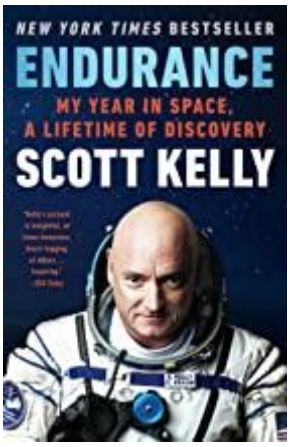

Endurance: My Year in Space, A Lifetime of Discovery

Written by Scott Kelly September 25, 2018

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A glimpse into the future: The significance of Scott Kelly's book is, that for the first time a unique "foundation" scale for physical, social and psychological endurance effects of long-term spaceflight missions could be established with Kelly's one year uninterrupted stay on the ISS. The setup was, to compare Scott's experience with his twin brother Mark, also an astronaut, staying back on earth during this time, as well as with his Russian fellow cosmonaut, Mikhail Kornienko sharing Scott's one year stay on the ISS exactly under the same conditions as Scott. With this setup it was possible to eliminate individual behaviour and to establish common physical and psychological basic effects which would be unavoidable, yet foreseeable and plannable for deep space exploration e.g., for human missions to Mars.

Scott tells his story “from the beginning”, the audio-book version he even narrates himself, in a way a friend and colleague would tell you his life story in your living room. Kelly was motivated by the Moon landing in 1969, which he watched as a 5- year old and by Tom Wolfe’s “the Right Stuff” he read in his teens.

In his book Scott gives detailed, rare and private insights in the activities at Star City and Baikonour, and observes the Russian cosmonaut rituals and describes the cordial, private and social interactions with his “endurance” flight crew Gennady Padalka and “Misha” Kornienko.
During his one year stay Scott and the varying ISS crew, being exchanges quarterly, had to cope with WHC (Waste and Hygene Compartment) and air cleaner problems, collision threats with decommissioned satellites, power outages, fire alarms, loss, failure and delay of resupply flights – but he also could savor one the first onboard brewed espresso’s (Kelly; “That’s one small step for woman, one giant leap for coffee”) and taste the first onboard grown lettuce with vinegar and oil (“pretty good”).

A minor hint for future space stations is the importance of view-ports in the modules (and their lack in the European Columbus module).

When asked by the public “what is it worth” he has a thoughtful answer like: The Soyuz rocket was the grand-grand -child of the R-5 rocket which would have had the (ICBM) - capability to hit targets in the USA – but the Russians converted it to the Soyuz series for civil space flight. Now we are using their Soyuz rocket cooperating with our cold-war enemy on the ISS for peaceful purposes – can you put a Dollar price on it?

Cautioning potential pilots considering to become astronauts, Kelly observes: “We are not flying the ISS, but we conduct science like in a highly specialized laboratory and perform maintenance of the space station to secure our living space and guarantee the functioning of all systems as instructed by the ground control team”.

The means is the OSTPV (On board short term the planning viewer) which controls strictly all activities of the entire crew, sometimes down to a 5 min resolution and Kelly complains that often activities take longer than planned and eat in the crew's "private time" or even "sleeping time".
Kelly also reports that minor factors like air quality, lighting and internal noise levels and the different smells of a hermetically sealed living and working place play an important role for long term duration flights for the well-being of astronauts – and of course food, privacy and contact with the family are of utmost importance. Also social contacts with the onboard crew are important like joint meals at fixed times ("sit down" at a table to eat and talk).

Kelly offers also some recommendations for the international ground crews at the participating ISS control centers: Although CO_2 is a big deal with respect to climate change discussions, effects of small CO_2 variations onboard, which cause "bad moods" for some astronauts, do not find the appropriate attention – the repair of a backup CDRA (Carbon Dioxide Removal Assembly) was postponed because of the upcoming weekend (on ground). Scott also suggests to reduce the "adoration speeches" ("thank you for the great job"/"super support from the ground") between onboard and ground to occasions where it matters.

There were more than 400 experiments on gravity and biological tests conducted on all astronauts on the station. Kelly sorts them into two categories, the ones conducted aimed to be also beneficial for life on Earth, like the development of new drugs, make combustion processes more efficient or the development of new materials and secondly, the ones solving problems of future space flight, like testing new, more efficient and reliable life support equipment, solving technical problems for human long term flights and handling the demands of the human body in space.
Kelly and his Russian flight companion Kornienko participated as "test" subjects in the second category: tests on eyes, heart and blood vessels, sleep and nutrition, DNA and effects of spaceflight on genetic level, psychological and social effects due to long term isolation and confinement. In addition Scott had to keep a meticulous log "on everything": eating and moods, reading skills and variations over the day, recording ultrasound results of blood vessels and heart and the results of eyes and muscles tests as well as fluid shift experiments to find out why damage to some astronaut's vision occurs.
Further long term experiments with overlapping science and exploratory goals were: measurement of bone loss, keeping the heart healthy, lettuce growing, water processing.

As pointed out above, Kelly also participated in a comparative study on the effects of spaceflight with his identical twin Mark as the ground control subject. Kelly's physical, cognitive, and genetic traits were measured before and after the flight to be compared with Mark's health and genetic developments for the next couple of years (NASA Twins Study).

Genetic tests revealed changes in Kelly's gene expression and an increase in the length of his telomeres (a compound structure at the end of a chromosome which determines biological aging) during his flight, but was observed to be reversible after landing. [1]

Within several months after returning to Earth, Kelly had adapted to living in gravity again.

The Twins Study has benefited NASA by providing the first application of genomics to evaluate potential risks to the human body in space. The NASA Twins Study also presented a unique opportunity for investigators to collaborate, participating in a team approach to HRP (Human Research Program) research.[1]

"Endurance" is an outstanding book – not only for professionals, but also for the public. It is providing a detailed and understandable account of what is done on the ISS (with taxpayer's money) for the benefit of current and future mankind. The unique selling point of the book is, that it not only tells Scott's experience and experimental results of his one year stay on the ISS, but is interwoven with the pursuance of his childhood dream to become an astronaut and the frank, unvarnished story of his not always straightforward professional and private life.

I highly recommend this book and I would like to thank Scott, Mark and "Misha" for their "endurance", patience and dedication and their achievements "pushing the envelope" and because "Space Flight is one of the crown jewels of our society" (Scott Kelly)

References:

[1] https://www.nasa.gov/feature/nasa-twins-study-investigators-to-release-integrated-paper-in-2019