2012 Behavioral Health and Performance Standing Review Panel

Research Plan Review for:

The Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team

Final Report

I. Executive Summary and Overall Evaluation

The 2012 Behavioral Health and Performance Standing Review Panel (from here on referred to as the SRP) met for a site visit in Houston, TX on December 11 - 12, 2012 to review the Research Plan for the Team Risk (The Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team) in the Human Research Program's (HRP) Integrated Research Plan (IRP Rev. D).

Craig Kundrot, Ph.D., Acting Chief Scientist of the HRP began the review with a presentation detailing NASA's current goals and planning for space exploration. The SRP was struck by the difficulty of "flexible path" planning, which is essentially making plans for a journey without knowing the destination (i.e., there was some debate over whether the next space flight would be to the moon, to an asteroid, or to Mars). This certainly exacerbates the problems facing the HRP (and NASA). The loss of personnel from the BHP Element is another problem, and if not remedied, a major detriment.

The SRP also thinks that the planned one-year expedition on the International Space Station (ISS) is an interesting experiment that will likely produce useful physiological data. However, even aside from the tiny sample size (two crewmembers), it is not a realistic analogue because the two participants are embedded in an otherwise changing social environment (i.e., other crewmembers spending approximately six months on the ISS). The SRP hopes that sometime in the future thought will be given to having a full crew remain on the ISS for an entire year for a credible set of behavioral results. The SRP strongly believes that work on the ISS should continue.

The SRP is pleased that a performance database is being worked on and that the data will be accessible to external researchers. The Habitation Demonstration Unit and the Human Performance Database are valuable and undoubtedly productive steps forward. The latter represents part of a potential cumulative behavioral-psychological database that for many years has been urged on NASA by relevant outside scientists.

The SRP thought that the presentations from Lauren Leveton, Ph.D. (BHP Element Scientist) and William Vessey, Ph.D. (Team Risk Lead) were very detailed and informative.

<u>Specific to the Team Risk:</u>

- The SRP was presented a very large amount of detailed material, but it is not obvious to the SRP how all the tasks outlined in the material will be managed and prioritized.
- Prioritization of gaps and tasks seems to be missing, as does a timeline detailing what is most important. It would be helpful if the gaps and tasks were prioritized, with a clearly explained rationale regarding the relative importance of each.

- Since the use of ISS may end in 2020, timing is an issue even if the tasks are perfectly coordinated.
- Closing the gaps may be difficult especially since the crews are unenthusiastic about participating in activities that take up their time, such as questionnaires; but the SRP notes that there is no such problem with the Journals study (Behavioral Issues Associated with Isolation and Confinement: Review and Analysis of Astronaut Journals, PI: Jack W. Stuster).
- The SRP noted that some of the new gap definitions showed regression, from the goal of making things as good as practicably feasible to making them "good enough" (e.g., Team Gaps 3, 4, 5, new Team Gap 9). The point was made that the reason for this apparent regression is that "enhancement" is more expensive than "maintenance" and possibly more difficult to objectively measure; that may be true in some cases, but certainly not in all, and in any case it is the cost-benefit ratio that needs to be assessed.
- The SRP encourages the BHP Element to continue and intensify enhancement-oriented research both internally and with regard to the funding of research by outside scientists. The SRP urges the BHP Element to pursue the Office of Naval Research -NASA collaborative study of team resilience, and similar collaborations with other relevant organizations.
- Leadership is needed in small isolated groups. A task should be added to the address this issue.
- The SRP thinks that cultural and societal aspects influencing group behavior are not addressed adequately in the current studies. Some of the studies sited below may provide a good starting point.
    - Oyserman, D., Sorensen, N., Reber, R., Chen, S.X., 2009. Connecting and separating mind-sets: culture as situated cognition. J Pers Soc Psychol 97, 217-235.
    - Fleming, K.K., Bandy, C.L., Kimble, M.O., 2010. Decisions to shoot in a weapon identification task: The influence of cultural stereotypes and perceived threat on false positive errors. Soc Neurosci 5, 201-220.
    - Klein, H.A., Lin, M.H., Radford, M., Masuda, T., Choi, I., Lien, Y., Yeh, Y., Boff, K.R., 2009. Cultural differences in cognition: Rosetta Phase I. Psychological reports 105, 659-674.
    - Aron, A., Ketay, S., Hedden, T., Aron, E.N., Rose Markus, H., Gabrieli, J.D., 2010. Temperament trait of sensory processing sensitivity moderates cultural differences in neural response. Soc Cogn Affect Neurosci 5, 219-226.
    - Miellet, S., Zhou, X., He, L., Rodger, H., Caldara, R., 2010. Investigating cultural diversity for extrafoveal information use in visual scenes. J Vis 10, 1-18.
    - Lovett, A., Forbus, K., 2011. Cultural commonalities and differences in spatial problem-solving: a computational analysis. Cognition 121, 281-287.
    - Moriguchi, Y., Evans, A.D., Hiraki, K., Itakura, S., Lee, K., 2012. Cultural differences in the development of cognitive shifting: East-West comparison. J Exp Child Psychol 111, 156-163.
    - Kim, B., Sung, Y.S., McClure, S.M., 2012. The neural basis of cultural differences in delay discounting. Philos Trans R Soc Lond B Biol Sci 367, 650-656.
    - Kuwabara, M., Smith, L.B., 2012. Cross-cultural differences in cognitive

development: attention to relations and objects. J Exp Child Psychol 113, 20-35.
    - Rockstuhl, T., Dulebohn, J.H., Ang, S., Shore, L.M., 2012. Leader-member exchange (LMX) and culture: A meta-analysis of correlates of LMX across 23 countries. The Journal of applied psychology 97, 1097-1130.
- The SRP also suggests that the BHP Element consider research that would unconfound communication delay and autonomy. Is autonomy a "necessary evil" when communication delay makes it inescapable, or is it beneficial in its own right and perhaps worthy of incorporation in all missions? What will happen on a prolonged return space exploration mission as the communication delay shortens - will autonomy continue at the same level, or decrease along with the delay? Which would be most acceptable and effective for astronauts and mission control?

II. Critique of Gaps and Tasks for the Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team

Gaps and Tasks:

Team Gap 1 (Formerly Team1): We need to understand the key threats, indicators, and life cycle of the team for autonomous, long duration and/or distance exploration missions.

- The SRP thinks that this gap is relevant.
- The SRP is unclear about what is meant by "the life cycle of the team". This should be defined.

Tasks:

- Risk Assessment – Task Performance, Teamwork, and Psychosocial Performance – Task completed
- Access to Performance Data Effort – Task completed
- Examination of Cultural Interactions Using Archival Data Footage on ISS – Task completed
- Job Analysis – Planned task
    - The SRP is unclear as to why this task has not already been done.
- Long Duration Antarctica Study - Teams in ICE – Planned task
- Long Duration ISS Space Flight Study –Planned task
- NSCOR: Long Duration Analog Studies (Russian Chamber) – Planned task
- Psychosocial Factors Model Development – Planned task
- Review of Team Function Benchmarking Studies (Duration/Distance) – Planned task
- Literature Review and Operational Assessment of Psychosocial Strategies related to BHP – PI: John Nicoletti, Ph.D., Nicoletti-Flater Associates, PLLP
- BMed/Team Workshop – Planned task
- Assessing the Impact of Communication Delay on Performance: An Examination of Autonomous Operations Utilizing the International Space Station – PI: Lawrence Palinkas, Ph.D., University of Southern California
    - The SRP is uncertain about the utility of this study. Any future long-duration mission (e.g., to Mars) would be characterized by increasing delays as the

distance from Earth increases. It might be worthwhile to do a parametric study to discover whether there is a threshold beyond which the lag becomes troublesome; but a 50-second delay vs. no delay comparison during an actual long-duration mission does not seem to provide much information. Past analog research and an ongoing study of three astronauts are not adequate to close this gap.

- Investigating the Influence of Personality on Performance Within the Astronaut Population – Task completed
- Psychosocial Performance Factors in Space Dwelling Groups – PI: Peter Roma, Ph.D., Institutes for Behavior Resources, Inc.

Team Gap 2 (Formerly Team 2): We need to identify a set of validated measures, based on the key indicators of team function, to effectively monitor and measure team health and performance fluctuations during autonomous, long duration and/or distance exploration missions.

- The SRP thinks that this gap is relevant.
- This SRP thinks that this gap cannot be closed until the key indicators from Team Gap 1 are established.
    - What is the alternative contingency plan if you do not get the clear indicators from Team Gap 1?

Tasks:

- Automated Behavior and Cohesion Assessment Tools – PI: Marcus Huber, Ph.D., Cybernet Systems Corporation
- Behavior Tracking Software Enhancement and Integration of a Feedback Module – PI: John Thompson, Ph.D., Horizon Performance
- Literature Review and Operational Assessment of Monitoring Tools and Technologies related to BHP – Task completed
- Monitoring Tools TEAM Mental Model Requirements – Planned task
- Analog Validation Study of Team Measures – Task completed
- Field Test of a Simple, Rapid, and Objective Behavioral Assay of Group Cohesion in an Antarctic Space Analog Environment – PI: Peter Roma, Ph.D., Institutes for Behavior Resources, Inc.
- Developing, Maintaining, and Restoring Team Cohesion – PI: Steve Kozlowski, Ph.D., Michigan State University
- Monitoring and Regulating Teamwork – PI: Steve Kozlowski, Ph.D., Michigan State University
- Development of an Objective Behavioral Assay of Cohesion to Enhance Composition, Task Performance, and Psychosocial Adaptation in Long-Term Work Groups – PI: Peter Roma, Ph.D., Institutes for Behavior Resources, Inc.
- AD ASTRA: Automated Detection of Attitudes and States through Transaction Recordings Analysis – PI: Chris Miller, Ph.D., Smart Information Flow Technologies, LLC

Team Gap 3 (Formerly Team 3): We need to identify a set of countermeasures to support team function for all phases of autonomous, long duration and/or distance exploration

missions.

- The SRP thinks that this gap is relevant.
- As with Team Gap 2, the SRP thinks that this gap cannot be closed until you have the key indicators from Team Gap 1.
    - What is the alternative contingency plan if you do not get the clear indicators from Team Gap 1?

Tasks:

- Spaceflight CM Validation Studies – Planned task
- Countermeasure for Managing Interpersonal Conflicts in Space: A Continuation Study – PI: James Cartreine, Ph.D., Brigham and Women's Hospital
- Just-in-Time, Cross Training Countermeasures – Planned task
    - The SRP is unclear of what is the difference between this task and the completed Crew Scheduling Tools (PI: Michael McCurdy, Ph.D., NASA ARC) task since the wording of the two appears identical.
- Literature Review and Operational Assessment of Countermeasures Related to BHP – Task completed
- Support/Adaptation Countermeasures – Planned task
- Crew Scheduling Tools – Task completed
- Factors Contributing to Food Acceptability and Consumption, Mood, and Stress on Long-term Space Missions – PI: Zata Vickers, Ph.D., University of Minnesota
- Literature Review and Operational Assessment of Communication Strategies related to BHP – PI: Rona Flin, Ph.D., University of Aberdeen
- Assessing the Impact of Communication Delay on Performance: An Examination of Autonomous Operations Utilizing the International Space Station – PI: Lawrence Palinkas, Ph.D., University of Southern California
- A Scheduling and Planning Tool in NEEMO 14 – A Simulated Space Environment – Task completed
- Protocols for Asynchronous Communication in Space Operations: Communication Analysis – PI: Ute Fischer, Ph.D., Georgia Institute of Technology

Team Gap 4 (Formerly Team 4): We need to identify psychological measures that can be used to select individuals most likely to maintain team function for autonomous, long duration and/or distance exploration missions.

- The SRP suggests combining Team Gap 4 and Team Gap 8 and adding cultural aspects to the language. The suggested rewording of the gap is ***"We need to identify psychological and cultural indicators that can be used to select individuals most likely to maintain team effectiveness and compose highly effective crews for autonomous, long duration, and/or distance exploration missions."***

Tasks:

- Selection Studies Retrospective - Planned task
- Virtual Reality (VR) Technologies for Enhancing Behavioral Health - Task completed

Team Gap 5 (Formerly Team 5): We need to identify validated team training methods that

can be used to maintain team function in autonomous, long duration and/or distance exploration missions.

- The SRP thinks that this is a relevant gap.
- It is not clear to the SRP whether training will continue once the mission starts.
- The SRP suggests rewording of the gap to ***"We need to identify validated ground-based training methods that can be both preparatory and continuing to maintain team function in autonomous, long duration, and/or distance exploration missions."***

Tasks:

- Training Needs Analysis – Planned task
  - How do you know the training needs until you run studies? This does not seem doable given that new training needs will likely arise every time the mission duration is extended.
- Simulation Run to Test Training – Planned task
- Analog Training Studies – Planned task
- Optimizing Crew Performance in Long Duration Space Exploration: Best Practices for Team Training and Cohesion Measurement – PI: Eduardo Salas, Ph.D., University of Central Florida
  - The SRP is unsure of what the aim of this task is and how it will fit back to resolve the gap
- Communications Training Review Requirements – Planned task
- Literature Review and Operational Assessment of Training Strategies related to BHP – Task completed
- Training and Culture – Planned task
- Virtual Reality Pre-Mission Training Countermeasures – Planned task
  - It is unclear to the SRP what this training is for (i.e., what exactly is being trained and how will VR be used to accomplish this training?)
- Enhancing Team Performance for Exploration Missions – Task completed

Team Gap 6 (Formerly Team 6): We need to identify the best methods to support and enable multiple distributed teams to maintain team function in autonomous, long duration and/or distance exploration missions.

- The SRP thinks that this gap is relevant.
- The SRP thinks that "multiple distributed teams" should be defined.
- The SRP thinks that autonomy should be defined. Is autonomy referring to the autonomy of team members from each other or from a command structure while doing their job or autonomy of the entire crew from ground-control assets due to communication delays during the mission?

Tasks:

- Assessing Team Performance in Autonomous Environments – Task completed
- Autonomy Literature Review Requirements – Task completed
- Crew Interactions and Autonomy During Long-Duration Isolation and Confinement (105-Day Russian Chamber Study) – Task completed
- Autonomy Workshop – Task completed

- Effects of high vs. Low Autonomy on Crewmember Performance in Analogues – PI: Nick Kanas, M.D., University of California, San Francisco

Team Gap 8 (Formerly Team 4): We need to identify psychological and psychosocial factors, measures, and combinations thereof that can be used to compose highly effective crews for autonomous, long duration and/or distance exploration missions.

- The SRP suggests combining Team Gap 4 and Team Gap 8 and adding cultural aspects to the language. The suggested rewording of the gap is ***"We need to identify psychological and cultural indicators that can be used to select individuals most likely to maintain team effectiveness and compose highly effective crews for autonomous, long duration, and/or distance exploration missions."***
- The SRP thinks that the BHP Element should leverage some of the work that the military has already done on self-sustaining teams. In particular, the BHP Element should coordinate with US Navy researchers since research aimed at successful ship and submarine deployments may at least partially address some of the team-effectiveness issues.

Tasks:

- Leader-Followership Team Composition – Planned task
- Specialized Roles Team Members – Planned task
- Composing and Developing Resilient, Adaptive, and Self-Sustaining Teams for Long Duration Space Exploration – PI: Scott Tannenbaum, Ph.D., The Group for Organizational Effectiveness, Inc.
- Field Test of a Simple, Rapid, and Objective Behavioral Assay of Group Cohesion in an Antarctic Space Analog Environment – PI: Peter Roma, Ph.D., Institutes for Behavior Resources, Inc.

Team Gap 9: We need to identify spaceflight-acceptable thresholds (or ranges) of team function, based on key indicators, for autonomous, long duration and/or distance exploration missions.

- This SRP thinks this is a relevant gap but that this gap should be answered prior to individual and crew selection.
- The reference to "acceptable thresholds (or ranges) of team function" is questionable on two points. "Thresholds" is a reminder of the justly criticized "selecting out" procedure (as opposed to "selecting in"), implying an acceptance of a level of functioning that merely satisfies minimal criteria; "ranges" implies that there is an upper limit of functioning above which the team should not reach.

III. Discussion on the strengths and weaknesses of the IRP and identify remedies for the weaknesses, including answering these questions:

Is the Risk addressed in a comprehensive manner?

- Yes, the SRP thinks that the Risk is addressed in a very detailed and almost too comprehensive manner.

Are there obvious areas of potential integration across disciplines that are not addressed?

- The SRP thinks that there are some additional areas of integration that the BHP Element should consider.
    - Pharmacology discipline
    - Space human factors engineering discipline
    - Visual impairment and intracranial pressure discipline
    - Engineers
    - ISS group
    - Vehicle design group
    - Net habitable volume group

How is the progress of the IRP, Rev. D since the 2011 BHP SRP?

- The SRP is pleased that the BHP Element has begun funding a lot more tasks.
- The SRP was pleased with the specific details they were provided with this year with respect to the Team Risk.

IV. Additional Comments

- The SRP thinks that the attempt to complete tasks is a good idea, but all funded tasks should show yearly progress and those completed should provide deliverables which are summarized on the website. The SRP suggests the following:
    - For planned tasks: a brief abstract (2-3 sentences) stated the specific aims of the task. For those studies that are not in the near future, as the knowledge base grows, the aims should be more refined.
    - For current tasks: what is currently being done and what are the implications of the current findings.
    - For completed tasks: a brief summary (2-3 sentences) of results and how these results will help close the gap.

V. 2012 Behavioral Health and Performance SRP Research Plan Review (Site Visit): Statement of Task for the Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team

The 2012 Behavioral Health and Performance (BHP) Standing Review Panel (SRP) is chartered by the Human Research Program (HRP) Chief Scientist. The purpose of the SRP is to review the BHP Element's section of the HRP's Integrated Research Plan, Revision D (IRP Rev. D) which is located on the Human Research Roadmap (HRR) website (http://humanresearchroadmap.nasa.gov/). Your report will be provided to the HRP Chief Scientist.

The 2012 Behavioral Health and Performance SRP is charged (to the fullest extent practicable) to:

1. Evaluate the ability of the IRP Rev. D to satisfactorily address the Risk by answering the following questions:
   A. Have the proper Gaps been identified to address the Risk?
      i) Are all the Gaps relevant?
      ii) Are any Gaps missing?

   B. Has the appropriate target for closure for the Gap been identified?
      i) Are the interim stages appropriate to close the Gap?

   C. Have the proper Tasks been identified to fill the Gaps?
      i) Are the Tasks relevant?
      ii) Are any Tasks missing?

2. Identify the strengths and weaknesses of the IRP Rev. D, *and* identify remedies for the weaknesses, including answering these questions:
   A. Is the Risk addressed in a comprehensive manner?
   B. Are there obvious areas of potential integration across disciplines that are not addressed?

3. Please evaluate the progress in the IRP Rev. D since your 2011 SRP meeting.

4. Please comment on any important issues that are not covered in #1, #2, or #3 above.

Additional Information Regarding This Review:

1. Expect to receive review materials at least four weeks prior to the meetings.

2. Participate in a 2012 BHP SRP conference call to discuss any issues, concerns, and expectations of the review process approximately three weeks prior to the meeting.
   A. Discuss the 2012 BHP SRP Statement of Task and address questions about the SRP process.

B. Identify any issues the 2012 BHP SRP would like to have answered prior to or during the meeting.

3. Attend the 2012 BHP SRP meeting at NASA JSC on December 11 -12, 2012.
   A. Attend Element or Project presentations, question and answer session, and briefing.
   B. Prepare a draft report that addresses each of the evaluation criteria listed in the panel charge. Debrief the HRP Chief Scientist and a representative from the BHP Element on the salient points that will be included in the final report and specifically the items in the panel charge.

4. Prepare a draft final report (within one month of the site visit debrief) that contains a detailed evaluation of the current IRP specifically addressing items #1, #2, #3, and #4 of the SRP charge. The draft final report will be sent to the HRP Chief Scientist and he will forward it to the appropriate Element for their review. The BHP Element and the HRP Chief Scientist will have 10 business days to review the draft final report and identify any misunderstandings or errors of fact and then provide official feedback to the SRP. The SRP will have 10 business days to address any issues and finalize the 2012 SRP Final Report. The 2012 SRP Final Report will be submitted to the HRP Chief Scientist and copies will be provided to the BHP Element and also made available to the other HRP Elements. The 2012 SRP Final Report will be made available on the Human Research Roadmap public website (http://humanresearchroadmap.nasa.gov/).

VI. 2012 Behavioral Health and Performance Standing Review Panel Roster

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