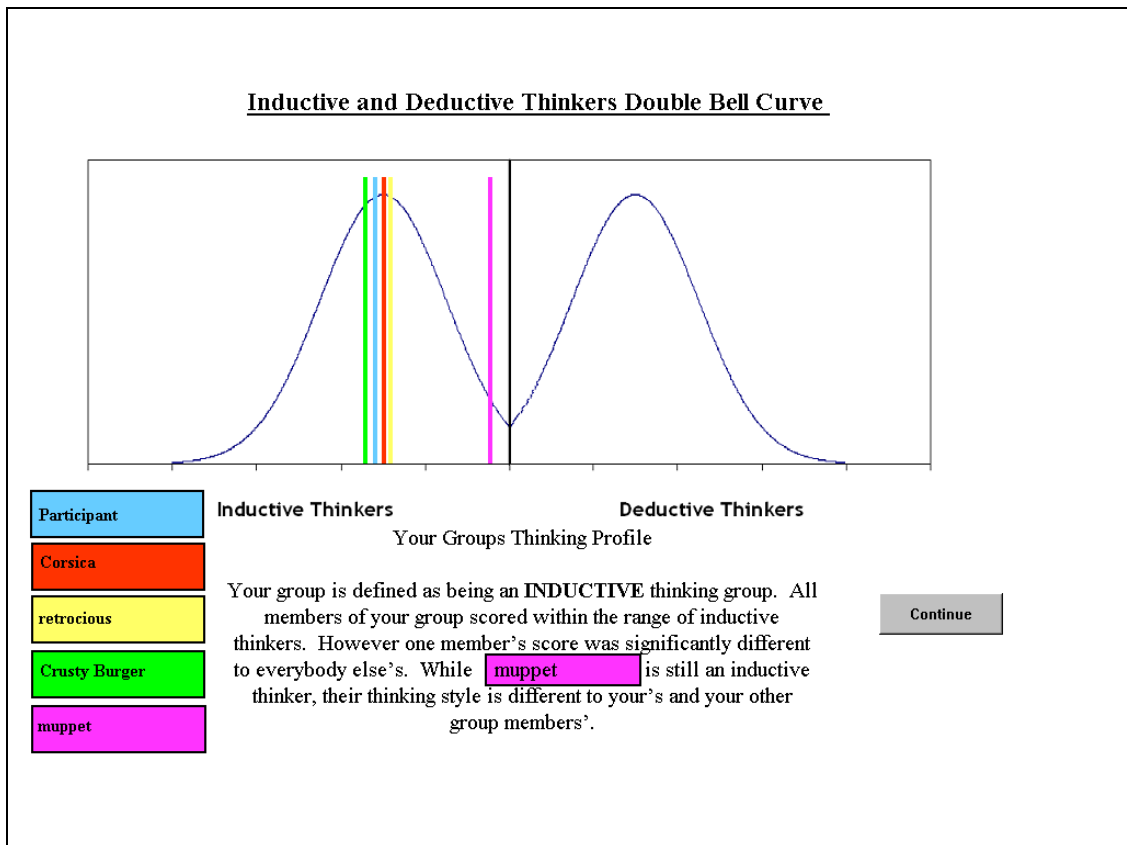
Figure 6.1. Snap Shot of Screen: Double bell curve demonstrating different thinking style of group member "muppet".

The next component of the experiment introduced the manipulation of "Diversity Norm". This was done by suggesting to the participants that a certain kind of "decision making culture" would allow their group to perform well in the group problem solving exercise. At this point one of two passages were displayed to participants, dependant on which condition they were in. The passages were as follows:

Pro-Uniformity Group Norm

*Some groups do much better at exercises like the "Survival in an Extreme Winter Environment" problem, because they **value** making quick and efficient **consensus decisions**. These groups tend to be good at exercises like this because they avoid wasting time figuring out each individual's point of view. Groups that **don't** use the "**uniformity and consensus model of decision making**" often waste vital time and energy trying to understand everybody's viewpoint. These groups can be thought of as valuing diversity over consensus and they often have trouble reaching any kind of decision at all. In life threatening situations like this one, it is absolutely vital that people are able to cooperate effectively with one another, so being in a group where everybody can quickly reach consensus, is very important. For problems like this one, diversity gets in the way. What is needed is uniformity and consensus.*

Pro-Diversity Group Norm

     *Some groups do much better at exercises like the "Survival in an Extreme Winter Environment" problem, because they **value** the inputs of all group members, no matter how **diverse**. These groups tend to be good at exercises like this because they avoid making bad decisions that fail to take everything into account. Groups that **don't** use a "**value in diversity model of decision making**" often get stuck on certain elements of a problem, or fail to see flaws in their solutions. These groups can be thought of as valuing consensus over diversity and they often make flawed decisions because they fail to take advantage of the varied inputs of all group members. In life threatening situations like this one, it is absolutely vital that people are able to see a problem from many angles, so being in a group which values the unique contribution of each member is very important. For problems like this one, too much agreement and early consensus will just lead to bad decisions. What is needed is an acceptance of differences and diversity.*

     Participants were then asked on a 7 point Likert scale the extent to which they thought their group should implement a "uniformity and consensus model of decision making" as opposed to a "value in diversity model of decision making". This was used as a manipulation check and to measure the degree to which the participant endorsed their given group norm. Scores closer to 1 indicated endorsement of the pro-uniformity group norm while those closer to 7 indicated endorsement of the pro-diversity group norm.

     After this, participants were then asked to wait while the other participants' responses to this question were gathered. They were kept waiting for a couple of minutes. They were then told that their group favoured either a "uniformity and consensus model of decision making" or a "value in diversity model of decision making" dependant on which condition they were in.

     The next phase of the experiment involved the completion of supposed group exercise (actually completed individually) "Survival in an Extreme Winter Environment" (SEWE). A number of information screens introduced this exercise to the participants and they were told of a scenario where they and their other team members had been survivors of a plane crash in snow covered mountains. Their task was to decide which six items (out of a possible fifteen items) to salvage from the plane wreck, in order to survive their situation. This problem was adapted from Kagan (1992) and the situation is supposed to act as a realistic survival scenario, with each item ranked by a survival expert on its importance.

     After reading all the information on the problem, participants were then told that their group would be completing this exercise using unidirectional communication. They were told that the decision maker would not be able to communicate with the other group members, but that the other group members would be able to send them an email. They

were then instructed that a decision maker would be chosen at random, but first they needed to wait for the other participants to reach this part of the experiment. After waiting for a few minutes, they were then shown a graphical display of the decision maker being chosen at random. All participants saw themselves being selected as decision maker. They were then told that their role as decision maker would be to receive emails from their fellow group members and then to make a final decision as to which six items their group would salvage from the plane wreck.

The email system was then introduced and participants were instructed that their group members could send as many emails as they liked, but that they had been instructed on how they should write their emails and that they were not allowed to give reasons for their choices. They were then told that their group had 5 minutes to complete this part of the exercise. Participants were then presented with a screen which was designed to look like an email program. They then waited to receive emails from their team members. Graphics were used to give the participant the impression that they were then receiving emails from their group members. They then had the ability to read the emails in whichever order they liked. Each email once opened was bordered by the group member's respective colour. The items suggested by each confederate participant were determined by the experimenter however to create a specific pattern of responses. To begin with items were balanced between participants so that they all shared an equal number of items with each other. This was done to prevent participants simply going with the most popular items and making a simple majority based judgement. Secondly, the group member "muppet" who was indicated as being different in the "diversity" conditions, provided the most useful items. This was done so that if this person was alienated, the SEWE score would be affected negatively. After 5 minutes had elapsed, participants were told their time was up and the email program closed down.

Representing their group, participants were then asked to make a selection of the six items to salvage. They were also given the option of reviewing the scenario. Once they had made their selection, they submitted their responses. After this they were told they would be given their results after answering a number of questions.

They were then asked to answer a series of questions, which related to how they felt about their group. They were instructed to consider their group as "the people you have been working with to complete the Survival in an Extreme Winter Environment problem". Participants were then asked to rate on a 7 point Likert Scale, the degree to which they

agreed or disagreed with a series of 17 statements. Scores closer to 1 represented stronger disagreement, while scores closer to 7 indicated high agreement. How each of the statements related to the dependent variables can be seen in Table 6.6. While all participants answered the items in the same order, this order was randomised so that no particular variables were measured before the others and also so that the items for specific variables were non-sequential.

Table 6.6. *Variables and Items used in Study Three*

Variables and Manipulation Checks	Items
Identification	- *"I see myself as a member of this group"* - *"I am pleased to be a member of this group"* - *"I feel strong ties with members of this group"* - *"I identify with other members of this group"* (Items adapted from Doosje, Ellemers & Spears (1995))
Alienation	- *"One person in this group doesn't belong with the rest of us"* - *"There is one person from this group who is not really one of us"* - *"I did not value the opinion of a particular member of this group"*
Group Functioning	- *"The people in this study would best be described as being part of a group rather than just a collection of individuals"* - *"This group is very important to all its members"* - *"Compared to other groups, there is a high degree of interaction between members of this group"* -*"The people in this group all share common goals"* - *"There is a high degree of similarity between members of this group"* - *"In this group, all members either succeed or fail together, whereas in other groups, individual members may succeed or fail independently of the other members"*
Diversity Manipulation Check	- *"There was one person in this group who was different to everybody else"* - *"Our group is very homogenous"* (Reverse Coded)
Group Norm Manipulation Check	- *"I thought that it would be better if our group were more "**Diverse**" and less "**Unified**"* - *"Our group thought it was best if we were very "**Unified**" and not very "**Diverse**""* (Reverse Coded)

Once participants had completed answering the series of questions they were presented with results of the SEWE exercise. They were also presented with the correct answers as suggested by Kagan (1992). Once they had finished reading these they were given the option of playing another computer game, while they waited to be collected by the experimenter. Once all participants had reached this stage, the experimenter opened the door then debriefed them on the experiment. Participants were then thanked for their time and given a detailed information sheet on the study.

6.3.2   Results

Scale Reliability   In order to measure the construct of 'Alienation' a composite scale was constructed by averaging responses from the three alienation Likert measures. This was found to be a reliable scale with a Cronbach's Alpha of $\alpha = .84$. An ingroup identification composite scale 'Identification' was also constructed by averaging the four Likert scale measures of identification. This scale was also found to have good reliability with a Cronbach's Alpha of $\alpha = .85$. The composite scale for 'Group Functioning' was constructed by averaging scores from the six Likert scale items which measured general group functioning. This scale was also found to be reliable with a Cronbach's alpha of $\alpha = .80$. Scale reliability can be seen in Table 6.7

Two scales were developed as manipulation checks of the two independent variables. In order to see if the manipulation of diversity worked the corresoponding items, were averaged to form a scale of 'Perceived Diversity'. These two items had a very low Cronbach's alpha of $\alpha = -.19$ however so it was deemed necessary to only use only one of the items. The second item was thought to better reflect the concept of diversity and so was used as the measure of 'Perceived Diversity'. As a check as to whether the group norm was successfully manipulated, the two corresponding items were averaged to form the scale 'Diversity Norm'. This scale was found to have an acceptable level of reliability with Cronbach's alpha of $\alpha = .61$. Both these analyses can be seen in Table 6.7.

Table 6.7. *Scale reliability*

Variable	Number of Items	Cronbach's Alpha
Identification	4	.85
Alienation	3	.84
Group Functioning	6	.85
Manipulation Check	2	-.19
Perceived Diversity (only 2nd item used)		
Manipulation Check	2	.61
Pro-Diversity Norm		

Manipulation Checks Manipulation checks were conducted on both of the manipulated independent variables in order to confirm that the experiment was operating the way it was intended.

The manipulation of the independent variable of 'Group Norm' was tested by comparing the means of the manipulation check variable 'Diversity Norm'. The two conditions of 'Group Norm' were 'pro-diversity' and 'pro-uniformity' and had mean scores of 3.78 (1.49) and 3.24 (1.19) respectively. Using a two tailed t-test these means were found to be only marginally significantly different from one another, with $t(72) = 1.726$, $p = .089$. This suggests that the manipulation of 'Group Norm' was very weak.

The manipulation of the independent variable of 'Diversity' was tested by comparing means of the manipulation check variable 'Perceived Diversity'. The two conditions of 'Diversity' were 'pro-diversity' and 'pro-uniformity' and had respective means of 3.34 (1.65) and 2.75 (1.61). No significant difference was found between these means when a two tailed t-test was conducted ($t(72) = 1.562$, $p = .122$). This suggests that the manipulation of 'Diversity', within this experiment was unsuccessful.

Because of the weak manipulations, both the original planned analyses as well as a secondary analyses were conducted in order to take advantage of the manipulation check findings.

Initial Analysis

To explore levels of identification across conditions a 2(Norm) X 2(Diversity) ANOVA was conducted. No main or interaction effects were observed however with $F < 1.1$, ns. Mean levels of identification across the conditions can be seen in Table 6.8.

Table 6.8. *Means (and standard deviations) of 'Identification' across conditions of 'Group Norm' and 'Diversity' (standard errors in parentheses).*

	Pro-Diversity Group Norm	Pro-Uniformity Group Norm
Low diversity within the group	5.03 (0.79)	4.85 (0.99)
High diversity within the group	4.55 (1.62)	4.96 (1.30)

The same analysis was conducted for alienation and again no main effects or interactions were found ($F < 1.5$, ns). Mean levels of alienation across the conditions can be seen in Table 6.9.

Table 6.9. *Means (and standard deviations) of 'Alienation' across conditions of 'Group Norm' and 'Diversity' (standard errors in parentheses).*

	Pro-Diversity Group Norm	Pro-Uniformity Group Norm
Low diversity within the group	2.00 (1.13)	2.64 (1.52)
High diversity within the group	2.23 (1.34)	2.53 (1.70)

Next the general group functioning was examined using the same 2x2 ANOVA as the two previous analysis. No main effects or interactions were found with $F < 1$, ns. Mean levels of group functioning can be seen in Table 6.10.

Table 6.10. *Means (and standard deviations) of 'General Group Functioning' across conditions of 'Group Norm' and 'Diversity' (standard errors in parentheses).*

	Pro-Diversity Group Norm	Pro-Uniformity Group Norm
Low diversity within the group	4.83 (0.66)	4.93 (0.81)
High diversity within the group	4.50 (1.45)	4.87 (1.03)

Finally the SEWE score (representing the group's performance) was examined in the using the same 2x2 ANOVA. This analysis also failed to find any significant main

effects or interactions ($F < 1.5$, ns). Mean SEWE scores for each of the experimental conditions can be seen in Table 6.11.

Table 6.11. *Mean 'Survival in an Extreme Winter Environment' task scores across conditions of 'Group Norm' and 'Diversity' (Standard errors in parentheses).*

	Pro-Diversity Group Norm	Pro-Uniformity Group Norm
Low diversity within the group	47.9 (6.9)	47.3 (7.7)
High diversity within the group	48.0 (7.9)	44.2 (9.2)

Secondary Analysis

Due to the failure of the manipulation of 'Diversity' within this experiment, the analysis was run again, this time using the manipulation check variable 'Perceived Diversity', in the place of the dichotomous 'Diversity' independent variable. In order to do this each hypothesis was tested using multiple linear regression, rather than ANOVA.

In order to investigate the effect of 'Group Norm' and 'Perceived Diversity' on the dependent variable 'Alienation', a two step multiple linear regression was conducted. The first stage consisted of the model with 'Group Norm' and 'Perceived Diversity' as predictors of 'Alienation' and the second stage included the interaction term between 'Group Norm' and 'Perceived Diversity' within the model. The first model predicted 41.8% (Adjusted R^2 = .418) of the variance of 'Alienation' ($F(2,71) = 27.17$, $p < .001$) with a main effect for 'Perceived Diversity' (β = .642, $t(71) = 7.14$, $p < .001$) and no main effect for 'Group Norm' (β = .090, $t(71) = 1.01$, $p = .318$). With the inclusion of the interaction term the second model was able to predict 45.5% (Adjusted R^2 = .455) of the variance of 'Alienation' ($F(3,70) = 21.32$, $p < .001$). This second model had a significant improvement over the first with an increase of 4.4% (at stage 2, *R Squared Change* = .044) prediction of the variance of 'Alienation'. This change in R^2 was significant with, $F(1,70) = 5.88$, $p = .018$. These results suggest a main effect for 'Perceived Diversity' (β = .626, $t(70) = 7.18$, $p < .001$), no main effect for 'Group Norm' (β = .092, $t(71) = 1.05$, $p = .296$), and a significant interaction between the two (β = .210, $t(71) = 2.43$, $p = .018$).

To demonstrate this interaction graphically a median split was created so that scores were either 'Low Perceived Diversity' or 'High Perceived Diversity', this was then plotted

in *Figure 6.2*. As can be seen from these results and from *Figure 1*, those people who perceived there to be more diversity within their group were more likely to alienate somebody within that group. This however interacted with the norm of the group, such that when perceived diversity was high and there was an pro-uniformity group norm, alienation scores were higher than when there was a pro-diversity group norm. This same pattern was not evident however when perceived diversity was low, here group norm had little impact.

Estimated Marginal Means of Alienation
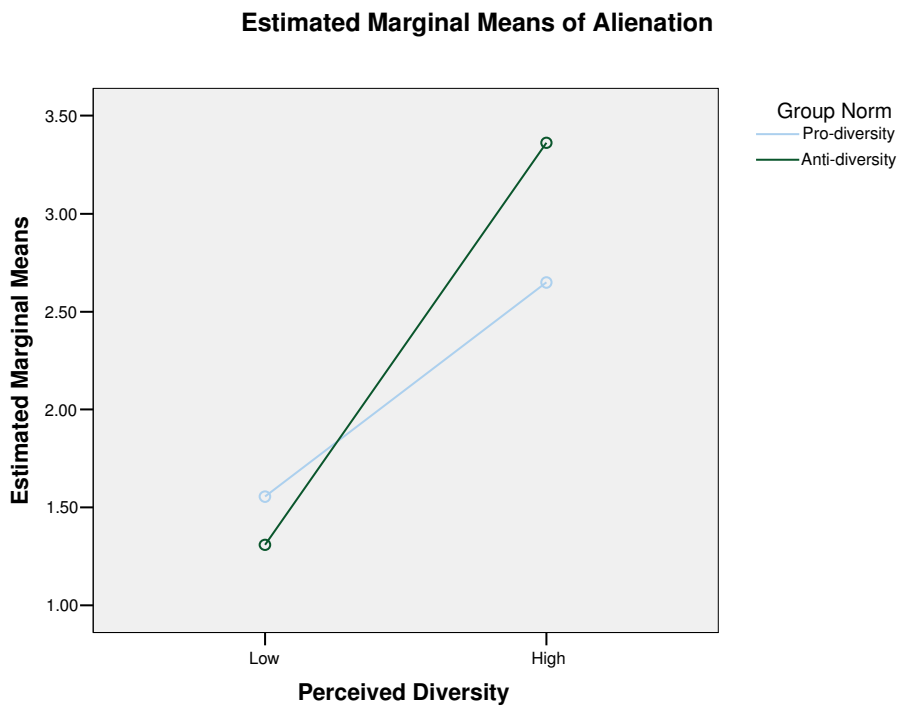
Figure 6.2. Alienation as a function of Group Norm and Perceived Diversity

The same multiple linear regression analysis was then used to test the other hypotheses. That is 'Group Norm' and 'Perceived Diversity' were used to predict 'Identification', 'Group Functioning', and 'SEWE Score', in three separate analyses. However, none of the models tested were significant predictors of the relevant dependent variables. Through the measure of alienation alone then, there is some evidence that pro-diversity group norms lead to more effective outcomes under conditions when there is believed to be diversity amongst group members.

6.3.3 Discussion

The experiment was designed to assess in a more controlled environment, the relationships between group diversity, group norm, group identification and group functioning. In the experiment actual group diversity as well as the group norm (pro-conformity vs. pro-diversity) were manipulated. The impact of these independent variables and the interaction between them on identification, group functioning and performance was assessed.

It was clear that the manipulation of group diversity and group norm were not successful however. It is possible that the group norm manipulation may have played a role in affecting the manipulation of group diversity. When all group members were shown to have endorsed the relevant group norm, effectively all members (irrespective of their style of thinking) behaved in similar ways as members of one group. It is also the case that the study had many different components that could have weakened the central psychological manipulations especially by the time participants completed the Survival in an Extreme Winter Environment task and completed the main dependent measures. Nonetheless using a quasi-experimental design where measured (rather than manipulated) variables of perceived diversity and group norm were used, some evidence to support the main hypotheses was found. In particular where there was a high level of perceived diversity less alienation was evident where there was a pro-diversity rather than a pro-conformity group norm. The norm of the group appears to be critical to the success of groups where there are certain types of diversity. In order to explore these points further an additional experimental study was devised using a simpler vignette-type procedure.

6.4   Study 4: Diversity Norms and group functioning

In order to investigate further the relationships between group identification, group diversity, group norms and group functioning, a second laboratory study was devised. This study was designed to investigate the same issues as the previous study, but in a more simplistic way. This time however a slightly different set of group functioning variables were used than in previous work outlined in the thesis. It was considered that these represented a broader range of aspects of group functionality. This included factors such as cooperation, communication, organisational citizenship behaviour and group efficacy. In addition, to simplify the experimental design further, the study had only two between group conditions; one in which the group had a pro-diversity group culture and the other in which

there was an pro-uniformity culture. Both groups now had high levels of subgroup and individual diversity. The hypotheses were the same as those in the previous laboratory experiment.

The following predictions were made in this study.

It was predicted that groups with a "pro-diversity norm", would be more likely to have higher levels of group identification and more positive group outcomes. Group outcomes were assessed in this study using a range of measures including pro-social organisational citizenship behaviour, group decision making processes, group efficacy and group effort.

6.4   Method

Participants and Design   Seventy two people participated in this study in exchange for an ice-cream voucher. Participants were recruited outside the ANU refectory with the offer of the ice-cream in exchange for ten to fifteen minutes worth of participation. Participation took place at the table where they were recruited and was supervised by the experimenter. The mean age of participants was 21.9 (standard deviation of 0.6) and of the participants twenty eight were men and forty four were women.

Participants were randomly assigned to one of the four between subjects experimental conditions, with a 2(Diversity Norm) X 2(Order of alienation measures) design. In addition to this design, for the dependent variable of "Alienation", there was a two level within-subjects factor, with the two levels of the design being "subgroup alienation" and "individual alienation". This factor will be referred to as "Target of Alienation".

Procedure   To begin with, participants read a short consent form containing information about this study and then indicated their informed consent by signing the form.

They were then randomly assigned to an experimental condition and given the appropriate vignette questionnaire booklet. Participants then read through the scenario presented in the first part of the booklet and answered the questions in the second part. Once participants completed the questionnaire, they were thanked for their time, given an information sheet about the research and then given a redeemable $3 ice cream voucher.

Materials   Materials used in this study included a consent form, four different types of questionnaire booklet (one for each of the experimental conditions), and an information sheet.

The questionnaire booklet contained two sections, the first section outlined the scenario and the second contained the measures of the dependent variables.

The scenario was described by means of a vignette at the beginning of the booklet. To begin with participants were asked to imagine themselves in what was described as a hypothetical scenario. They were told that the situation would be about a recreational expedition group of which they were to imagine themselves as being a part. Next participants were told about the expedition. In this vignette the expedition was described as being organised by a company called "Live Your Life Expeditions" (LYLE) which runs trips to remote yet beautiful areas of Australia. The current expedition was described as running for 14 days and involved camping, hiking, kayaking and caving.

The next part of the vignette described the people on the expedition. Participants were told that there were nine expedition members including themselves. They were told that two of the expedition members were from LYLE; the expedition leader Matt and his assistant James. They were then told that the other group members were four men and two women, all of a similar age to the participant. The group was then described visually as can be seen in *Figure 6.3* with the visual distances between members representing social distances.
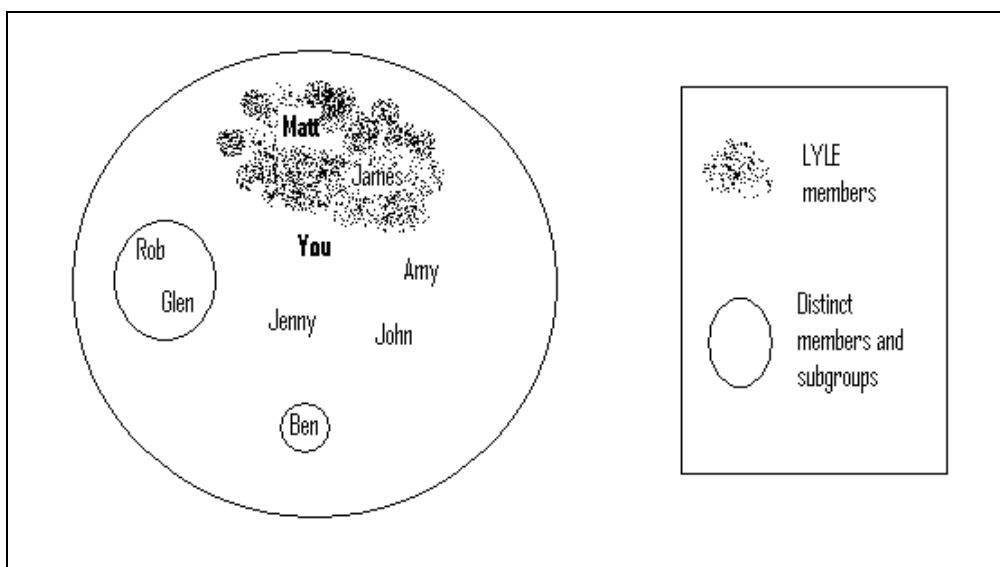
Figure 6.3. The visual description of the LYLE expedition group.

At this point in the vignette the manipulation of the within subjects variable "Target of Alienation" was introduced. Visually it was apparent that there was a distinct subgroup of two members (Rob and Glen) and an individual (Ben) who seemed further apart than the other group members. This was described in the vignette in the following way.

> *"As shown in this diagram, not all expedition group members are close to one another. Rob and Glen, who have much prior experience of expeditions such as this tend to spend a lot of time together and do not mix much with other members of the expedition group. Also Ben, who seems to have much stronger personal, individual goals for the expedition, spends a lot of time on his own reflecting about things."*

This passage in conjunction with the diagram was intended as an operationalisation of the "Target of Alienation", with the potential target of "subgroup alienation" being Rob and Glen and the potential target of "individual alienation" being Ben. Both subgroup and individual were highlighted as having a high degree of social distance from other people and were described as being normatively (or descriptively) distinct.

The next part of the vignette contained the manipulation of the between subjects variable "Diversity Norm". This was done by having the participants read an excerpt from the group leader, Matt's journal. This passage was introduced as the group leader's journal and they were told that this would give them insight into how the group functions as well as its strengths and weaknesses. The journal was intended to give the participant a sense of what the group's norms, and culture was like with respect to whether they valued diversity or conformity. There were two versions of the journal, with one intended to create a sense of a group that valued diversity (pro-diversity norm) and the other for valuing conformity (pr-conformity norm). Half of the participants received the "pro-diversity norm" journal entry the other half received the "pro-conformity norm" journal entry.

In the passages used to manipulate the group norm, key phrases were changed to reflect the different conditions. For example in the "pro-diversity" norm condition the group was described as valuing the different opinions and diversity of members, while the pro-conformity group was described as reaching decisions quickly and valuing conformity amongst members. In the pro-diversity group, it was also stated that people often voiced different opinions, where as in the in the pro-conformity group, it was stated that people were more focused on reaching agreement than voicing their own opinions. Passages for

both the conditions were phrased in such a way as to avoid one seeming more positive or effective than the other.

This marked the end of the vignette and the beginning of the second part of the booklet. The second part contained a series of statements, to which participants indicated their extent of agreement or disagreement. This was done by way of a Likert scale ranging from one to seven, with one representing "disagree completely" and seven representing "agree completely". This section was introduced by asking participants "In light of these comments, what are your views about this group?" and then asked them to circle the number which reflected their feelings about the group. Each question was designed to measure one of the dependent variables, with most dependent variables having multiple questions. The dependent variables measured and their corresponding questions can be seen in Table 6.12.

Table 6.12. *Variables and Items used in Study Three*

Variable	Item
Manipulation of Diversity Norm	-*"I think that this is a group that values diversity above conformity"*
	-*"I think that this group would be open to new ways of doing things"*
Endorsement of Group Norms	-*"It seems as if people in this expedition group are able to voice their opinions freely"*
	-*"It seems that people in this expedition group can readily disagree in order to solve problems"*
	-*"It seems that in this expedition group important differences are being glossed over and ignored"* (reverse coded)
	-*"It seems that in this expedition group everyone is forced to think the same way"* (reverse coded)
Identification with the expedition group	-*"I identify with other members of this expedition group"*
	-*"I am like other members of this expedition group"*
	-*"I am proud to be a member of this expedition group"*
	-*"I respect the people who are on this expedition group"*
	-*"I think I will fit in well in this group"*
	(These items were adapted from Ellemers, Kortekaas & Ouwerkerk, 1999)
Group Functioning - Decision Making	*"It seems that this expedition group provides opportunities for members to participate in meaningful discussion"*
	-*"It seems that this expedition group allows everyone's "voice" to be heard during decision making"*

Group Functioning - Success	-"This expedition group would be successful in achieving its goals"
Group Functioning - Efficacy	- "This expedition group would be able to adapt to new situations" -"This expedition group would be able to deal effectively with an emergency situation"
Group Functioning - Cooperation	- "When solving problems, this group of people are very good at cooperating with one another" "The people on this expedition would feel very motivated towards doing things for one another"
Group Functioning - Communication	"The people on this expedition group would be very good at communicating with each other".
Group Functioning – Importance	- "The expedition group is very important to all its members"
Group Functioning – Organisational Citizenship Behaviour	- "If a member of this expedition group saw a problem with the way work was being done, they would call attention to it" -"Members of this expedition group would put the group's interests above their own"
Group Functioning – Effort	-"When working with other group members, people from this expedition would put in as much effort as possible".
Leadership	-"This expedition group would be a good one to lead" -"On this expedition the leader would often be challenged in this group" -"On this expedition the leader would get quality input from group members during decision making"
Alienation - Individual	-"Ben would feel included as part of this expedition group" -"Ben would be valued as a member of this expedition group" -"People on this expedition would help Ben out" -"On this expedition Ben's knowledge, skills and abilities would be fully utilised"
Alienation - Subgroup	-"Rob and Glen would feel included as part of this expedition group" -"Rob and Glen would be valued as members of this expedition group" -"People on this expedition would help Rob and Glen out" -"On this expedition, Rob and Glen's knowledge, skills and abilities would be fully utilised"
Group member satisfaction	-"I personally would be very willing to join an expedition like this one" -"I personally would find an expedition like this very enjoyable"

The part of the questionnaire concerning the alienation measures included the manipulation of the other between subjects factor "Order of alienation measures". This manipulation was done by having half of the participants answering the "individual

alienation" questions first and the other half answering the "subgroup alienation" measures first.

Finally the questionnaire contained a number of demographic variables, which measured participants "experience with camping expeditions", "age" and "gender". The last line of the booklet simply thanked participants for their time and effort.

6.4.2   Results

Scale Reliability   Scales for each of the dependent variables were constructed using the items described. For most of the variables, scale reliability was very high, with the majority of the Cronbach's Alphas ranging between α = .84 and .96. Cronbach's Alphas for each of the scales can be seen in Table 6.13. (Note: the third and fourth "endorsement of norms" items were reverse scored).

There were however problems with both the "group functioning" scale and the "leadership" scale. "Group functioning" was problematic in that despite having a high Cronbach's Alpha (.85), conceptually there were quite different elements within the Scale. Because of this Reliability was assessed for each of the subscales. Only two of the subscales had multiple items; these were "efficacy" and "organisational citizenship behaviour". Both of these subscales had low Cronbach's Alphas however (α = .45 and α = .10 respectively), and so individual items were treated as separate subscales. This was done as it was thought that each of the four items considered unique aspects of group functioning. These new variables will be referred to as "efficacy 1", "efficacy 2", "OCB 1" and "OCB 2". Analysis was conducted on both the "group functioning" scale and all of its subscales.

"Leadership" however was problematic with a low α of .50. A marginal improvement was found by dropping the first item from the scale (α = .68). On closer inspection it was considered that the second and third items related to a leader's input from group members, where as the first item referred to a more general sense of leadership effectiveness. Because of this leadership was treated as having two subscales, "leadership 1" (effectiveness) and "leadership 2" (group input).

Table 6.13. *Reliability of Scales and Subscales*

Multiple Item Scales	Number of Items	Cronbach's Alpha
manipulation check	2	.85**
endorsement of norms	4	.85**
ingroup identification	5	.87**
group member participation	2	.95**
group functioning	9	.86**
efficacy	2	.45
organisational citizenship behaviour	2	.10
leadership (original)	3	.50
leadership 2	2	.68*
individual alienation	4	.84**
subgroup alienation	4	.85**
satisfaction	2	.91**

** indicates high reliability, * indicates medium reliability

Primary Analysis

A 2(Diversity Norm) X 2(Order of alienation measures) ANOVA was carried out for each of the dependent variables and statistics can be seen in Table 6.14. As can be seen from the table, there were no significant main effects for "Order", however there was one significant interaction between "Order" and "Diversity Norm" for "effort" which will be discussed later. "Order" will not be discussed any further for the other variables however, due to the lack of main effects and interactions (All Fs close to or less than 1). The following section will deal with differences across the "Diversity Norm" conditions for each of the dependent variables in turn.

Table 6.14. *Results from 2(Diversity Norm) X 2 (Order of alienation measures) analysis of variance for each of the dependent variables.*

Dependent Variable	"pro-diversity norm" Mean (standard deviation)	"conformity norm" Mean (standard deviation)	$F(1,68)$ "Diversity Norm"	$F(1,68)$ "Order of alienation measures"
manipulation check	5.5 (0.2)	2.6 (0.2)	127.6**	1.1
endorsement of norms	5.4 (0.1)	2.9 (0.1)	183.6**	1.7
ingroup identification	5.1 (0.2)	3.4 (0.2)	51.1**	0.0
group decision making	5.5 (0.2)	2.7 (0.2)	87.1**	0.0
group functioning	4.8 (0.1)	3.4 (0.1)	43.5**	0.1
leadership 1	4.4(0.3)	3.9(0.3)	1.3	0.1
leadership 2	5.6(0.2)	2.9(0.2)	121.0**	1.5
individual alienation	4.3(0.2)	3.1(0.2)	19.6**	0.4
subgroup alienation	4.9(0.2)	3.7(0.2)	18.5**	0.2
satisfaction	4.9(0.2)	2.8(0.2)	55.8**	0.2

* indicates significance at $p < .01$, ** indicates significance at $p < .001$

A significant difference was found between conditions, with those in the "pro-diversity" groups scoring higher on the manipulation check than those in the "conformity" groups, with means of 5.5 (0.2) and 2.6 (0.2) respectively. This indicated that the "pro diversity" group perceived their group to have more of a pro-diversity norm than the "conformity norm" group. This confirms that the manipulation of the "Diversity Norm" was successful.

Results from a comparison of the "pro-diversity" condition and the "pro-conformity" condition, indicate that participants endorsed the norms appropriate to their experimental condition. The mean level of "endorsement of norms" for the "pro-diversity" groups was higher than for the pro-confmity groups (Ms and standard deviations (in brackets): 5.4 (0.1) and 2.9 (0.1), respectively). (Note: Higher scores represented greater endorsement of the pro-diversity norm and lower scores greater endorsement of the conformity norm).

For "ingroup identification" a significant difference was found between these "pro-diversity" groups and the "conformity" groups (Ms and standard deviations (in brackets):

5.1 (0.2) and 3.4 (0.2), respectively. This suggests that people identified more strongly with a group that had a pro-diversity norm compared to one with a conformity norm.

This pattern of results was also found for "group decision making" in that those in "pro-diversity" groups had a higher degree of participation than the "conformity" groups (Ms and standard deviations (in brackets): 5.5 (0.2) and 2.7 (0.2), respectively). This suggests that groups with a pro-diversity norm are more likely to have members that participate actively in decision making.

General "group functioning" was found to be higher for groups with a pro-diversity norm compared to those which had a conformity norm (Ms and standard deviations (in brackets): 4.8 (0.1) and 3.4 (0.1), respectively). This pattern was found for all of the "group functioning" subscales except for "efficacy 2", "cooperation" and "OCB2". Comparative means for each of the subscales can be seen in Table 6.15 as well as the results of the ANOVA. These results suggest that under conditions where there is individual and sub-group diversity, groups with a pro-diversity norm function better than those with a conformity norm.

Table 6.15. *Results for "group functioning" subscales 2(Diversity Norm) X 2(Order of alienation measures), analysis of variance.*

Group Functioning Subscale	"pro-diversity norm" Mean (standard deviation)	"conformity norm" Mean (standard deviation)	$F(1,68)$ "Diversity Norm"	$F(1,68)$ "Order of alienation measures"
success	5.2 (0.2)	4.2 (0.2)	9.8*	1.3
efficacy 1	5.3 (0.2)	3.3 (0.2)	49.3**	0.2
efficacy 2	4.1(0.3)	4.3(0.3)	0.4	0.6
cooperation	4.8(0.3)	4.3(0.3)	2.0	0.2
motivation	4.3(0.2)	3.2(0.2)	12.7**	1.6
communication	4.7(0.2)	2.3(0.2)	76.0**	0.0
OCB1	5.8(0.2)	2.3(0.2)	185.2**	0.0
OCB2	4.0(0.3)	4.0(0.3)	0.0	0.1
effort	5.0(0.2)	3.2(0.2)	37.1**	0.2
general group functioning	4.8 (0.1)	3.4 (0.1)	43.5**	0.1

* indicates significance at p < .01, ** indicates significance at p < .001

As mentioned earlier there was a significant interaction found between "Diversity Norm" and "Order of alienation measures" for the group functioning subscale "effort", $F(1,68) = 4.4$, $p < .05$. The interaction was such that the magnitude of the difference between "pro-diversity" and "conformity" groups (in terms of effort), was greater when people, answered questions about "subgroup alienation" before items about "individual alienation". However as the questions regarding alienation were both after the question regarding "effort", this suggests that either participants had looked ahead and this finding does have something to do with subgroup diversity or is a finding due to random factors.

For the first measure of leadership (leadership 1), no significant difference was found between those with a pro-diversity norm and those with a conformity norm (Ms and standard deviations (in brackets): 4.4 (0.3) and 3.9 (0.3), respectively). This suggests that participants thought that the effectiveness of leadership would be similar in both groups. However, in terms of how much input a leader would get from the rest of the group, participants perceived the leader of a pro-diversity group to receive more input than a group with a conformity norm (Ms and standard deviations (in brackets): 5.6 (0.2) and 2.9 (0.2), respectively).

The general trend of positive outcomes for groups with a pro-diversity norm was continued with "satisfaction", with groups that were "pro-diversity" having higher levels of satisfaction (Ms and standard deviations (in brackets): 4.9 (0.2) and 2.8 (0.2), respectively). This suggests that people find being in a group which values the diversity of its members more satisfying than groups which value conformity.

The alienation of individuals was shown to be lower for groups which had a pro-diversity norm (Ms and standard deviations (in brackets): 4.3 (0.2) and 3.1 (0.2), respectively). This was mirrored in the alienation of subgroups, with groups which valued diversity having decreased levels of alienation (Ms and standard deviations (in brackets): 4.9 (0.2) and 3.7 (0.2), respectively. (Remember that high scores on both of these scales indicate decreased levels of alienation).

In addition to this a 2(Diversity Norm) X 2 (Order of alienation measures) X 2(Target of Alienation) mixed factorial analysis of variance was carried out, with "Target of Alienation" being the within subjects factor. A significant main effect for "Target of Alienation" was found such that people were more likely to alienate an individual than a subgroup (Ms and standard deviations (in brackets): 3.7 (0.1) and 4.3 (0.1), respectively

$F(1,68) = 18.9$, $p < .001$). A significant main effect was also found for "Diversity Norm", with groups that had a pro-diversity norm less likely to alienate people in general than those with a conformity norm (Ms and standard deviations (in brackets): 4.6 (0.2) and 3.4 (0.2), respectively; $F(1,68) = 25.4$, $p < .001$. There was no significant main effect for "Order of alienation measures" and no interactions between any of the independent variables, with all Fs < 1. The pattern of results for this can be seen in *Figure 6.4*.
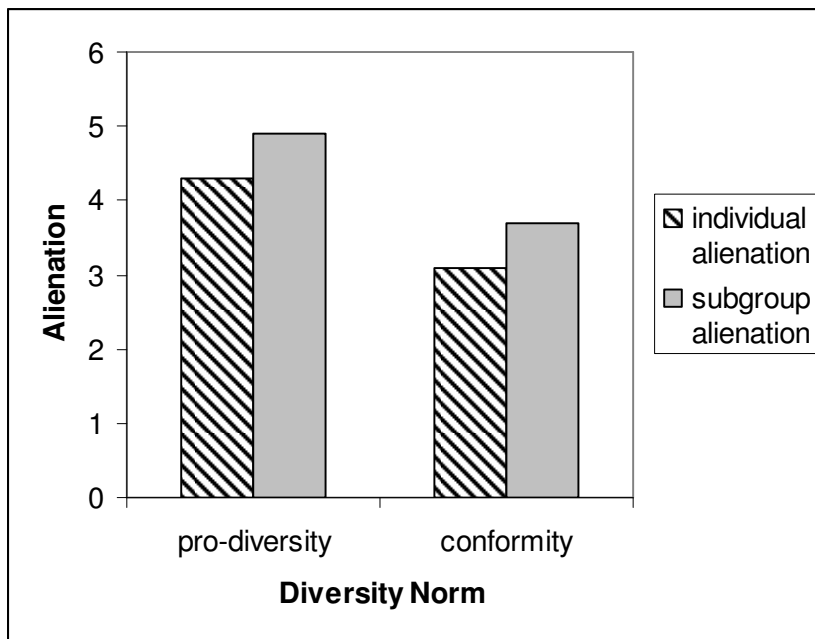
Figure 6.4. Mean levels of alienation across "Target of alienation" and "Diversity Norm". (Higher scores represent lower levers of alienation)

In order to assess how some of the key dependent variables related to one another, a correlation analysis was conducted. The results of this can be seen in Table 6.16.

Table 6.16. *Correlations between key dependent variables*

Variable	1.	2.	3.	4.	5.	6.	7.	8.
1. endorsement of norms	-							
2. ingroup identification	.67**	-						
3. group functioning	.70**	.64**	-					
4. leadership 1	.08	.36**	.44**	-				
5. Leadership 2	.80**	.66**	.60**	.12	-			
6. individual alienation	.55**	.46**	.64**	.38**	.47**	-		
7. subgroup alienation	.57**	.42**	.57**	.26*	.52**	.61**	-	
8. satisfaction	.64**	.69**	.67**	.35**	.68**	.567**	.52**	-

* indicates correlation is significant at p <.05. ** indicates correlation is significant at p < .01.

As can be seen from Table 6.16, all the variables are highly related, but the correlations are not so strong as to suggest these are all measures of the one factor. Based on the social identity perspective it would be argued that it is one's psychological connection to the group that would be associated with a range of positive group outcomes. Furthermore, work to date on group norms would suggest that group diversity and a pro-diversity norm would be associated with positive outcomes. In order to investigate the degree to which psychological identification mediates the relationship between a pro-diversity norm and group functioning, mediation analyses were conducted.

Mediation analysis is conducted by way of regression analysis, where by a two stage regression model is constructed. In the first stage of the model the primary predictor variable (in this case "the diversity norm") is used to predict the dependent variable. In the second stage, the mediator variable (in this case "identification" with the expedition group) is introduced into the model as a second predictor variable. If the effect of the first predictor variable is no longer present in this second model, then complete mediation is said to occur. In this case all of the variability of the dependent variable that was explained by the first predictor variable in the first model could actually be explained by variability of the second predictor variable. Partial mediation occurs when there is a significant reduction in the effect of the first predictor variable on the dependent variable, but where the first predictor variable still has a significant effect on the dependent variable. A Sobel test is used to assess if the change in the effect of the first predictor variable is significant between the two stages of the regression model.
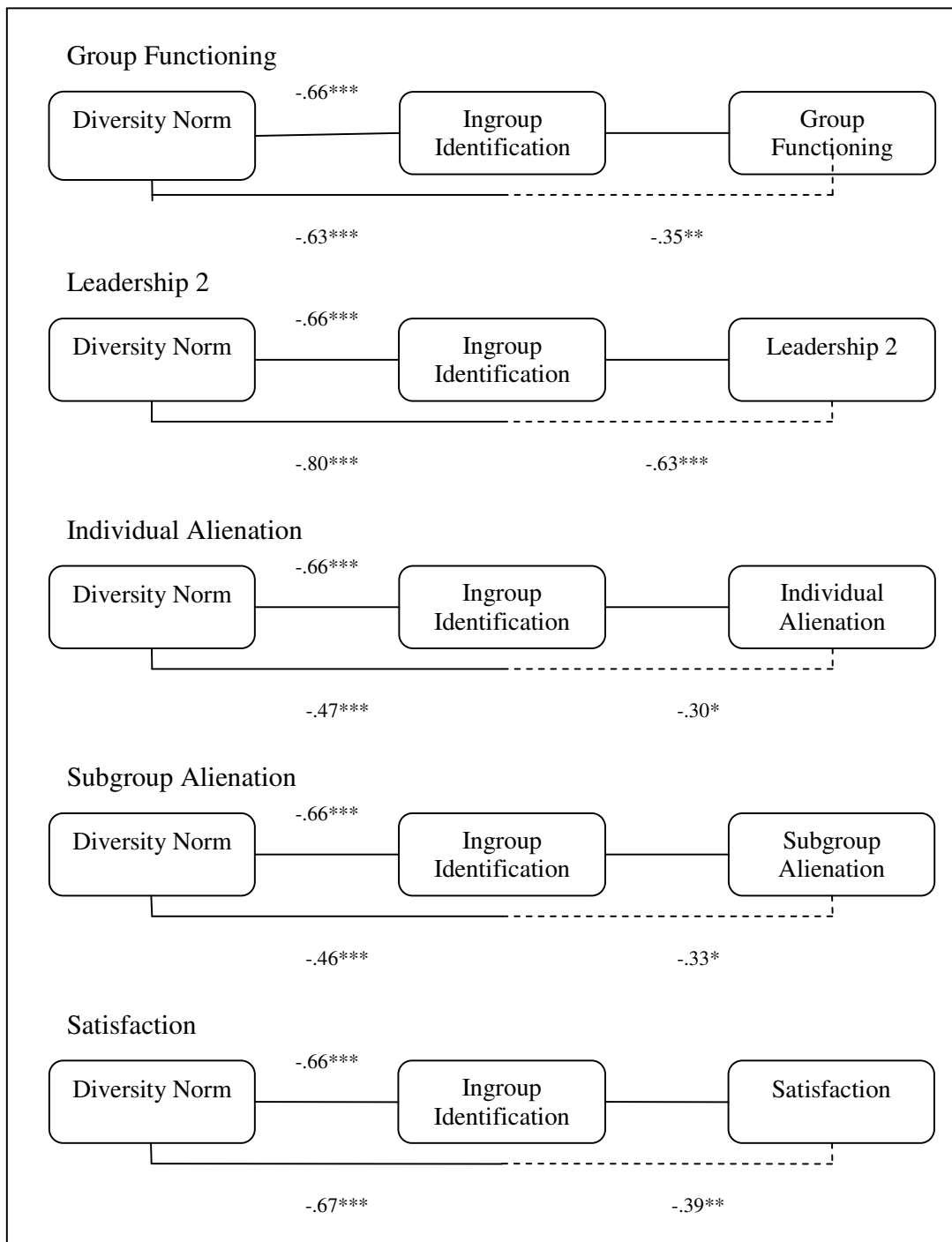
So in this study if mediation occurs, it would mean that the effect of the pro-diversity norm is simply to increase ingroup identification which in turn improves group functioning. The results of the mediation analysis conducted in this study can be seen in *Figure 6.5*. In this figure Beta coefficients are used to demonstrate the strength of relationships, the dotted line represents the effect of the diversity norm on the outcome variables once identification with the expedition group has been included in the model. Explanation of these results follows.

A Sobel test for mediation found partial mediation of the effect of "Diversity Norm" on "group functioning" by "ingroup identification", with $z = -3.21$, $p < .001$. This suggests that a certain proportion of the positive benefit of having a "pro-diversity norm" on group functioning, was related to people identifying more strongly with that kind of group.

A similar, but weaker mediation was found for the effect of "Diversity Norm" on "leadership 1" by "ingroup identification". A Sobel test found $z = -2.51$, $p < .05$. This indicated that a small degree of the effect of the manipulated diversity norm on perceptions of how much input leaders had from their group was in fact due to people having a higher degree of ingroup identification.

Partial mediation was also found using a Sobel test for "Diversity Norm" on "satisfaction" with $z = -3.58$, $p < .001$. This suggests that part of the benefit of the pro-diversity norm, was actually due to higher levels of ingroup identification.

A Sobel test found only marginally significant mediation for the relationships between "Diversity Norm" and either "individual" or "subgroup" alienation by "ingroup identification, with $z = -1.89$, $p = .06$ for individual alienation and $z = -1.46$, $p = .14$ for sub-group alienation. This suggests that the decreases in alienation from having a pro-diversity norm were not entirely due to higher levels of identification with the expedition group. This result provides a key piece of evidence for the importance of a pro-diversity norm to preventing group fragmentation and signifies that ingroup identification serves, at least, in part as an important mediating variable.

Group Functioning

Diversity Norm —— -.66*** —— Ingroup Identification —— Group Functioning

-.63*** -.35**

Leadership 2

Diversity Norm —— -.66*** —— Ingroup Identification —— Leadership 2

-.80*** -.63***

Individual Alienation

Diversity Norm —— -.66*** —— Ingroup Identification —— Individual Alienation

-.47*** -.30*

Subgroup Alienation

Diversity Norm —— -.66*** —— Ingroup Identification —— Subgroup Alienation

-.46*** -.33*

Satisfaction

Diversity Norm —— -.66*** —— Ingroup Identification —— Satisfaction

-.67*** -.39**

*indicates significance at p < .05. ** indicates significance at p < .01. *** indicates significance at p < .001*

Figure 6.5. Mediation of the effect of "Diversity Norm" by "ingroup identification" on key variables.

6.4.3   Discussion

This study found strong evidence in support of the core predictions of the thesis. The groups were structured to have individual as well as sub-group diversity. Under these conditions, it was those groups that were defined by a pro-diversity versus a pro-conformity norm that performed better on a range of group functioning measures (e.g., effort, pro-social citizenship behaviours, communication, and motivation). They were also shown to have lower levels of alienation in terms of the ostracism and exclusion of different individuals and subgroups. Ingroup identification was also higher in the pro-diversity compared to the pro-conformity condition These results show strong support for the notion that where there is likely to be group diversity, a pro-diversity culture has a range of benefits and seems to counteract the negative effects usually associated with diversity.

One possibility that arose during this study was that benefits to group functioning in the pro-diversity condition was simply a result of people "liking" the group with the pro-diversity norm more and hence identified more strongly with it. The meditational analysis demonstrated though that the effect of the diversity norm on various aspects of group functioning was partially, or fully, related to increased identification with the expedition group. With respect to alienation, the norm of the groups seemed to be particularly important to this aspect of group functioning. The pro-diversity norm affected alienation independently of its benefits to group identification.

These findings allow us to draw two strong conclusions. The first is that in the face of group diversity, groups with a "value in diversity" norm or culture are likely to have increased group identification and that this in turn will lead to improved group functioning. The second conclusion is that a "value in diversity" norm in the face of actual information that makes certain group differences explicit can avoid some of the pitfalls associated with such groups.

While the results of this study were statistically very strong, there were a number of important limitations. The first, as discussed earlier, was the lack of ecological validity. It involved a brief vignette study undertaken by university students. The second limitation is more subtle. As this study simply asked people how they thought their group would function, the focus was on participants' opinions about how they thought their group would function hypothetically. While there are obvious differences between this study and the very real and highly meaningful experience of an ICE environment it is the psychological processes that underpin such results that are common to both settings. Previous work

reported in earlier chapters has already highlighted that these same variables are evidebnce and can be assessed in more naturalistic field settings. These findings in combination with previous work, point to the importance of considering ingroup identification, group norms and broader definitions of diversity in understanding group processes.

Perhaps, most relevant for both the social psychology and the spaceflight literature, group norms appear to be critical to group functioning. The shared norms, values and beliefs that define a social identity are critical to certain group behaviours. The implication is that theory and research on group diversity needs perhaps to more explicitly address the role of group norms and associated processes of group identification on influencing group effectiveness.

6.4   General Discussion and Conclusion

In Chapter 3, the importance of identity processes to group behaviour was introduced and in the main the evidence from the three studies presented in the present chapter has supported this work. In Chapter 5, literature was presented which argued that diversity had the potential to fragment social groups and it was suggested that one way to deal with this was through the development of a pro-diversity culture (Tyler & Blader (2000); van Knippenberg & Haslam (2003); van Knippenberg, Haslam & Platow (2004). Taken together the studies presented in this chapter provided evidence for a "value in diversity" model for solving the problem of crew heterogeneity in general and perhaps in the space flight context. Study 2 provided further evidence that identification processes and associated outcomes could be reliably assessed and that the pattern of relationships between variables was as would be expected based on previous social psychology theory and research. In particular, group identification and measures of individual and sub-group alienation were significantly and strongly related. These alienation measures are taken as an indicator of a group's success with dealing with conflict and diversity and also an indicator of negative group outcomes. Study 3 also showed that in the context of diversity amongst group members, a group norms where such diversity is valued and group defining had an impact on group outcomes. Again alienation was less likely where diversity was made explicit in the group but there was a pro-diversity compared to a pro-uniformity group norms.

Study 4 provided stronger evidence of these same patterns but using broader measures of group functioning that included alienation as well as decision-making and

organisational citizenship or pro-social behaviour. Building on the outcomes and limitations of earlier work in this thesis, Study 4 in this chapter provided the strongest evidence yet to support the core hypotheses of the thesis. Not only were there strong relationships between group norm (pro-diversity or pro-uniformity) and group functioning measures there was evidence that such relationships were related to the level of psychological connection between the individual and the group. In this way, as predicated social identity processes were demonstrated to play an important role. Ideally, given the aim of the thesis to demonstrate these group processes at work in the spaceflight context, these same variables would be shown to be important and related in a more naturalistic setting. The next chapter outlines such a study which was conducted during a winter-over period at an Antarctic research station.

- Chapter 7 -

Diversity Culture in Antarctica: A Winter Over Study at the Concordia Research Station

7.1   Introduction

In the last chapter three studies were described that investigated how the content of a social identity, in this case an identity which valued the diversity of group members, impacted on ingroup identification, levels of alienation and various other aspects of group functionality. The third study described in the last chapter found strong statistical evidence for the predicted effects; however because this study was a vignette it had very low ecological validity. The first study described was the only one of the three studies which did have high ecological validity, but the small sample size and data set, meant that statistical inferences making was somewhat problematic. The conclusion of the last chapter was that in order to find significant evidence for the importance of identity processes in extreme environment situations and the potential benefits of diversity cultures, a study which had high ecological validity and a large data set was required. The current chapter outlines such a study, which was conducted during the Antarctic winter of 2006, at the Concordia research station.

Antarctic research stations during the winter over period provide one of the most ideal places on Earth to conduct psychological space analogue research (Suedfeld & Weiss, 2000). People at these stations experience long-term geographic isolation; they live in confined habitats, have small group sizes, are exposed to real physical dangers, are psychological screened prior to embarkation, and undertake scientific and technical activities similar to those conducted during space flights. For all purposes they represent a true isolated confined extreme environment. In almost every way, space psychology studies conducted in these environments have higher ecological validity than anywhere else on Earth.

Due to the scarcity of research stations that are crewed during the winter-over period, it is also extremely difficult to get access to conduct psychological research. Generally research proposals need to be submitted a number of years in advance and are thoroughly screened and assessed on their merits. In order to conduct the study presented in this chapter, a proposal was submitted for review to a committee within the European Space Agency (ESA). The Concordia research station was built by the French Polar Institute and Italian Antarctic Programme for the purpose of conducting space related research; however research there is managed by the ESA. The process to be included in the 2006 research program was competitive with only a small number of studies selected. The study presented in this chapter therefore represents a very rare opportunity to conduct psychological research in such an excellent space analogue context.

In order to take full advantage of this opportunity, the fifth study of the thesis was devised in such a way as to utilise some of the newest and most advanced statistical tests available. By doing this it was hoped that the data could be interpreted in an effective and statistically robust way. As in the first and second study, this data set would be non-independent, meaning that standard statistical testing could not be conducted. Unlike the second study however the eight month winter-over period provided an opportunity to collect data on many occasions. So like in the first study of the thesis, Multilevel Linear Modelling could be used to model relationships between variables. In addition to this however, another technique was utilised which takes full advantage of the interdependencies within the data set. This technique is Social Network Analysis and involves the quantification and modelling of network data. In other words it models the relationships between different individuals and can be used to understand the social structures that exist within groups.

Social Network Analysis is not new to extreme environment research and an example can be seen in the research by Johnson, Boster, and Palinkas (2003). The present study however will be the first time that such a technique has been used to explicitly document identity processes in an extreme environment. It will also be the first time that any major social psychological theory has been attempted to be modelled using social network techniques in an ICE environment (see also Copeland, Reynolds & Burton, 2008 for the use of such techniques in an organisational sample).

Network data is different from traditional data sets as it is comprised of "ties" between agents within a network. A social network it is made up of relational data and

describes the nature of the connections between individuals in the domain of interest. These connections can describe a range of constructs often including communication, trust, friendship and cooperation. In its basic form network data allows for these connections to be graphed so that the relationships can be viewed and interpreted visually. This use of social network techniques allows for the observation of social structures, without detailed quantification. More advanced methods of interpreting social networks have also been developed however. Hanneman and Riddle (2005) for example describe a range of ways that social relations can be modelled using Social Network Analysis. They use network structures such as "global coherence" to develop advanced statistical models. A globally coherent network for instance can be described as "one that forms a single group composed of a unitary core and periphery and lacks clearly defined cliques or subgroups" (Johnson, Boster, & Palinkas, 2003, pg 98). Using Social Network Analysis, it is possible to build statistical models in which a variable (such as diversity culture), can be used to predict social structures like global coherence. In this way it provides an opportunity to measure and analyse group dynamics on an interpersonal and group level. For isolated groups of continuously interacting individuals, such as is found in Antarctica, this methodology can effectively be used to answer social psychological questions.

In the context of the current research, both ingroup identification and the extent to which a group has a pro-diversity culture can be used to predict social network structures over time. Research from social identity theory and self categorisation theory suggests that groups within which members identify highly with their group tend to be more functional (in term of factors such as cooperation, trust, communication), if this is the case it would be expected that these groups would have a higher number of ties between individuals in these domains. So for example a network showing cooperation ties between individuals, would have more connections if those individuals all identified with their common ingroup. In this study as we are only studying one particular group, these effects can be expected to be observed over time.

From the literature reviewed in Chapter 5 and the findings from Chapter 6 we would also expect similar findings in relation to diversity culture. For example when the expedition group endorsed a pro-diversity norm we would expected it to have less fragmentation (isolated individuals or subgroups) within networks that describe pro-social relationships. In this way a social network analysis enables us to measure the impact of

these social psychological variables on the relationships between individuals and to observe the effects on relational structures.

In addition to non-relation variables (variables which do not indicate ties between individuals) predicting network structures, one kind of network can be used to predict another. In the case of the current research, a network which shows which people think they are similar to one another could be used to predict which people socialise with one another. This kind of analysis would be particularly informative as it could demonstrate directly how perceptions of diversity impact upon group structures. In this way Social Networks Analysis can be used to model how different networks relate to one another within a given data set.

7.2   Study 5: The Concordia Antarctic Research Station

The study presented in the current chapter, was designed to utilise both Multilevel Linear Modelling and Social Network Analysis to continue on from the research conducted in Chapter 6. The research questions are essentially the same, but this time the study was conducted in a real ICE environment. What's more this environment had real cultural diversity as is often found during space missions, with half the crew being Italians and half French.

The following main hypotheses were investigated:

H1. Identification with the Concordia expedition group will be associated with positive group functioning.

H2. When the expedition group endorses a pro-diversity norm, levels of identification with the expedition group will be higher and group functioning will be improved.

7.2.1   Method

Participants   Nine of the ten crewmembers spending the winter at Concordia participated in this study. Four of these crewmembers were Italian and five were French. There were two women amongst the crew, both of whom participated in the study. One of the women was French and the other was Italian. All crewmembers were undertaking scientific work during their time at Antarctica.

Design   Two forms of formal analysis were planned for this study. The first was to apply Multilevel Linear Modelling (MLM) to investigate the relationship between the expeditions group's "Diversity Culture" and how strongly people identified with this expedition group. The second planned analysis was to use Social Network Analysis to investigate how both "Identification" and "Diversity Culture" impacted group functioning. Using this analysis it would be possible to generate models of the networks based on "Identification" and "Diversity Culture". Networks related to group functioning to be modelled in this way included the ties between individuals in regards to advice seeking, cooperation, socialisation, friendship, and perceptions of similarity. For each of these networks it would be expected that there would be more connections between individuals when identification with the expedition group was high and the group endorsed a pro-diversity norm. It would also be possible to see if there was a higher likelihood of individuals or subgroups being isolated within the networks when there was less of a presence of a pro-diversity norm. All these analyses would be possible through a longitudinal examination of the data. In that way the networks of the expedition group could be compared at different times.

In addition to these formal analyses, visual examination of the data was also planned in order to make full use of the data. The objective of this would be to observe how "Identification" and "Diversity Culture" levels changed over time and whether they corresponded to any changes to group functioning This part of the experiment was intended to be descriptive rather than inferential.

Unfortunately, around half of the Concordia crew declined to participate in this study after the first data collection point (2 weeks into the isolation period). Due to language difficulties and lack of direct communication channels, it was difficult to understand why participation rates dropped back but it is not unusual to have about 50% response rates in survey work. Because of this some of the planned analysis could not be carried out. There was enough data however to successfully carry out MLM in order to investigate the link between diversity culture and identification. While the planned social network analysis could not be undertaken to investigate the hypotheses, it was still possible to investigate these hypotheses more descriptively through a visual examination of the social networks at "Time 1" and by observing the pattern of responses over time.

Materials and Procedure   The questionnaire used in this study took the format of an excel file. Each participant had their own personalised version of the file. Before the study commenced, each participant had the opportunity to request the language of their questionnaire. Five of the participants requested that their questionnaire be in French and four requested that their questionnaire be in Italian. The original questionnaire was written in English and then translated into French and Italian. Translations were conducted by two PhD students from the School of Psychology at the Australian National University. Both were fluent in English and the language that they were translating into, and understood how to translate appropriate psychological terminology.

Before the study commenced, each participant submitted a password to the experimenter, so that their own personal Excel file could be password protected. Once completed, personal files were emailed to each of the participants. Before commencing the study, the participants were informed of the content of the study and signed an informed consent form.

An initial research schedule was agreed upon between the experimenter and the expedition Doctor (who acted as the administrator of all psychological testing during the expedition), with data collection points spaced two weeks apart. The first measurement took place two weeks into the isolation period on the 22nd of February 2006. A decline in the numbers completing the questionnaire however lead to data collection points being spaced every month during the later months of the study. The last data was collected on the 27th of October 2006, just before the isolation period ceased.

Participants completed their questionnaires when prompted by the medical Doctor at the appropriate time points. After completing the questionnaire, they would save the file using a file name that included the date and their own name. They then emailed this password protected file to the experimenter. One problem that arose from this technique of data collection was that participants still had access to their previous responses. In one particular case a participant was found to have provided the same responses for every data collection point. Because of this, only the data from the first collection point could be used from this participant.

The questionnaire used in this study had eleven distinct parts, eight of which were relevant to the present study. Sections 2 to 8 asked participants about the kind of relationships they had with the other individuals on the expedition. Each of these sections was used to map the different social networks. The networks mapped and the

corresponding questions can be seen in Table 7.1. For each of these questions participants were asked to select a value between 0 and 4 for each crewmember, where 0 represented a low level and 4 represented a high level.

Table 7.1. *Statements used to measure Social Networks*

Section	Network	Question
2	Advice	*"From whom did you seek advice in the last two weeks, and to what extent? By advice we mean consultation with someone whose opinion you value highly about important issues."*
3	Cooperation	*"Whom did you cooperate with in the last two weeks, and to what extent? People you cooperate with are those you work with to achieve goals at Concordia."*
5	Friendship	*"To what extent did you regard each person at Concordia as a friend in the last fortnight? By friend we mean someone you felt a close personal affinity with."*
6	Socialise	*"To what extent do you socialise with each person at Concordia in the last two weeks? By socialise we mean joint activities that are not work related."*
7	Similar	*"In the last two weeks, how similar did you feel each person at Concordia was to you? Similar people are those that share your attitudes and behaviours to some extent."*
8	Distinctive	*"To what extent could each individual be considered distinctive, or different, from other people at Concordia in the last two weeks."*

Sections 9 and 10 investigated levels of identification with the expedition group and the diversity culture of the group respectively. Both sections used 7 point Likert scales, in which participants selected a number between 1 and 7 to represent the extent to which they agreed with a series of statements. As in the previous sections they selected the number from a drop down menu next to each statement. A value of 1 represented strong disagreement with the statement and a value of 7 represented strong agreement. The statements used to measure "Identification" and "Diversity Culture" can be seen in Table 7.2.

Table 7.2. *Statements used to measure "Identification" and "Diversity Culture"*

Variable	Items
Identification	1 - *"I have a lot in common with other people at Concordia"*
	2 - *"I feel strong ties to other people at Concordia"**
	3 - *"I find it difficult to form a bond with other people at Concordia"* (reverse coded)
	4 - *"I don't feel a sense of being "connected" with other people at Concordia"* (reverse coded)
	5 - *"I often think about the fact that I am a member of the Concordia expedition"*
	6 - *"Overall, being a member of the Concordia expedition has very little to do with how I feel about myself"* (reverse coded)
	7 – *"In general, being a member of Concordia is an important part of my self-image"*
	8 - *"The fact that I am a member of Concordia rarely enters my mind"* (reverse coded)
	9 – *"In general I am glad to be a member of Concordia"* **
	10 – *"I often regret that I am a member of Concordia"* (reverse coded)
	11 – *"I don't feel good about being a member of Concordia"* (reverse coded)
	12 – *"Generally, I feel good about myself as a member of Concordia"*
Pro-diversity Culture	1 - *"Our expedition group values the differences that each individual brings to the group"*
	2- *"Different points of view are readily accepted within this expedition group"*
	3 – *"In this expedition group it feels as if people are encouraged to think and act in a similar way" (reversed coded)*
	4 – *"In this expedition group we are encouraged to voice opinions even if they generate much debate and disagreement"*
	5 – *"In this expedition group it is very important to conform to current ways of doing things"* (reverse coded)
	6 – *"In this expedition group people will listen to constructive suggestions about how to improve its effectiveness*
	7 – *"In this expedition group people are not open to change"* (reverse coded)

*(Items adapted from Doosje, Ellemers & Spears (1995))

**(Items adapted from Brown, Condor, Mathews, Wade & Williams (1986))

7.2.2 Results

To get around the non-independence in this dataset MLM and Social Networks Analysis, were employed. Traditional statistical techniques were also employed however for an analysis of scale reliability. In this case no alternative technique was available, so

the Cronbach's Alphas must be interpreted with caution. A follow up correlation analysis was also conducted to see if the relational social network data could be linked to identification and diversity culture using more traditional means.

Scale Reliability The entire data set was used to assess scale reliability. Scales were constructed for both identification with the expedition group ("Identification") and for the extent to which the participant perceived the group to have a pro-diversity culture ("Diversity Culture"). The twelve identification items did not hold together well as a scale but when items "5", "6" and "7" were dropped had a Cronbach's Alpha of $\alpha = .77$. All of the 7 diversity culture items did form a reliable scale, with a Cronbach's Alpha of $\alpha = .93$. These findings indicate that these items (which were used in previous studies) also can be used to measure group processes in ICE environments.

Multilevel Analysis of the relationship between Identification and Diversity Culture
MLM was used to predict identification with the expedition group from the extent to which the group had a pro-diversity culture. A thorough explanation of the MLM analysis process will not be provided here as it was already done in Chapter 4 (please refer to that chapter for explanations of terms).

As in Study 1 (described in Chapter 4), responses were grouped by individual crewmembers. Initially an intercept-only model was constructed for "identification" which suggested that 95.7% of the variance came from differences between individuals. While this may seem very high, it may have been due to the small number of individuals (only five crewmembers for the majority of the study).

After this, a fixed effect for the covariate "pro-diversity culture" was added to the model. This model was found to be a significant improvement on the first model with $\chi^2(1, N = 62) = 76.0 - 51.2 = 24.8$, $p < .05$. Next, "pro-diversity culture" was added as a random effect. While this produced a significant improvement of model with $\chi^2(2, N = 62) = 51.2 - 32.9 = 18.3$, $p < .05$, no significant effects were found for parameters. This means that the fixed effects model provides a better explanation of the relationship between "identification" and "pro-diversity culture". This fixed effects model can be described with the following equation. (For ease of understanding this equation can be considered like a regression equation where β_{1j} can be considered to be like a Beta coefficient).

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$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

Where

$$Identification_{ij} = \beta_{0j} + \beta_{1j}Diversity\ Culture_{ij} + e_{ij}$$

And

$\beta_{0j} = 3.43\ (0.55)$

$\beta_{1j} = 0.33\ (0.05)$

As this was a "fixed effects" only model the *t statistic* rather than $\acute{\eta}^2$ is reported. Here, for β_{1j}, $t(53) = 6.17$, $p < .001$. This confirms that "pro-diversity culture" was a significant predictor of "identification". These results suggest that for every increase of 1 point in "pro-diversity culture" there is a corresponding increase in "identification" of 0.33. In the face of cultural subgroup diversity, where it was perceived the expedition group was characterised by an acceptance of diversity and the ability to deal effectively with differences, identification with the expedition group was stronger.

Pro-diversity culture, Identification and group functioning over time

In order to examine how the group's diversity norm or culture evolved over time, the averaged scores for each data collection point were graphed and can be seen in Figure XX. In addition to this, mean levels of identification with the expedition group can also be seen in *Figure 7.1*. Time points were approximately two weeks apart, except for time points "11", "12" and "13" which were approximately one month apart. From this graph it appears that there was a very weak trend towards a mild pro-uniformity group norm over the eight month time period. While the graphs for "Identification" and "Diversity Culture" do not seem to mirror each other particularly strongly, there may be some association between the lines. It would appear from the two graphs that the two dips in "Identification" at time points 7 and 11 were preceded by dips in "Diversity Culture". This suggests that as the expedition group was perceived to be less accepting of diversity and differences, there appeared to be a corresponding drop in levels of identification. The other observation that can be made from this graph was that mean levels of "Identification" never dropped below

the mid point of the scale. This may suggest that despite the slight pro-uniformity norm, participants continued to identify with the expedition group during the winter over period.
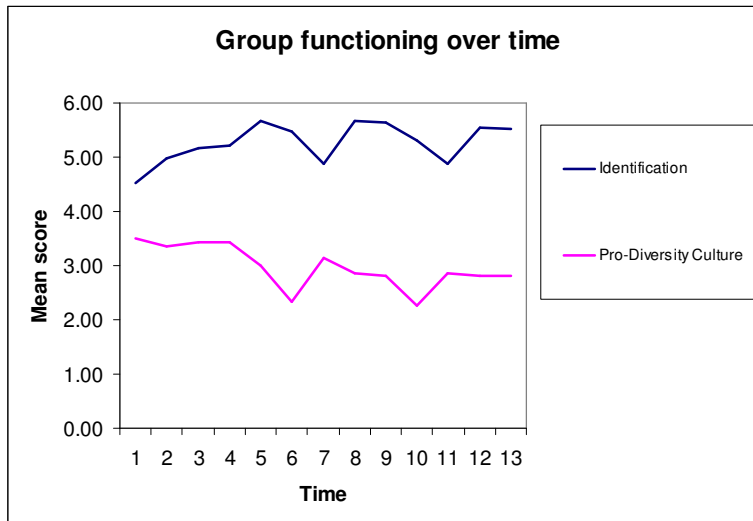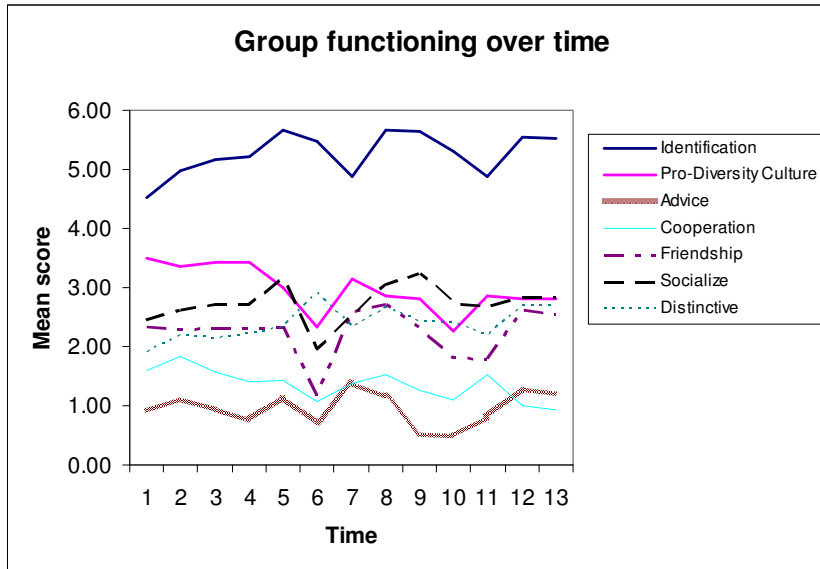

Figure 7.1. Mean levels of "Identification" and "Diversity Culture" over time

In Chapter 6 a clear link between diversity norms and group functioning was demonstrated and it was shown that this link occurred through increased group identification. In order to investigate the same relationships here, variables were calculated from the social network data (relational variables), that could be used to assess group functioning. This was done by averaging a participant's relational scores (to each other person) for each variable (e.g. Socialisation) at a given time. In this way at a given time a participant had a score which reflected their average connectedness to other people. *Figure 7.2* shows these scores across time. From this graph it can be seen that as with Identification, a number of other group functioning variables also declined around time 6, when there was a decrease in the degree to which the expedition group was believed to endorse a pro-diversity culture. Of particular note here is that there was also a corresponding spike in perceptions of difference between individuals. This provides anecdotal support for the earlier findings regarding both the diversity-identification-group functioning link and of the importance of perceived diversity as found in Study 4 in Chapter 6.

The sensitivity of the measures used to detect changes over time is encouraging and the analysis conducted here supports previous theory and research that has shown relationships between identification, diversity and group functioning.

Group functioning over time

Figure 7.2. Mean levels of "Identification", "Diversity Culture" and group functioning variables over time

Following up on this a correlation analysis was conducted to see if diversity norms and identification were significantly related to these measures of group functioning. As Time 1 had the largest number of participants it was chosen as the time point for analysis. The results of this analysis can be seen in Table 7.3.

According to Cohen (1988, 1992), regardless of significance, correlations of .3 can be considered to be of a medium size, and greater than .5 can be considered to be large. As this study had such a small sample size, it is useful to use these as a guide for the meaningfulness of the correlations found.

Using Cohen's guide, these results show medium and strong correlations between pro-diversity culture and identification with the expedition group, advice seeking, cooperation, friendship and socialisation. This result provides further evidence of the benefit of a diversity culture to positive group functioning.

Results for identification indicate significant and strong correlations with levels of co-operation and socialising as well as a strong correlation with distinctiveness which assess the perceived diversity of individuals on the mission. The diversity norm or culture

variables was also significantly related to advice, indicating that the more there was a recognition of a pro-diversity norm the more likely one would seek advice from others, friendship and socialise. The higher one's perceptions of this being a group that valued diversity, the more likely stronger friendships and socialisation relationships were also reported.

Table 7.3. *Correlations between key variables*

Variable	1.	2.	3.	4.	5.	6.	7.
1. Identification	1						
2. Diversity Culture	.41	1					
3. Advice	.10	.31*	1				
4. Cooperation	.68*	.46	.68*	1			
5. Friendship	.33	.84*	.45	.59	1		
6. Socialise	.83*	.76*	.58	.90**	.77*	1	
7. Distinctive	.66	.23	.04	.42	.52	.65	1

*indicates correlation is significant at p < .05, **indicates correlation is significant at p < .001

The Social Networks at Concordia at "Time 1" As discussed earlier, lack of participation by many of the Concordia crewmembers, prevented a more complex social network analysis being carried out. This was because in order to conduct the analysis properly, we needed data from the majority of people within the network, without that data, it becomes impossible to create an accurate representation of the network. Instead social networks were only graphed at "Time 1" (when the networks were almost complete), for the "similarity" network, the "socialisation" network, and the "cooperation" network. The networks can be seen in *Figures, 7.3a, 7.3b*, and *7.3c* respectively.

Figure 7.3a (the "similarity" network) depicts the network of perceptions of similarity amongst crewmembers. Each dot represents a different crewmember (v1 represents participant 1) and the lines between dots represent how similar the two people perceive themselves to be to one another. The values on the lines represent the sum of the two individuals' perceptions of similarity. There was no relational data available from participants 6 and 10 for this particular network, so they appear unconnected in the network. In order to show only strong connections, this graph only depicts lines or "ties"

with a value of 5 or above. The size of the dots represents how strongly crewmembers identify with the expedition group. From this graph it can be observed that generally the French crew members had a tendency to perceive themselves as similar to other French crewmembers, and the Italian crewmembers tended to see themselves as being more similar to other Italian crewmembers. There was some crossover between the two groups however, suggesting that there was not a clear distinction between French and Italians in terms of similarity.

Figure 7.3b, depicts the network of shared perceptions of socialisation at Concordia at "Time 1". As in the previous graph dots represent specific crewmembers and ties represent shared perceptions of socialisation. Values on ties are the sum of the two participants' perceptions of how much they socialise with one another. As with the previous graph, only ties with values of 5 or above are shown on this graph. This network was also missing data from participants 6 and 10. The sizes of the dots also represent participants' level of "Identification" with the expedition group. From this graph its can be seen that generally, Concordia crewmembers socialised quite a lot with one another. Interestingly, there seemed to be higher levels of socialisation amongst Italian crew members, than amongst French crewmembers, or between French and Italian crewmembers. In general it appeared that the Italian crewmembers socialised more with everybody else, but particularly with the other Italians. In this way the socialisation network mirrored the similarity network for the Italians but not for the French.

Figure 7.3c depicts the network of perceptions of cooperation amongst the Concordia crewmembers. The format of this graph is the same as in the two previous graphs; however in this graph ties with values of 4 or above are depicted. This was done as cooperation scores generally were lower, and so a lower cut off was used to better show relationships between individuals. Also, network data was available from participant 6 (but not participant 10), so this person appears more connected here than in the two previous networks. From this graph it appeared that all Concordia crewmembers were cooperating with at least two other crewmembers. Generally however cooperation levels were not very high (values of four represent the mid point of the summed scale). Once again it appeared that the Italian crewmembers seemed to have higher levels of cooperation with one another and their sub-network seemed more connected and denser than the French sub-network. Interestingly, crewmember 6, whose data was missing from the two previous networks, now can be seen as quite connected to their fellow Italian crewmembers.
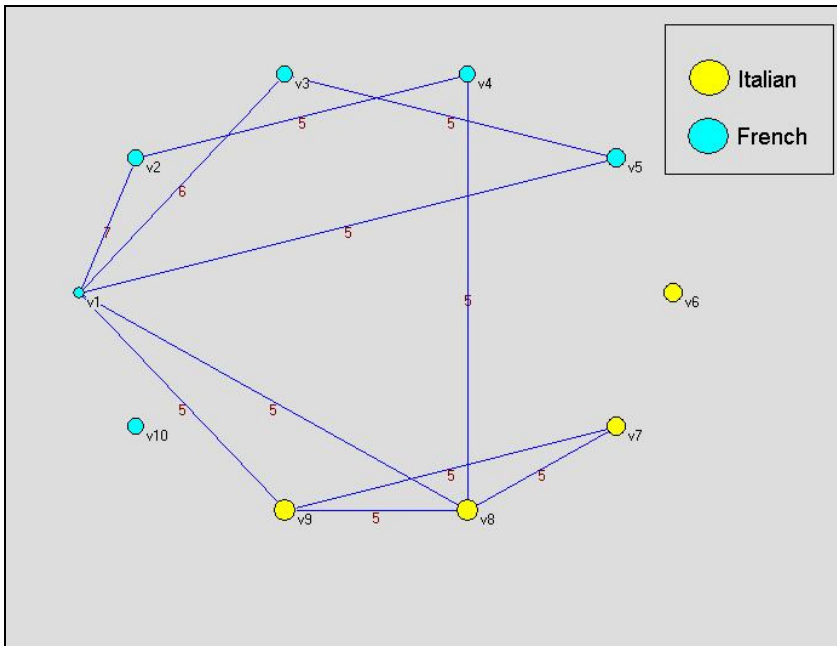
Figure 7.3a. Similarity Network of Concordia Crewmembers at "Time 1"
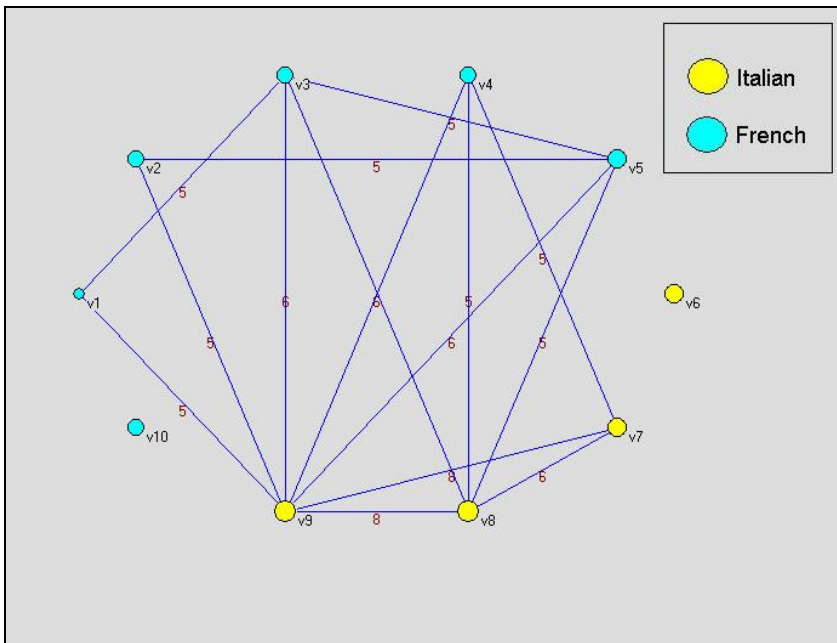
Figure 7.3b. Socialisation Network of Concordia Crewmembers at "Time 1"
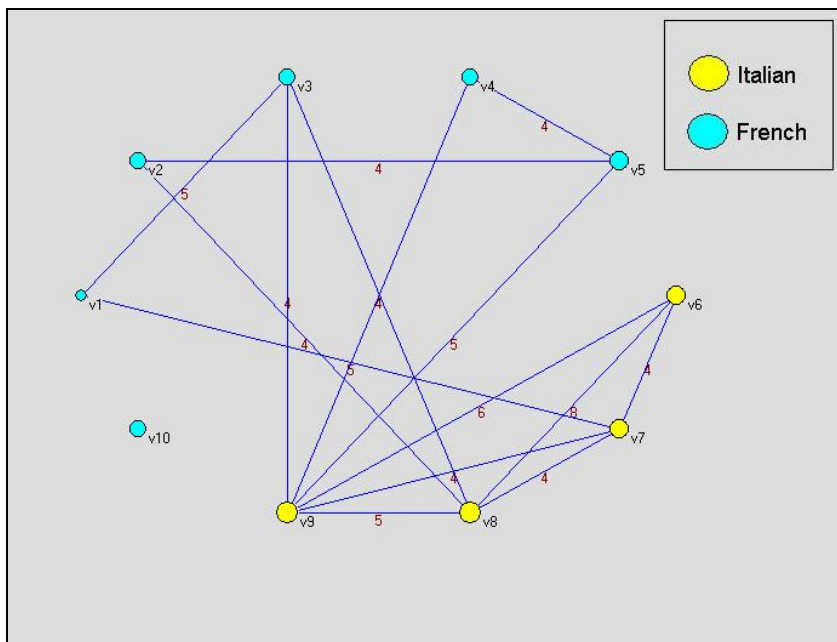
Figure 7.3c. Cooperation Network of Concordia Crewmembers at "Time 1"

There appears to be certain similarities between the three networks depicted in *Figures 7.3a, 7.3b* and *7.3c*. It would appear that the Italians are well connected with one another in terms of perceptions of similarity, how much they socialise with one another and also how much they cooperate with one another. The same consistency in the three networks was not observed for the French crewmembers.

A visual examination of the three networks suggested that "identification" may have something to do with the more connected Italian sub-networks. In order to investigate this, an independent samples t-test was conducted to examine if there was a difference between the two groups in terms of levels of "identification" at Time 1. The t-test found that the Italian crewmembers did indeed identify more strongly with the expedition group than the French crewmembers, with means of 6.19 (0.4) and 3.2 (0.7) respectively and $t(7) = 7.4$, $p < .001$.

Following on from this, differences between the Italian and French crewmembers in terms of their perceptions of the expedition group's "pro-diversity culture" was then investigated for Time 1. As with the previous analysis an independent samples t-test was conducted. This t-test also found a significant difference between the two subgroups with the Italians perceiving a stronger pro-diversity culture than the French crewmembers (Ms

and standard deviations (in brackets): 4.4 (.80) and 2.8 (1.1) respectively; $t(7) = 2.3$, $p < .06$). Considering the small sample size, these results are strongly indicative of differences in perceptions between the two sub-populations within the crew, regarding the expeditions group's diversity norms and culture, with the Italians believing there was more of a pro-diversity culture than the French. As with the previous analysis these results must be interpreted with caution due to problems of non-independence within the data.

In summary, this study has again indicated that those variables that were expected on the basis of previous theoretical work to be related were related. It was the case that the group norm or culture was related to levels of group identification. These two variables were also correlated with other group functioning measures such as co-operation, advice, friendship and socialising. There was also evidence that certain forms of connections between individual crew members could be reliably mapped and described. Furthermore, preliminary analyses indicated that these techniques could reveal the emergence and maintenance of certain sub-group divisions and individuals who could perhaps leverage influence in both "camps" if required to resolve conflict or the like.

7.3   Discussion

Using Multilevel analysis, this study found strong support for the second hypothesis; that the diversity culture of the group would be positively associated with identification with the expedition group. These finding are consistent with those made in the first and fourth studies of this thesis, and also with the research described in Chapter 5. These results suggest that if a group has an emergent norm or culture which values the diversity of its members, then this can act as the basis for strong identification with that group. This is especially true where a key characteristic of the group is the cultural diversity of its members (as was the case in this real ICE environment expedition group). This finding is the strongest found so far in the thesis, as it comes from an ecologically valid source while being statistically robust.

Due to logistical issues associated with the ICE context (which is typical of this research) complete social network data was not collected. This meant the data set could not be analysed using complex modelling Social Network Analysis techniques. Because of this, the impact of the group's diversity culture on group functioning (observed by way of social network structures) could not be measured. However by converting social network data (showing relationships between individuals) into non-relational data, evidence was

found for the benefit of having a pro-diversity culture to various aspects of group functioning (such as cooperation, advice seeking, friendship and socialisation). In this way H2 was also supported. Using the same technique, support was also found for H1, which stated that higher levels of identification with the expedition group would be associated with improved group functioning.

Through visual examination of the trends of identification with the expedition group and diversity culture over time, some evidence was also found to support hypothesis H2. The findings appeared to show that the group became less tolerant of diversity over time. Anecdotal evidence for the association between identification levels and the group's way of working with diversity (e.g., our expedition group values the differences that each individual brings to the group) was also apparent. Two observed drops in identification levels across time were preceded by similar drops in perceptions of a pro-diversity norm or culture within the group. Although descriptive, this can be taken as further evidence for the relationship between the two variables.

When these trends over time were considered in relation to various aspects of group functioning (adapted from the social network data), further anecdotal support was found for the link between diversity culture, identification and group functioning type measures. From this data it appeared that H2 was supported in that higher levels of diversity culture were associated with higher levels of socialisation, cooperation, advice seeking, and friendship. Similarly (albeit to a lesser extent), identification with the expedition group was also positively related to these group functioning outcomes.

When the graphed social networks were compared to one another at Time 1, it was apparent that there was a similar pattern of connections between the "similarity", "socialisation" and "cooperation" relationships. For example, how similar people thought they were to one another seemed to be related to how much they socialised and cooperated with one another. This suggested that in this particular group, perceptions of similarity played a key role in determining who social relationships would be pursued with. This fits with work discussed in Chapter 5 regarding social attraction.

The other observation to arise from a visual examination of the network data was a difference between the French and Italian crewmembers in terms of identification levels. It appeared that the Italian crewmembers identified more strongly with the expedition group than their French counterparts. Analysis did indeed find this to be the case which raises questions about why there was increased connectivity between Italian crewmembers in all

three of the networks. It may be that their increased identification led them to be more motivated towards working and socialising with their fellow group members. If this was the case then this would provide further anecdotal support of H1. If complete network data had been collected throughout the winter-over period, it would have been possible to test this using Social Network Analysis.

The work from this chapter has found support for the importance of identity processes to group functionality through a number of different data sources and analysis techniques. Although not all of the results are strong, they all converge in their findings and with the findings from previous chapters. When taken in context of a long line of research, it seems clear that social identity processes are having a direct effect on group processes in the extreme environments. This study has also provided important evidence in support of the notion that a pro-diversity culture can be beneficial to group functioning in space analogue environments.

There were two important limitations of this study. The first as already discussed was the lack of complete network data, which was a result of logistical difficulties in conducting this kind of research. The second limitation is that by mainly focusing on Time 1 measures, many of the dynamics of interest were probably only just emerging in the expedition group. Further longitudinal data is still needed in order to be more definitive about the processes at work in these groups. While the problem of the use of inferential statistics was addressed in this study, issues associated with the investigation of small isolated groups continue.

Suedfeld and Weiss (2000) pointed out that one of the biggest challenges in conducting space analogue research is obtaining cooperation from the crewmembers. People in these environments often have their own time consuming work and mission objectives and when they are physically removed from the experimenter it becomes much more difficult to inspire motivation towards a psychological study. When there is also a language barrier and minimal communication options, as was the case in this study, the task becomes very difficult indeed. This had significant impacts on the data collected in the present study. This highlights a major drawback in these kinds of studies which have high ecological validity. One solution to this problem can be if the experimenter actually takes part in the extreme environment mission. This can be very difficult though, as it is much easier to get research access to a group in an extreme environment than it is to actually be part of that mission. Even when this does happen, being part of the group in question, as

was done during the first study of the thesis, can cause problems. For example if the researcher has a formal role to assist group functionality (e.g. manage conflict) and is also motivated to improve the functionality of the group. There is no easy solution to this problem, and it will most likely continue to plague extreme environment psychological research.

7.4   Conclusion

Despite a poorer turn out in research participation than had been anticipated, this study succeeded in providing a number of benefits both to this thesis and to the understanding of group processes in isolated confined extreme environments. This study showed a clear link between a pro-diversity norm and ingroup identification, and less robust evidence also suggested that this flowed through to improved group functioning. This study demonstrated that in isolated confined extreme environments, it would be beneficial for expedition groups to try to develop a group identity which incorporated the diversity of all team members.

Another major benefit of this study was that it again demonstrated the effectiveness of Multilevel Linear Modelling as a technique for assessing relationships in extreme environment research. Where appropriate and possible, this technique should be used in place of correlation analysis, regressions and ANOVA when there is non-independence in the dataset.

The final benefit of this study was that it highlighted the usefulness of Social Network Analysis in modelling and assessing social structures in extreme environments. While not effectively utilised in this study, this technique has the potential to be a very valuable tool in the understanding how different factors affect social structures. At the same time it also has great potential as a diagnostic tool during extreme environment missions. It could very effectively be used to assess who is most influential in a group (in terms of their interconnectivity) as well as who has become or is becoming isolated from the group.

The next chapter of this thesis will relate the findings of this study and the other studies, to the broader issues that have been discussed in earlier chapters. In this concluding chapter these issues will be explored in more depth and their implications to space psychology discussed.

- Chapter 8 -

Summary, Implications and Limitations of the Thesis

This thesis has investigated the relevance of particular core social psychological processes in the context of human space flight. It has reviewed both space and social psychological literature and empirically tested important questions that have arisen from these literatures. The focus of this thesis has been to understand the role of group identification and social identity processes in group functioning, particularly in the context of actual group diversity. In the main the relationship between the variables of group diversity, group norms, group identification and group functioning have been explored. It is also the case though, that through a focus on actual group diversity, this work also sheds light on theoretical questions and debates of interest in social psychology that concern group diversity in general.

This concluding chapter will outline the key findings that have arisen both from the literature and from the empirical studies which were conducted. In this way a summary of the findings for each of the chapters is presented. After this the theoretical implications are discussed, followed by the practical implications for both extreme environment missions and extreme environment psychological research. In this part of the chapter, the contribution of this thesis will be made clear and the limitations explicitly outlined. Following on from this, directions for future research in this domain will be suggested. The final part of this chapter reiterates the importance of human endeavours in space and the relevance of understanding human psychology in the context of space exploration.

8.1 Recapitulation

The thesis began with an introduction which described what would be covered throughout the dissertation. The second, third and fifth chapters of the thesis were literature review chapters, covering space psychology, key aspects of social psychology theory and

issues of diversity (in space and in organisations). The forth, sixth and seventh chapters described a research program that began by investigating issues of identification in extreme environments, but then focused down on the core issue of how a pro-diversity norm (in the face of certain types of diversity) could improve group identification and group functioning. Each of the five studies described in these chapters provided evidence for the benefits of having such a pro-diversity nom in groups in ICE environments. The following section will outline what was covered in each of those chapters in detail.

The purpose of Chapter 1 was to provide an outline of what this thesis would contain. It defined the purpose and the scope of the thesis as well as a brief overview of what would be contained in each chapter. This chapter also made the case for the importance of understanding human psychological processes in the context of space missions.

The second chapter of the thesis provided a broad review of a large proportion of the literature related to the psychology of space flight. In this chapter, five domains of psychological literature were reviewed. These were issues concerning stress in the space flight environment and issues related to psychopathology in space; issues related to cognitive performance, ergonomics and habitat design; personality and how this relates to numerous other aspects of astronaut functionality; issues of interpersonal relations and social psychology in space; and finally research on countermeasures against established psychological problems. The review of this literature was intended to be informative without being critical of individual studies. In this way a large amount of research was described and the critique presented at the end of the chapter was generalised.

Chapter 2 presented the case that much of the literature related to space psychology was limited in three important ways. The first was that it was methodologically weak, with much of the information coming from anecdotal sources, or from small sample sizes, in which inferential statistics were often used without explicit recognition of the limitations of such analyses. The second problem was that much of the research did not draw upon mainstream psychological knowledge to inform its understanding of phenomena. Many of the studies simply developed their own constructs and tended to "reinvent the wheel". The third problem outlined, was that there was very little research which took into account group-based processes when considering social issues in space flight associated environments, in particular, work on psychological group memberships and related social identity processes. It was then argued that the later two of these problems could be easily

remedied. From this point it was suggested that the social identity perspective may be informative in the space psychology domain.

Chapter 3 reviewed significant developments in social psychology with respect to the justification for not only focusing on individual and interpersonal relations but also group processes which cannot be reduced to individual characteristics or contributions. Two core theories were outlined: social identity theory (Tajfel, 1972; Tajfel & Turner, 1979) and self categorization theory (Turner et al., 1987). The central tenant of these theories is that people can define themselves and others in terms of their memberships in social groups. It is possible to categorise oneself and others as individuals or members of the same group who shared certain norms, values and beliefs. One of the key findings of work done in this area is that groups function more effectively on a wide range of dimensions when a shared social identity becomes salient and psychologically meaningful for group members; in other words when members identify strongly with that group. This chapter then detailed the relevance of these theories to group functioning including communication, trust, co-operation and group motivation.

Following on from this, in Chapter 4 more attention was devoted to how both social identity theory and self categorisation theory could be applied to the spaceflight context. This chapter explored some common social psychological problems that have been observed in the space psychological literature, and drew upon the social identity perspective to explain them. After this the issue of the "right group" was explored by discussing what social psychological characteristics an adaptive spaceflight crew might possess. One of the characteristics identified as being important was that the crew members all identified strongly with the collective goals of the mission. This was followed by some initial predictions from the social identity perspective about how the space flight environment might be different from those environments that are typically researched in this field.

Based on the issues that had been discussed in Chapters 3 and 4, an initial field study was devised and conducted. This study was undertaken during a four week Mars simulation mission to the Australian outback. The context of the study was analogous to a space mission in terms of physical isolation and the nature of the work being conducted, but had only medium ecological validity in terms of crew size, confinement, mission duration and exposure to real danger. It did represent however an excellent place to test some of the basic predictions that had been developed and the degree to which certain variables could

be measured. The study investigated the emergence of shared social identities within the crew as well as predictions regarding how the isolated environment would constrain the use of social identities. An initial investigation into how a number of different aspects of group functioning related to each other was also conducted in this study. It concluded that the emergence of a shared social identity could not be assured during extreme environment expeditions. The study failed to find any evidence however to support the notion that the isolated environment constrained social identity use. It also found that a number of relationships which had been commonly observed in traditional social psychological research were also present in this extreme environment. This suggested that the social psychological processes that are common to everyday life were likely to occur in the same way in an isolated extreme environment. This validated the idea that mainstream social psychological theories were essential to understanding group dynamics in space.

Of particular note in this study, was the finding that a group's diversity culture was associated with how strongly people identified with that group. In addition to this was the observation that stress was associated with tension between subgroups within the expedition. This finding was of particular interest when coupled with the evidence for a lack of development of a shared expedition identity. Together these suggest that there is a strong likelihood that people will not categorise themselves together into one cohesive group and that if they do not, there is a danger that intergroup tension could arise which in turn could lead to increased stress levels. These findings lead to the development of a new direction for the thesis, informed by the social identity perspective, it was suggested that a focus on the management of the relations between subgroups and issues of diversity be investigated. The finding of the relationship between the pro-diversity group norm and identification levels was particularly important here as it suggested that a diversity norm could be useful in terms of boosting identification while at the same time creating a group environment in which everybody (including subgroups) could be included within a shared identity.

Chapter 5 followed on from the findings of this study, by exploring the issue of diversity in space in more depth, both in subgroup and individual terms. Building on the space psychology literature which had been introduced in Chapter 2, issues relating to diversity in space were discussed. From this literature it emerged that crew diversity in space was something that would almost certainly be a permanent feature of future space missions. It also emerged that this diversity had great potential to cause division and

conflict during space flights. At this point a large gap in the space psychology literature was exposed. There was no literature that was informed by an understanding of underlying psychological processes, which presented effective ways of dealing with this diversity. For this reason the chapter then turned to the domains of social and organisational psychology to see what was understood about the effects of diversity on group dynamics.

At this point a review of diversity literature from organisational and social psychology was undertaken. From this it emerged that diversity could be defined in two broad ways; informational diversity and social category diversity (Williams & O'Reilly (1998). Williams and O'Reilly suggested that informational diversity tended to be associated with improved group functioning, while social category diversity was associated with group fragmentation and poor group functioning. They argued that this disadvantage of social category diversity arose from people categorising each other into different social groups and that this inevitably led to prejudice, ingroup favouritism and intergroup conflict. It was pointed out in this chapter however that being aware of others differences in terms of social categories (e.g., gender, ethnicity) would not necessarily lead to negative outcomes.

A line of research on "diversity culture" was investigated which suggested that diversity could be taken advantage of and could in fact be used as the basis for a shared positive identity. This notion was based on the work of Haslam, Eggins and Reynolds (2003), Rink and Ellemers (2007a, & 2007b), Tyler and Blader (2000), van Knippenberg and Haslam (2003), and van Knippenberg, Haslam and Platow (2004). It was argued that if a group valued diversity and that this "value in diversity" was as a central part of their identity, then they would not suffer from the negative effects of social category diversity. This kind of identity would allow for people to be different from one another, while at the same time being categorised together into the one group. The ASPIRe model (Haslam, Eggins & Reynolds 2003) took this notion to the next level suggesting that this "value in diversity" could be extended to include valued but different subgroups within a larger "superordinate" group. In addition to this, it was argued by van Knippenberg and colleagues that, not only could a "value in diversity" identity benefit group functionality by being inclusive, but that it could also act as the basis for a positively distinct identity. It was demonstrated in an organisational context that groups with a diversity culture were more likely to have individuals who identified strongly with that organisation than those organisations without a diversity culture.

It was then noted that these observations had the potential to benefit the management of diversity in space. Basically the idea was that in a space flight context, where group diversity is likely to exit, if the crew could be encouraged to develop a norm or culture which valued the diversity of its members, then it may be able to benefit from crew heterogeneity (and the creativity and innovation that can flow from it) rather than suffer from the negative effects that have traditionally been observed. This work on diversity culture was relatively new however and had not been investigated extensively within the organisational and social psychological literature. While it seemed very promising, more investigation was needed, especially in the context of extreme environments. For this reason an empirical research program was devised to investigate these issues. In particular, the role group norms and group identification processes have in shaping group outcomes was investigated under conditions where certain forms of group diversity were or were not made explicit (e.g., demographic differences and difference in terms of role, skills and expertise).

The first three studies of this program (Studies 2, 3 and 4) were described in Chapter 6. Each study was designed to test the two potential benefits of having a "value in diversity" group norm; increased identification and increased inclusiveness which translated into less alienation of both individuals and subgroups and better group functioning. The first study (Study 2) was a field study which took place during two simulated Mars missions to the Mars Desert Research Station in Utah. The second and third studies (Studies 3 and 4) were experimental where core variables were manipulated to assess the impact on the outcome variables of interest. As a program of research, the methods were refined across studies leading to a very clear set of findings especially when considering the limitations of conducting research in these settings. The results of this study were far more conclusive than the first two studies. The diversity norm of the group effectively predicted ingroup identification levels, alienation levels and various other aspects of group functioning. These results strongly supported the notion that groups that are defined by their respect for, and valuing of, the diversity and difference amongst members are associated with increased ingroup identification, decreased alienation (both subgroup and individual) and boost group performance.

While the results of this study confirmed the core hypotheses of the thesis, they were not all conducted in an ICE environment. For this reason a further more naturalistic

study involving participants from a winter-over period at an Antarctic research station was conducted and described in Chapter 7 (Study 5).

This final study provided a rare opportunity to investigate the issue of diversity culture in an excellent space flight analogue environment. In addition to this, the eight months the crew spent in isolation provided a long length of time, during which a large amount of data could be collected (albeit only for a sub-set of expedition members).

As in Study 1, Multilevel Linear Modelling was used to model the relationship between diversity culture and identification with the expedition group. In addition to this however a new technique was introduced in order to assess how these variables impacted upon the structure of relations amongst members of the expedition group. This chapter introduced Social Network Analysis as an ideal way to observe and make inferences relating small groups. As this technique models the dyadic relationships between individuals, it (like MLM) does not require independence in the data set. In this way it provided researchers with an excellent tool for investigating social psychological issues in extreme environments. While social network analysis has been used to examine groups such as these in the past, this work focused on aspects central to social identity processes.

The study was undertaken over a period of eight months during the Antarctic winter of 2006 at the Concordia research station and data was collected at 13 different time points. Unfortunately however participation in the research program dropped to only half of the crew members after the first data collection point. This rendered the proposed social network analysis inoperable as it required a larger sample and more complete network data. Despite this however the results from the MLM provided strong evidence for the existence of a positive relationship between the crew diversity norm and identification with the expedition group. This was taken as very powerful evidence for the link between diversity culture and group identification in isolated extreme environments and confirmed the relevance and importance of social psychological factors in the space flight context (or the closest possible alternative to such a context).

The Concordia study also reconfirmed the link between both group identification and the presence of a pro-diversity norm with group functioning. While not as statistically robust, visual and correlational analyses were suggestive of the benefits of group identification and the pro-diversity norm.

This study also confirmed comments by Suedfeld and Weiss (2000) regarding the difficulties of conducting extreme environment research, particularly concerning lack of

cooperation between expeditioners and experimenters. In this study logistical difficulties made it very difficult to maintain high levels of participation across time.

Possibly one of the most important contributions of this chapter however was the introduction of Social Network Analysis and the use of Multilevel Linear Modelling as effective tools in extreme environment. In this way this chapter provides an example of how certain statistical methods (MLM and SNA) along with certain social psychological constructs may have the potential to revolutionise the way social psychological research is conducted in extreme environments. At the same time it provided evidence in a naturalistic setting for the core hypotheses of the thesis and the earlier experimental findings.

8.2   Implications of the Thesis

One of the important contributions of this thesis was to provide a relatively detailed review of the space literature with respect to the role of the group. What was revealed was a very individualistic analysis of group functioning very much focused on individual characteristics and interpersonal relations. While this work is useful, it was argued that major developments in social psychological theory and research with respect to group processes and intergroup relations had not been integrated or seriously investigated.

A review of the past social psychological space research suggested that very little work had been framed in established theoretical paradigms. In addition, there was almost no literature which drew upon group-based theories to inform work on issues of group dynamics. This thesis demonstrates the importance of drawing on established mainstream social psychological theory, by showing the benefits of applying the paradigm of the social identity perspective to issues of group dynamics in space.

Through the application of the social identity paradigm to the space flight context, it became possible to explain the psychological underpinnings of numerous social phenomena which had been observed in space. Issues such as the "host guest" problem, the Sky-Lab strike, and a number of interpersonal conflicts that had been observed were related to more group-based dynamics outlined within the social identity perspective. In particular this thesis demonstrated the value of these theories for dealing with issues of diversity. This thesis advances space psychology by introducing an approach to understanding group processes and intergroup relations, which draws upon a well established and empirically supported social psychological paradigm.

Where SCT and SIT contribute beyond individual based psychological theory is their ability to explain the cognitive underpinnings of a variety of aspects of human social behaviour within a space flight context. The principal psychological process of relevance here is ingroup identification and its behavioural and cognitive implications on personal association with a group, alignment with a groups goals, adherence to group norms, alienation and rejection of outgroup members, increased group cohesion, increased trust of ingroup members and generalised improved cooperation. SCT and SIT are able to provide explanations for how these operate through mechanism such as depersonalisation (SCT), whereby a person adopts their group's values and behaviours as their own, and the need to see one's group as positively distinct from others (SIT). Depersonalisation for example can be used to explain why a person might conform to a norm (such as pro-diversity norm), and the need to see one's group as positively distinct can be used to explain why a person alienates a member of a group which the person sees as being a threat to their own group's positively distinct identity. Without listing all factors here, other aspects of these theories are also useful, such as principals of perceiver readiness and cognitive and normative fit to explain the mechanisms a person might use to define another person as being a member of his or her group. It is the ability of these theories to explain how people come to see themselves as a member of a group, how they judge others to be a member of their group and the effects this has on their social behaviour that makes SCT and SIT unique in their ability to explain social behaviour.

One of the implications of this thesis, then, is to highlight the need for further theoretical connection and integration between space psychology and social psychology. The empirical work of the thesis aimed to demonstrate the applicability of social psychological understandings of the group within the social identity perspective to the space analogue research context.

The results reported in this thesis serve to highlight the importance of group norms and group identification to group functioning. In the face of group diversity, group functioning was highest where there was, or was perceived to be, a pro-diversity rather than pro-conformity group-norm. There was evidence for this point in both the experimental studies (in particular study 4) and from the studies in more naturalistic settings (studies 1,2 & 5). The question of diversity has been a direct focus of research in the space psychology literature. A crew on the space station, the moon or going to Mars is likely to bring together individuals with different skill sets and contributions as well as different

demographic and cultural make-ups. What has been largely missing, in all of this work to date, is recognition of the role of group norms in translating this diversity into a group strength rather than a possible source of weakness and fragmentation.

These findings with respect to the diversity norms are also relevant to organisations more generally. Increasingly groups are becoming more diverse because of the multicultural nature of modern societies, the cross-national nature of many organisations and the increasingly complex tasks that require individuals who bring expertise that is unique and different from that of other team members. The results of this thesis build on the diversity work in the organisational literature and explicitly show the role of pro-diversity norms in producing positive group outcomes. In this way the work addresses the question raised by Poltzer, Swann and Milton (2003) of whether a diverse group can have a shared social identity. These and other researchers have questioned the fit between a group characterised by the diversity of its members and the emergence of a social identity where group members are perceived to be similar and interchangeable. The research findings of this thesis reveal that there is no inconsistency between the emergence of a strong social identity and group norms, values and beliefs that focus on the diversity amongst group members. In the same way, Jetten and colleagues have found that an individualistic culture can operate as a group norm (Hornsey & Jetten, 2004; Hornsey, Jetten, McAuliffe, & Hogg, 2006; and Jetten, Postmes & McAuliffe, 2006).

These ideas, in particular, support and extend work by van Knippenberg and colleagues (van Knippenberg, & Haslam, 2003; van Knippenberg, Haslam & Platow, 2004) and by Rink and Ellemers (2007a & 2007b). They suggested that the negative consequences which have traditionally been associated with social category diversity in the literature could be avoided through the development of a social identity which was characterised by a "value in diversity" culture. The results reported in this thesis, directly show that in the face of diversity, a pro-diversity versus pro-conformity norm, can lead to the inclusion of people who might otherwise be categorised into a separate social group. The results also suggests that this kind of pro-diversity norm can lead to increased group identification as people feel their individual contributions will be valued and respected (see also Tyler & Blader, 2000). Van Knippenberg and colleagues presented evidence to support the second benefit regarding a boost to organisational identification, but their work did not provide empirical evidence to support the first benefit. In this way the research

presented in this thesis provides evidence in a naturalistic setting that strengthens the case for the benefits of a "value in diversity" group norm in certain settings.

The evidence presented in Study 4, most clearly supported the work of Haslam, Eggins and Reynolds (2003) on the ASPIRe model. In their model they argue that an organisation will function more effectively if it has a superordinate organisational identity that values the diversity of its subgroups and individuals. The results of Study 4 indicated that the "value in diversity" culture could be used to prevent group fragmentation by preventing individual and subgroup alienation, while at the same time increasing group identification. As diversity in this study was operationalised in broad terms (where diversity could mean any kind of meaningful difference between groups or individuals), the research presented in this thesis supports the argument that a group which values the diversity of its component parts (individuals and subgroups), will function more effectively as a whole. In this way the present thesis has contributed to the body of knowledge that supports the ASPIRe model.

The results also speak specifically to work by Chatman, Polzer, Barsade and Neale (1998). As outlined in Chapter 5, in their study they found that groups which had a focus on unity and were "collectivist" were better able to deal with heterogeneity than those which focused on the individuals within the group and were "individualistic". In Chapter 5 it was discussed how Chatman et al (1998) relied upon the "common ingroup identity" model for their interpretation of how best to deal with diversity in organisations. It was also discussed how this view failed to appreciate the attachment that people have to their existing identities. The argument made in Chapter 5 was that while a purely individualistic approach to group diversity may be inferior to a "common ingroup identity" one, an approach more akin to the ASPIRe model could also be effective. In this regard the results presented in the current thesis support the ASPIRe model and demonstrate that group identity can be strong for groups where diversity is valued and group defining.

The work conducted in this thesis also has implications for the way in which research is conducted in space and related environments. Much of the work that has been conducted in these environments has suffered from key methodological problems. The first is small sample sizes and the second is non-independence within the data set. Traditional statistical analyses often make the assumption that data is independent. When participants interact with one another, this violates this assumption. Despite this, there are numerous examples within the space psychology literature which report statistical tests that have

assumptions of independence but where all the data is collected from a single group of interacting people. Leon, Kanfer, Hoffman and Dupre (1994) is one such example where correlational analysis is conducted on variables relating to group processes even though all the data is taken from the one group of people. The limitations of such techniques though could be made more explicit.

The present thesis addressed this issue in two of the three field studies that were conducted however by effectively using one technique and introducing a second data analytic technique which does not require data to be independent. The first technique that was utilised in these studies was Multilevel Linear Modelling. This technique allows for complex statistical models to be developed using non-independent data, the simplest of which resemble linear regression. This technique does require a substantial amount of data before it is effective however which can be problematic in extreme environment research. One solution to this is to sample data from each participant on numerous occasions. This creates a second form of non-independence in the data, but this is not a problem for MLM. In this way MLM has the potential to revolutionise the way data can be analysed in extreme environment research.

The second data analytic technique introduced in this thesis was Social Network Analysis. While not effectively utilised in this thesis, due to data collection problems, it too has great potential to revolutionise the way data is analysed in extreme environment research. This technique models relationships between different individuals within a social network and can be used as a way of investigating social structures that may exist within a group. What is particularly useful about this technique is that variables can be used to predict network structures. In this way research could be conducted in which factors of interest are used to predict either adaptive or maladaptive network structures.

The present thesis was not the first piece of work to introduce this technique to the space psychology domain however; Johnson, Boster and Palinkas (2003) used this technique to investigate social structures at an Antarctic research station. This thesis builds on their work, reiterating the potential of this technique for conducting statistically robust research in a domain which is plagued by poor statistical methodology. This study also built on their work by demonstrating how key variables that relate to established psychological processes can be used in conjunction with social network modelling to better understand group dynamics.

Through the introduction of these two powerful statistical techniques, it is hoped that a contribution has been made, which will advance the methodological accountability of the discipline of extreme environment psychology.

This thesis has a number of implications for how social psychological issues should be managed during real space flights. Possibly one the most important contributions was to highlight the relationship between ingroup identification and group functioning. This construct, has the potential to act as a key indicator for adaptive or maladaptive social psychological functioning during space missions. At the same time it can also be used to measure the success of a range of other psychological interventions designed to improve team dynamics. In this way this thesis provided evidence that identification as a construct would be very useful in the toolbox of those responsible for managing the psychological wellbeing of space flight crews.

With increases in the heterogeneity of space flight crews, the issue of how to manage this diversity and avoid its potential pitfalls is a very real problem faced by those who manage the psychological wellbeing of these crews. The current thesis makes a large contribution to this area through the work that has been conducted on diversity norms. The findings of this thesis suggest that the way to manage diversity in space is to develop a group culture in which "value in diversity" is a central part of the crew's identity. It has been argued here that, if this can be managed the disadvantages commonly associated with crew heterogeneity can be reversed. It would be naïve to suggest that all problems associated with diversity, such as very real language barriers, can be solved using this technique, but it does provide a way in which diversity can be utilised as a unifying force rather than a divisive one. Thus another important contribution that this thesis makes is to demonstrate a way that space agencies can promote harmony within their space crews.

In a more specific sense, this thesis could be utilised by those developing social relations training programs for astronauts. Earlier in the thesis one such training program was described which had been developed by Kring (2001). While this training program would be useful, ones such as this could be improved, by drawing upon the findings of this thesis. To begin with it would be more effective if it were based upon a model the recognised and sought to develop certain group norms which incorporated the diversity of the mission's individuals and subgroups. Through this focus on group norms and group identification the present thesis could be used to contribute to the development of future astronaut training programs.

8.3   Limitations of the Thesis

While this thesis has made an important contribution to both social and space psychology, it is important to recognise the limitations of this work. These can be broken down into practical, methodological and theoretical limitations.

Practically this study was limited to only three studies in naturalistic settings. What's more, the research that could be conducted in these three settings was constrained by the research goals and activities of the relevant expeditions. Because of this there was a limitation on the amount of data that could be collected from ecologically valid sources. This outcome limited the depth to which the psychological processes behind the group dynamics in these settings could be investigated in the actual locations of interest. Despite this however, enough data was collected across different settings to make some overarching conclusions. The addition of two laboratory studies also helped to increase the scope of the research.

Methodologically this study was limited first by some of the analyses that were conducted in the field studies and secondly by the ecological validity of the laboratory studies. In each of the three field studies standard statistical techniques were conducted which relied upon and assumption of independence. Due to the interacting nature of the groups in question, this assumption was violated. This therefore meant that conclusions drawn from these analyses needed to be interpreted with caution. As discussed earlier in this chapter, this problem is common in extreme environment research and so in that way the work of the current thesis conforms with expectations within this field. However the research that was conducted in this thesis succeeded in dealing with this issue in two important ways. Firstly, by collecting data from numerous sources (with convergent findings) and secondly by introducing new analytical techniques that did not require non-independence, which meant analysis could be conducted in a more statistically robust manner.

The laboratory studies conducted in this thesis can be said to have low ecological validity, as they were not conducted in an environment that psychologically represented space flight and related environments. Despite this however these studies made an important contribution to the thesis. They demonstrated the action of the social psychological processes in question and contributed to a theoretical understanding of how group norms can impact upon group functioning outcomes. They also provided convergent

validity for the results found in the more naturalistic settings. By having a balance between field and laboratory studies this thesis was able to contribute both to a theoretical understanding of group processes and the practical management of these processes in ICE environments.

The key theoretical limitations of this study came from the range of psychological processes investigated. As achieving convergent findings from both naturalistic and laboratory surroundings was so critical to this work, this prevented numerous questions being investigated. Had there been greater opportunity to conduct further research in naturalist settings, a broader range of questions regarding how identification processes influence group dynamics in space flight and related contexts may have been investigated. Considering the difficulties associated with conducting research in these environments however, it can be considered an achievement that the specific issues investigated here have been dealt with so thoroughly.

This thesis does however represent the beginning of what could be a new paradigm for understanding social behaviour in space and related contexts. This thesis has only begun to scratch the surface of the implications theories such as SIT and SCT have for group dynamics in ICE environments. In that way there is great scope to continue on from this research program to answer other related questions.

8.4   Future Directions

In a broader sense, it would also be useful for future research to investigate how identity processes related to a range of other aspects of group dynamics in extreme environments. There is a significant amount of work on leadership, for example, within the social identity perspective literature. This topic is of particular interest within space psychology, but almost all of the work has focused on individual factors such as personality. There is much evidence from the social identity perspective that suggests that leadership effectiveness is heavily influenced by group level processes (e.g., Turner & Haslam, 2001). It is argued here then that it would be worthwhile for future research to investigate how social identification processes impact on leadership effectiveness in extreme environments. This is just one example of how the social identity perspective can be used to understand issues of group processes in space, there are numerous others that are yet to be investigated.

Some questions also remain over a demonstrated benefit of concepts like ingroup identification and the presence of diversity norms over and above the effects of individual difference based variables. There is also interest in the interdependencies between social identity, group norms and individual attitudes and behaviour including personality processes (e.g., Turner, Reynolds, Haslam & Veenstra, 2006). For this reason it may be useful to conduct further research in an extreme environment context in which both individual and group based variables are measured simultaneously so as to assess the degree to which both influence positive group outcomes.

As discussed earlier in this chapter, it would also be valuable for future extreme environment psychology research to draw upon both Multilevel Linear Modelling, and Social Network Analysis which includes variables related to one's psychological connection to the group. In this way this is not so much a recommendation for the content of future research but rather for the methods of future research. Through using both of these techniques, future space psychology research could potentially greatly increase the fidelity of its findings. At the same time this future work could investigate complex research questions that until now were unassailable using traditional analyses.

One further area for future research would be the development of a social state monitoring system. It would be possible in the future to develop a system, similar in principal as that designed by Dudley-Rowley and colleagues (Dudley-Rowley, 1997; Dudley-Rowley, Gushin, & Gorry, 1999). Such a system could be designed to alert mission control if maladaptive social situations were developing during a space mission. This kind of system could build on the work of Dudley-Rowley and colleagues, but this time could be informed by the paradigm of the social identity perspective and use the measurement techniques of Social Network Analysis. If this could be done successfully then a powerful new instrument could be developed that was capable of diagnosing social dysfunction during space missions, before problems got out of hand. This research would build on some of the best research from both social and space psychology, while at the same time utilising cutting edge statistical techniques. For this reason, the development of such an instrument could potentially be a very valuable avenue for future research.

8.5   Final Comments

At its core the value of this thesis is based on two value propositions:

"*human life is worthwhile and should be protected*"

And

"*it is a worthwhile human endeavour to explore space*"

The first proposition is almost universally accepted and is relevant to the current thesis in that mission failure during expeditions into space can result in the deaths of human beings. This thesis has been focused on the development of knowledge that can be used during space missions to maximise mission success. It has been argued in this thesis that the knowledge that has been generated could indeed be used to increase the chance of success for future space missions. In this way, it is argued that this thesis helps to achieve some small protection of the first value proposition.

The second value proposition is not as universally accepted as the first and indeed there are many people who would argue that human space exploration is a waste of resources and not of value. The author of the present thesis would argue otherwise however.

As a species humans are currently only capable of surviving indefinitely on our home planet. To date the longest time any person has spent away from the Earth is not that much longer than a year; when cosmonaut Valeri Polyakov spent 437 days aboard the Russian space station Mir. This means that the fate of humanity is currently tied in with the fate of the Earth. This makes us vulnerable as a species, to any global events that might threaten our existence.

At present there is a growing body of evidence to suggest that our planet is undergoing climate change. Without getting caught up in this debate, this kind of possibility stands as a potential threat to human existence. There are numerous other hypothetical calamities that could befall our planet, from large meteorite strikes capable of causing mass global extinction (as was believed to have befallen the dinosaurs), to a nuclear war between human governments, as was feared during the cold war. Any of these possibilities, whether they happened in 10 years or 10,000 years time have the potential to end human civilisation and existence permanently.

In this way, whilst humans are only capable of inhabiting the Earth, we are at a long term risk of extinction. Only through the advancement of space exploration will we ever, as a species, be able to leave the Earth permanently. If this argument is true, it follows then that the long term fulfilment of the first value proposition is dependent upon the second. In other words, if human existence is of extreme value, then the long term preservation of human existence is dependent upon space exploration.

It is this central argument that guides the author's perspective on space exploration and through that the motivation to advance the understanding of human psychological functioning in space. As discussed earlier, the goal of the present research was to enhance the chance of success for future space missions. If this research does benefit future space missions, it is hoped then that the fulfilment of the second value proposition will also be supported and through that will help in the long term fulfilment of the first value proposition.

These arguments have been the guiding motivation behind the thesis and it is hoped by the author, that at least some small benefit to human space exploration will be realised through the knowledge that has been generated.

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