

# Extrapolation of Conflict Mitigation Strategies to Long Duration Space Exploration Missions

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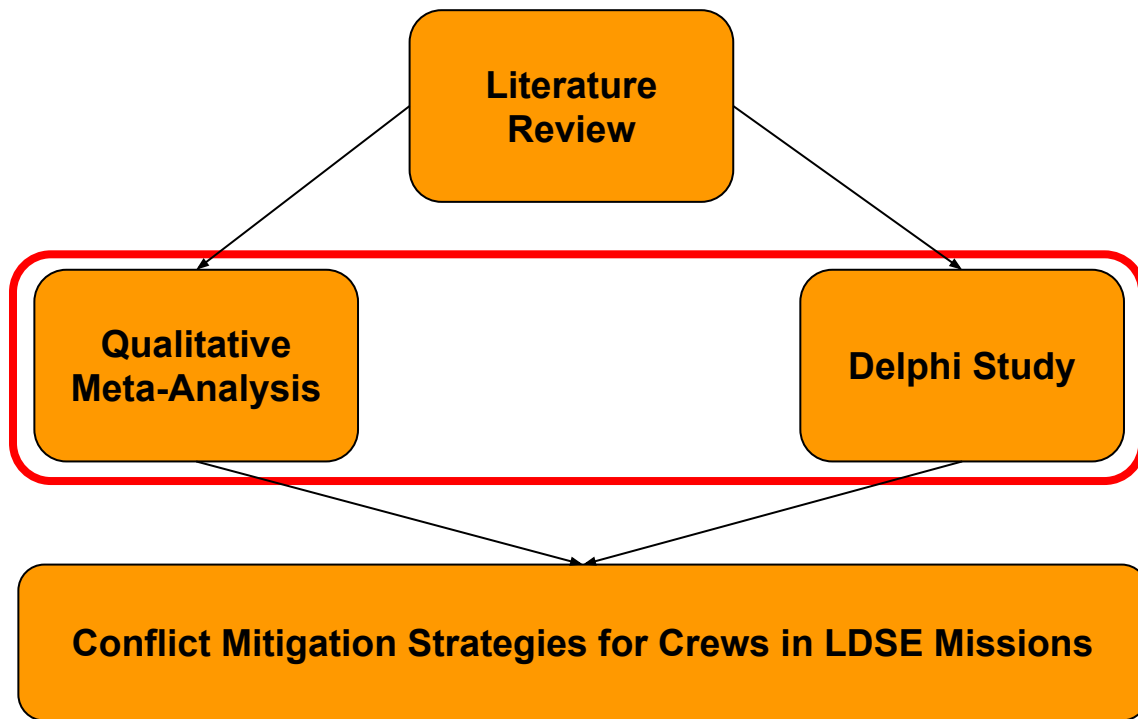
# Introduction

This paper investigates team dynamics from a general standpoint and in Earth-based ICE environments, and extrapolates findings to develop conflict mitigation strategies in space.

**This is done through an analysis of:**

- Conflict types
- Conflict resolution modes
- Relationship between team cohesion and performance, team identity versus individual identity
- Commonalities between Earth and Space ICE environments

# Our Approach



# Literature Review Outline

The literature review is conducted in three main phases:

1. **Reviewing the most general cases of conflict mitigation:**  
*defining concepts, types of conflict, approaches to conflict resolution, team identity vs. individual profile, McGrath's Group Task Circumplex*
2. **Understanding conflict mitigation in Earth ICE environments:**  
*defining concepts, ICE impact on team dynamics, Antarctica, NEEMO, HERA, Mars-520*
3. **Understanding conflict mitigation in Space ICE environments:**  
*defining features, Earth vs. space ICE, ISS*

# General Conflict Mitigation-Definitions

**Conflict:** Interplay of opposing and differing goals in a team setting.

**Conflict mitigation:** The positive and constructive handling of difference and divergence.

**Conflict resolution:** The termination of conflict.

**Team cohesion:** The level of attractiveness to the team from each member.

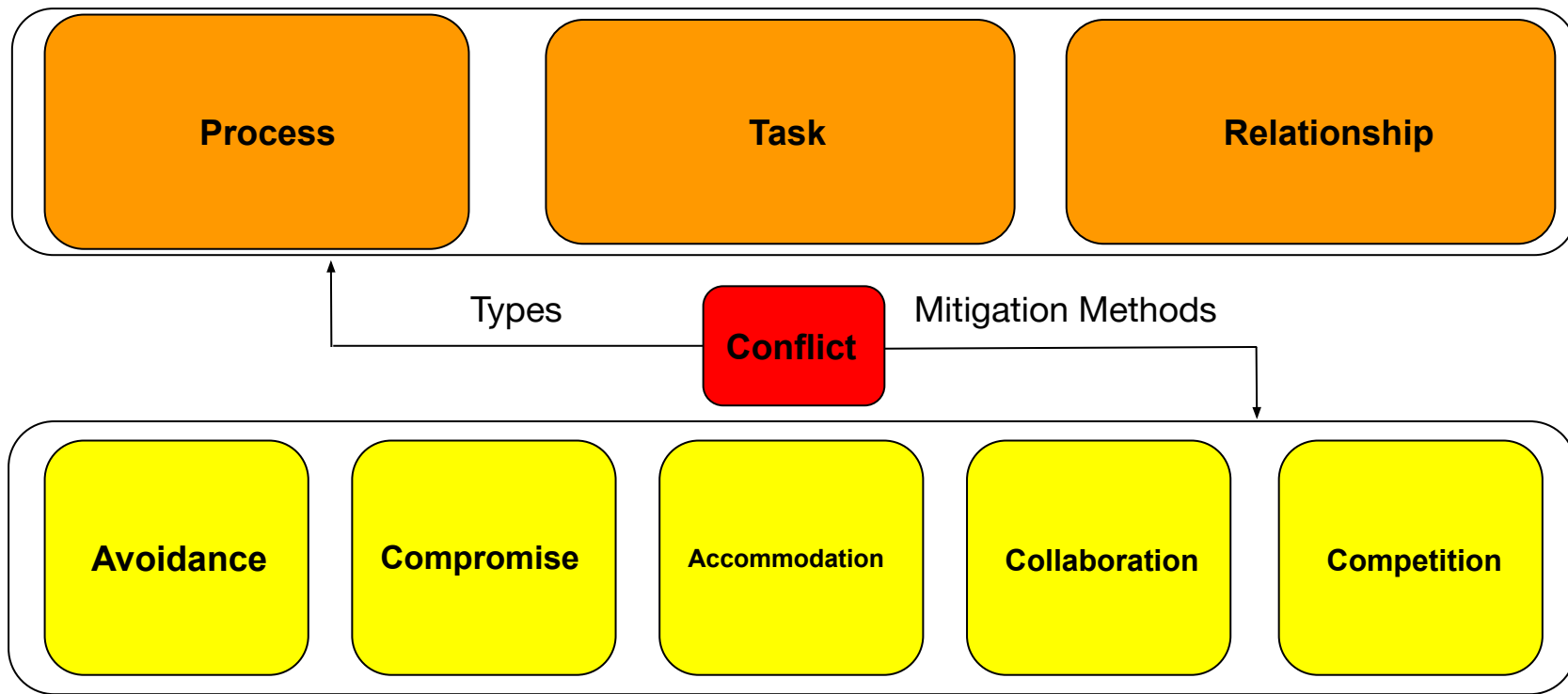
**Team performance:** The ability of a team to accomplish group tasks and achieve team goals.

# General Conflict Mitigation- Team Cohesion

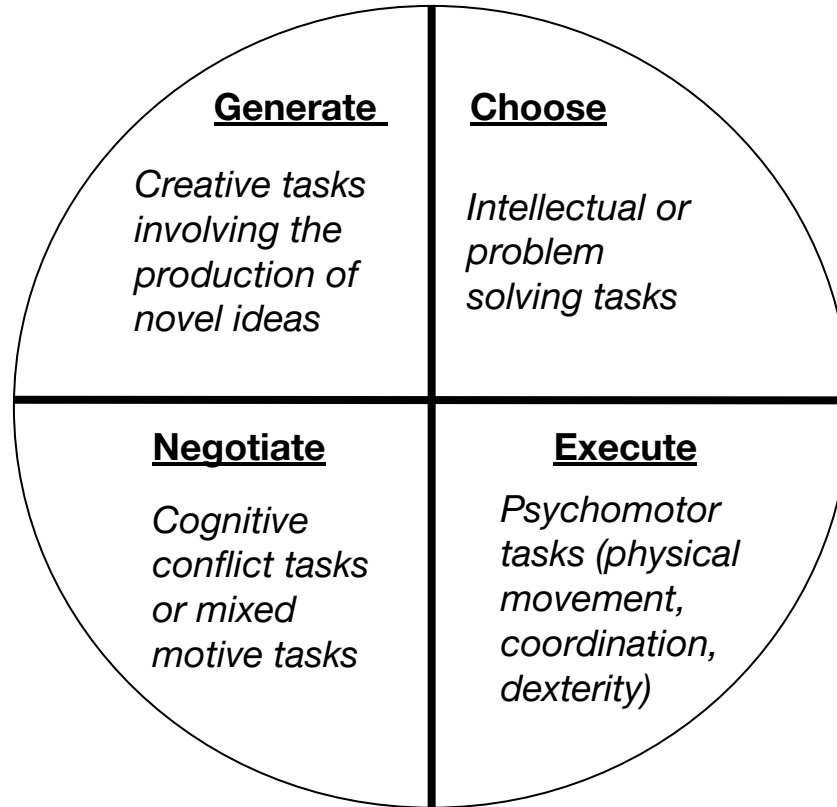
## Three main types of team cohesion

Subdimension	Definition
Task	A shared assignment or objective that results in a companionship between team members
Social	A familiarity due to social interactions carried out by group members
Group Pride	A contentment held by all group members with regards to the principles the group upholds

# General Conflict Mitigation- Types of Conflict & Modes of Mitigation



# General Conflict Mitigation- McGrath's Group Task Circumplex

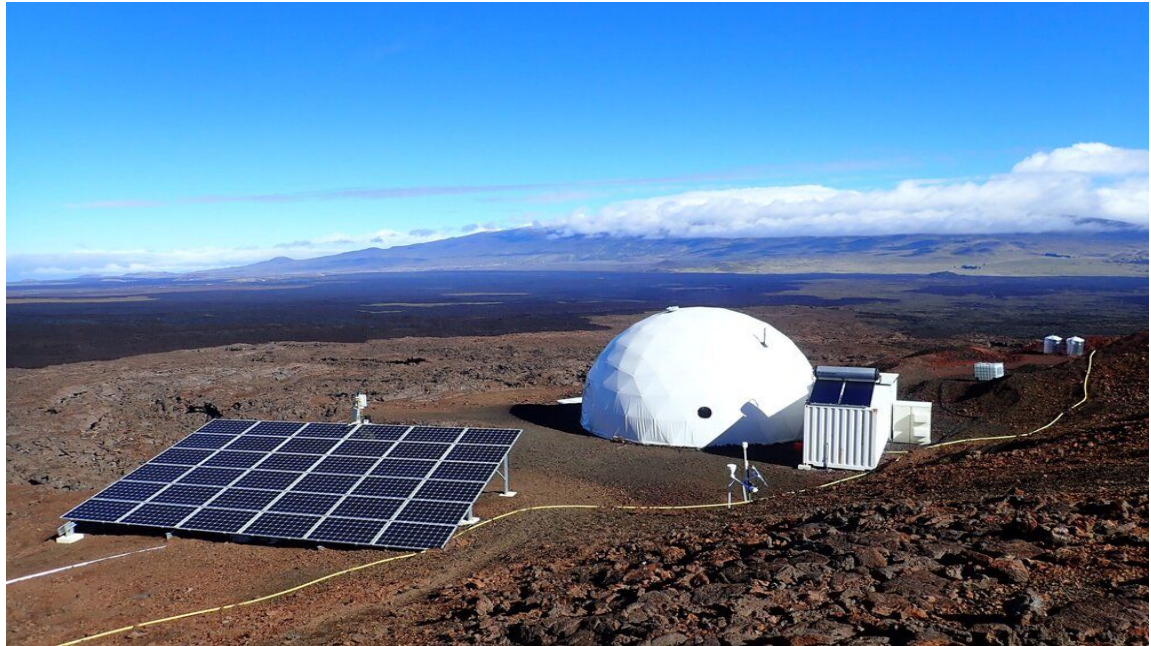




# Literature Review - Earth based ICE Conflict Mitigation

Important to understand connection between general conflict and LDSE conflict:

- ❖ Antarctica
- ❖ NEEMO
- ❖ HI-SEAS (figure)
- ❖ HERA
- ❖ MARS-520



# Literature Review - Space ICE Conflict Mitigation



To date, the most relevant space-based research has been done on short term (>520 days) missions in LEO space stations, such as the ISS.

Accurate analog in terms of space environment, however lacking all features of LDSE missions

# Gaps in the Current Literature

Group based ICE analogs cannot accurately simulate the effect of the following factors on group dynamics:

- a. Microgravity
- b. Day-night cycle changes
- c. Limited mission control contact/communication lag
- d. Accurate simulation of imminent danger/threats
- e. Extreme (5+ yrs) time durations

The connection between team cohesion and performance in LDSE versus traditional conflict studies is not known:

*“...to date, no systematic attempt has been undertaken to measure the performance effects of team cohesion, team composition, team training, or team-related psychosocial adaptation during spaceflight”*

# Method: Delphi Study

## Round 1: Open-ended (two versions)

Question	Non-Psychology	Psychology
1	Relationship between individual mood and team cohesion	Relationship between individual mood and team cohesion
2	Relationship between team cohesion and team performance in ICE	Relationship between team cohesion and team performance in ICE
3	Relationship between diversity, team cohesion and team performance	a) Effect of isolation on team performance b) Effect of confinement on team performance c) Effect of an extreme environment on team performance
4	a) Effect of isolation on team performance b) Effect of confinement on team performance c) Effect of an extreme environment on team performance	Is conflict mitigation different on Earth than in an ICE environment
5	Is conflict mitigation different on Earth than in an ICE environment	a) Effect of an extreme environment on the human psyche b) Effect of ICE on the human psyche c) Psychological effects of ICE environments on task performance d) Psychological effects of ICE environments on human interaction
6	The evolution of consecutive conflict episodes on Earth VS an ICE environment	

## Round 2: Likert Scale

1. The questions in this study will be answered with a slider. The slider showcases a scale from:

- 1 - strongly disagree
- 2 - disagree
- 3 - neutral
- 4 - agree
- 5 - strongly agree

☐ Please check the box below to continue.

2. How much do you agree with the following statement: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1 3 5

3 Clear

**Goal: to measure diversity of opinions and address research questions**



# Method: Qualitative Meta-Analysis

## Goal of Quality Assessment: inclusion/ exclusion criteria to shortlist studies

ID	Author(s) & Published Date	Purpose of the Study	Sample Size & Participant/ Gender Ratio	Methodology (Standards, Data Collection, Data Analysis, etc.)	Results
1	J. G. Corneliussen; G. R. Leon; A. Kjaergaard; B.A. Fink; N.C. Venables 2017	To study individual traits, personal values, and conflicts within groups that are in isolated, confined and extreme environments.	10 10 M	Participants were deployed to stations in Greenland for a 1 year rotation. They completed the NEO PI-R, Triarchic Psychopathy Measure, and Portrait Values Questionnaire, and participated in interviews. During the deployment, subjects also completed questionnaires biweekly and a cognitive function test monthly. The age range was from 24 to 33 and all had military training.	An overall configuration of positive personality traits, along with boldness (adventurous), appears to be highly adaptive for long-duration performance in an ICE environment. Extended training in conflict resolution, with an emphasis on strategies will also be helpful.
2	Domuschieva-Rogleva; Galina & Iancheva; Tatiana 2017	To study security needs and sensation seeking and to find a relation with the participants preferred coping strategies in highly risky activities in an extreme climatic and social environment.	21 17 M, 4 F	During the expedition, the participants fill out a number of psychological tests which inform the research questions.	The people surveyed are significantly more resilient in extreme situations, threatening incentives in situations of danger and risk, their anxiety is controlled, relying heavily on their internal resources, on their own capabilities in situations of threat
3	Johnson, J.C.; Boster, J.S.; Palinkas, L.A. 2003	To explore the effects of leadership roles as they relate to evolution of social network structure over time.	Year 1: 28 Year 2: 27 Year 3: 22 Year 1: 19 M, 9 F Year 2: 20 M, 7 F Year 3: 18 M, 4 F	Data was collected through self-reports and ratings as well as a framing task in which participants associated crew members with one of 11 different informal social roles	The presence/absence of certain informal social roles was important in allowing or preventing the evolution of a globally coherent group structure
4	Leon G.R.; Atlas M.M.; Ones D.S.; Magor G. 2002	To explore individual adjustment and group processes, team communication and interaction, the relationship between personality traits and adaptation to ICE conditions, and coping strategies	7 3 M, 4 F	Participants completed forms covering topics of personality measures, work-life satisfaction, and the PAIR (partner and intimacy form) several weeks prior to the start of the expedition. During the expedition, they regularly completed a weekly rating form, sleep log, monthly rating form, and the PAIR.	The relatively positive group living experience was facilitated by the generally good psychological adjustment of team members; the study findings showed associations among positive and negative mood, negative events, and stages of the expedition; the importance of the emotional support provided to individuals in partnership relationships in the ICE situation and its benefits for overall team functioning were significant findings.

# Method: Qualitative Meta-Analysis

**Goal of Coding Table:** to address research questions through meaning units, condensed meaning units, codes, and marking relevant themes

Research questions:		(1) What differentiates conflict mitigation in the general case from conflict mitigation in ICE environments? What differentiates conflict mitigation in ICE environments on Earth from conflict mitigation in ICE environments in space?	(2) What are the factors contributing to successful conflict mitigation in the general case? In ICE environments on Earth? How do we extrapolate these findings to ICE environments in space that are maintained for exorbitantly long durations?	THEMES					
Question	Paper ID	Meaning unit	Condensed meaning unit	Code	Conflict types	Mitigation patterns/modes	Temporal evolution	Location	Team Characteristics
1	1	"Clearly, an analog is a simulation of specific aspects of the situation of interest and does not provide all of the components of the situation itself; in this case, the space environment. However, the ICE analog can provide relevant information on how small groups interact together while living and working in a confined and environmentally challenging situation, with limited contact with the outside world, and during periods in which there are limited possibilities for evacuation"	While analogs are not a perfectly accurate model for space environments, they may still provide valuable information on team dynamics in challenging environments under high-stress situations.	Limitations of analogs				1	
2	1	"Assessment of polar work group personnel indicated that those judged notably well adapted in terms of psychological functioning, social adaptability, and work performance had high scores on the NEO-FFI Openness factor; the best work performers among Antarctic winter-over personnel scored low on neuroticism, need for order, and achievement motivation".	Successful team members performed well on their adaptability and scores on the NEO-FFI Openness factor.	Crew Selection					1
2	1	"Compatibility of values appears to be highly important for optimal team member performance over extended missions. In the Mars-105 simulation study, tensions occurred among team members viewed as dissimilar in values. Over the course of the following Mars-500 study, emphasis on self-direction increased, while valuation of benevolence, stimulation, and tradition significantly decreased. Crewmembers attributed group tension to individual differences in benevolence".	Common views on benevolence and other values appear to have a notable impact on team cohesion.	Team Cohesion	1				1

# Results and Discussion: Delphi Study (Round 1)

Question Asked	Opinions Generated
Do you think that there is a relationship between an individual's mood and team cohesion? If so, what is the relationship and how does one affect the other?	No consensus regarding individual vs team mood
Studies have not found a definite link between team cohesion and team performance in isolated, confined, and extreme (ICE) environments, while such a relationship is observed to exist among more general team environments (where strong team cohesion tends to boost team performance). Why do you think that is the case, and what is your view on the relationship between team cohesion and team performance in an ICE environment?	Survival as a task priority effects team performance the most
Do you believe there is a relationship between team diversity (e.g. ethnicity, gender, skill set, etc.) and team cohesion? How would this relationship impact the team's performance? If you do not believe team diversity is a big proponent of team cohesion and/or team performance, what factors do you believe affect team cohesion and team performance?	No consensus regarding diversity and team performance
a) How do you believe team performance is affected if the team members are isolated? The team members would only have interactions with themselves (away from their typical social network), having no other support system (family, friends, individuals outside of the team). b) How do you believe team performance is affected if the team members are confined? The team members would not be able to leave the situation even if they are uncomfortable. c) How do you believe team performance is affected if the team members are in an extreme environment? Based on the fact that the team members could face traumatic events and the threat of losing their life, will the team members develop a more positive working relationship or will those stressors lead to a breakdown of team union?	No consensus regarding team performance and the ICE environment
Do you think that the conflict mitigation strategies generally used to promote a positive work environment would apply to a team that is in an ICE environment such as space? If so, why? If not, what would be an extra "ingredient" needed to promote a positive work environment?	Preparation prior to the mission can manage conflict
Considering the case where there are consecutive conflicts regarding the same team, generally, how does the evolution of conflict resolution affect the team's conflict mitigation strategies in the long run? How do you think this evolution would differ if the team was in an ICE environment such as space?	ICE requires conflict resolution
a) How does an extreme environment affect the human psyche? b) How do isolation and confinement in an extreme environment affect the human psyche? c) How do the effects mentioned in parts a and b affect a person's ability to do a task? d) How do the effects mentioned in parts a and b affect a person's ability to interact with others?	ICE affects individuals differently

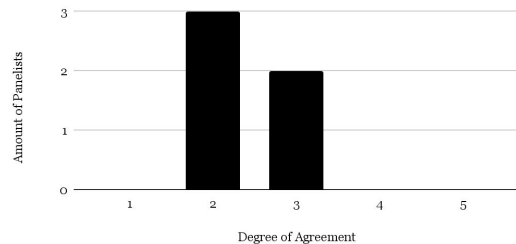
# Results and Discussion: Delphi Study (Round 2)

Question Asked	Average Degree of Agreement
Similar Qualifications/Preparation Improves Team Cohesion	2.4 +/- 0.5
Similar Qualifications/Preparation Strengthens Trust	3.8 +/- 0.4
Diversity Leads To Conflict	3 +/- 0.9
Diversity Improves Team Performance	4
Conflict Is Required For Higher Team Performance	3.6 +/- 1.0
ICE Environments Promotes Less Conflict	3 +/- 0.9
Individual Priorities Change Over The Course Of The Mission	2.4 +/- 1.0
A Good Leader Can Offset The Effects Of An ICE Environment	4 +/- 0.6
Training In Isolation Prepares For Potential Conflicts	2.6 +/- 0.8
Screening Can Prevent Potential Conflicts	3 +/- 0.6
A Lack Of Third Party Communication Leads To Conflict	2.6 +/- 0.5
An Evolving Team Dynamic Is Necessary	4.4 +/- 0.8



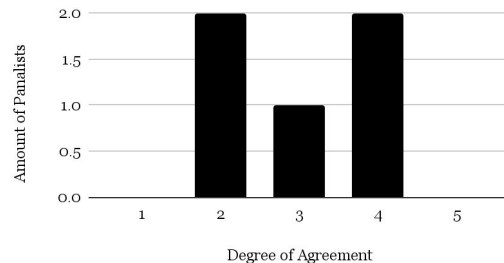
# Results and Discussion: Delphi Study (Round 2)

Q1: Similar Qualifications/Preparation Improves Team Cohesion



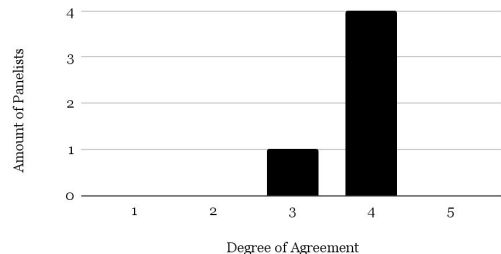
**Training beforehand**

Q3: Diversity Leads To Conflict



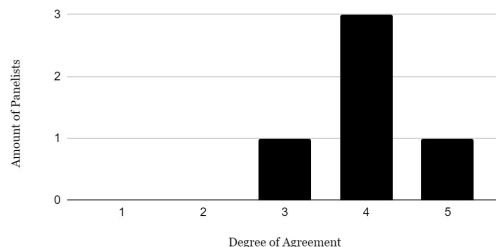
**Individuality**

Q2: Similar Qualifications/Preparation



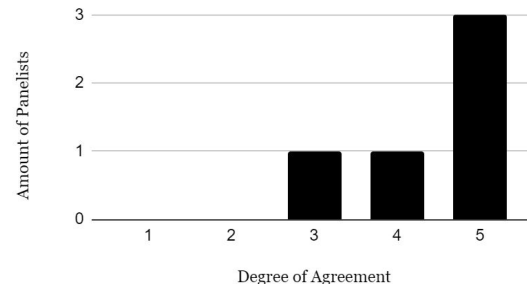
**Trust building**

Q8: A Good Leader Can Offset The Effects Of An ICE Environment



**Team leader**

Q12: An Evolving Team Dynamic Is Necessary



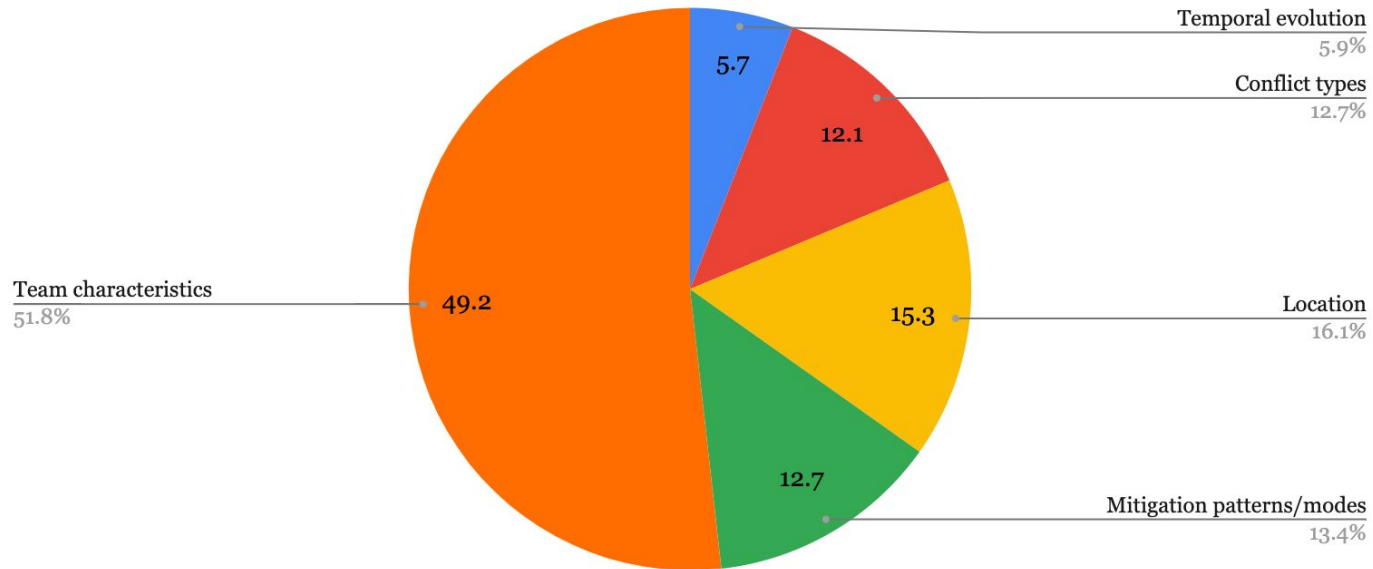
**Adequate  
communication, minimal  
avoidance, and no  
competition**

# Results and Discussion: Qualitative Meta-Analysis

Themes	Units in RQ1	Units in RQ2	Overall Units
Temporal evolution	2	5	7
Conflict types	1	14	15
Location	6	13	19
Mitigation patterns/modes	4	18	22
Team characteristics	8	53	61
Total number of comments around themes			124

# Results and Discussion: Qualitative Meta-Analysis

Frequency of theme occurrence (%)



# Conclusion

## Qualitative Meta-Analysis

**RQ1:** Common themes are mitigation patterns/modes, location, team characteristics.

**RQ2:** Common themes are conflict types, mitigation patterns/modes, and team characteristics.

## Delphi Study

**RQ1:** Conflict mitigation in ICE is critical while on Earth it is highly desired.

**RQ2:** A definition of successful conflict mitigation comprising five factors was created.



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