Review of Human Cognitive Performance in Spaceflight

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Introduction: Human space exploration is inherently hazardous, particularly for long duration (LD) missions (22 days or longer). Maintenance of cognitive functioning is essential, but flight environments pose numerous potential risks to the brain and cognitive performance (eg, radiation, toxins, chronic stress, sleep deprivation, hypercarbia, fluid shifts, hormone imbalances, and injury). There have been persistent anecdotal reports of cognitive deficits during missions, but an up-to-date review of the evidence for such changes has remained unavailable. Methods: We identified and reviewed English language publications found via electronic searches in PubMed, PsycInfo, Inspec, the NASA Technical Report Server, and the Defense Technical Information C enter, plus recursive searches of publication bibliographies. Search terms included the word cognition, cognitive, or performance along with spaceflight, flight, mission, or closely related terms. Results: Inter-study variability precluded meta-analysis. Some 32 published studies involving cognitive assessment during spaceflight were identified, involving a total of 110 participants (mean: 3.4 participants per study). The longest-duration study spanned 438 days, with six additional studies involving flight durations of 90 days, and 11 more studies involved flight durations exceeding 21 days. The available evidence failed to strongly support or refute the existence of

cognitive deficits in LD spaceflight, in part due to inadequate power or control conditions. Evidence of increased variability in cognitive performance during spaceflight, both within and between individuals, was common. Discussion: These results represent a negative finding based on small numbers of subjects for any given cognitive function. The increased variability within and (particularly) between individuals highlights the potential danger of generalizing from case studies. A mismatch therefore remains between anecdotal reports describing generalized cognitive slowing, attention and memory problems during missions and the experimental evidence supporting such deficits. Since a major justification for manned spaceflight rests with the cognitive flexibility of humans, additional studies and further analysis of existing operational data appears warranted.