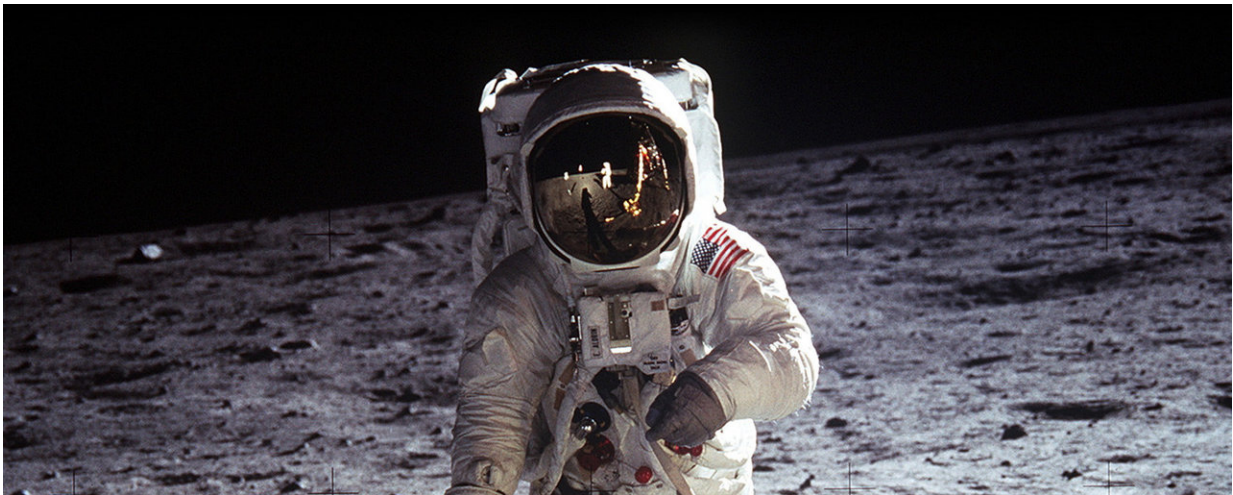


Sticking to the schedule was difficult for Apollo astronauts

January 19 2018, by Jason Maderer



Buzz Aldrin on the Apollo 11 mission in 1969. Credit: NASA

No one plans like NASA, and when it came to exploring the moon, the Apollo program was no different. However, even despite their best efforts, the astronauts consistently demonstrated the challenges of keeping to schedule.

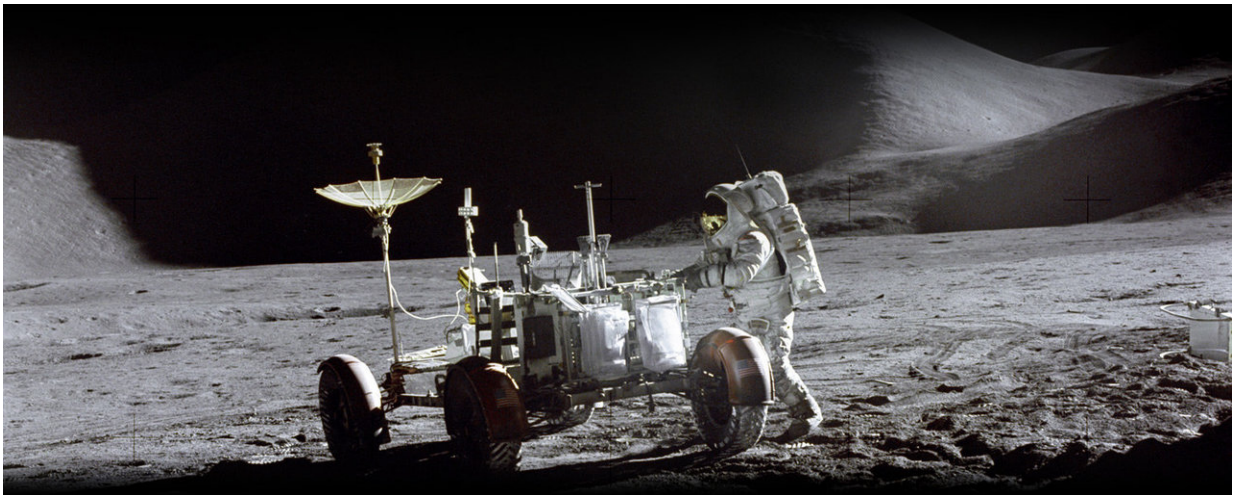
Georgia Institute of Technology researchers analyzed the archived [mission](#) reports from the Apollo moonwalks to see how well moonwalkers were able to stick to their expected timelines. The Georgia Tech team also examined life support systems—oxygen, power and

water consumption levels—to see if the relationships between NASA's pre-flight estimates and timeline performance were accurate.

The moonwalks were a success. However, on nearly every extravehicular activity (EVA), those activities took longer than predicted to complete and individual tasks were sometimes skipped entirely to get the moonwalkers back on schedule. Astronauts were at times an hour behind schedule.

"Most of that time was lost when trying to walk or drive across the lunar surface," said Karen Feigh, an associate professor in Georgia Tech's Daniel Guggenheim School of Aerospace Engineering. "Only one of the 11 EVAs we analyzed, Apollo 15's first moonwalk, finished ahead of schedule—and most of it was behind schedule until the end."

That EVA was historic. It marked the first-ever drive of the lunar rover.



July 31, 1971 - The inaugural drive of the first car on the moon occurred on the Apollo 15 mission. Credit: NASA

As for life support systems, predicted consumable usage estimates were underestimated by as much as 20 percent compared to what was actually required by the crew to complete the EVA.

Feigh and the Georgia Tech team looked at all EVAs during Apollo 15, 16 and 17, which represent the exploration-class EVAs performed during the Apollo program.

"These missions serve as the only precedence to help understand and guide future exploration EVA programs, including NASA's 'Journey to Mars' program," said Matthew Miller, who wrote the report as a doctoral [aerospace engineering](#) student at Georgia Tech. "The synthesis of timeline execution and life support trends from Apollo captured in this study provides realistic bounds on what future exploration missions might likely face."

The research was presented to NASA as a technical paper ([download here](#)), which has been reviewed and archived by the organization. Miller compiled a portion of the data and worked alongside NASA engineers as part of his NASA Space Technology Research Fellowship (NSTRF) at the Johnson Space Center.

In addition to the analysis of the mission reports, the researchers used the data to help inform the development and simulation of a computer timeline management system. This system served as a prototype for a new way of calculating how far ahead or beyond astronauts get while performing EVAs by integrating [life support](#) system performance and timeline execution trends. This effort contributes to the goal of making EVAs more efficient and predictable in anticipation of future surface missions well beyond the moon.

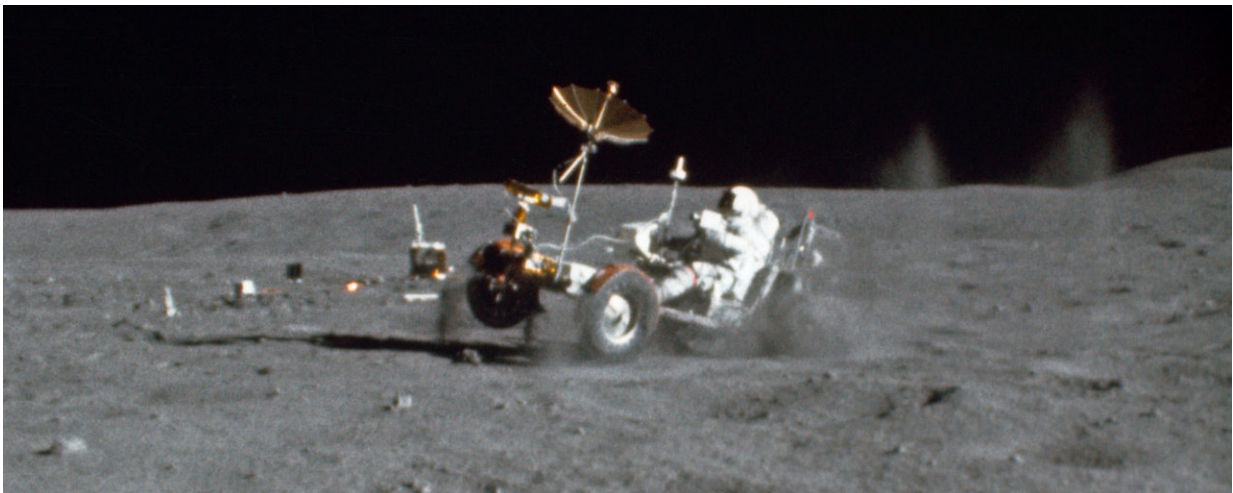


Georgia Tech graduate John Young, AE 1952 (center), was the commander of the Apollo 16 mission. On February 7, 1972, his team participated in a Lunar Rover training exercise at Kennedy Space Center in Florida. Also pictured is Lunar Module Pilot Charles M. Duke (left) and Command Module Pilot Thomas K. Mattingly II (right). Credit: NASA.

During the Apollo missions, the crew was in radio contact with mission control in Houston, which kept track of the clock and communicated schedule adjustments in real time. That won't be possible when astronauts land on Mars.

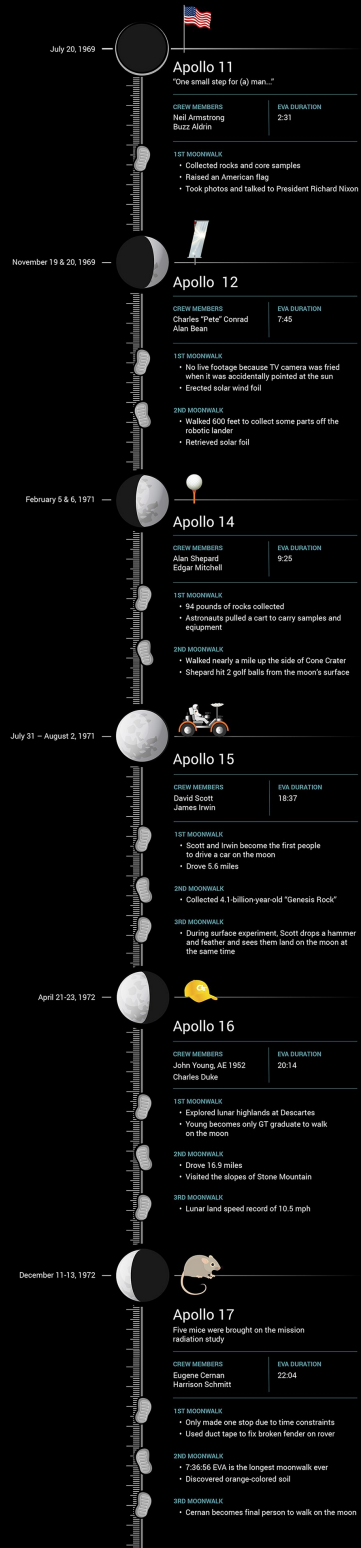
"Communication delays will be too extreme to rely on mission control," said Feigh. "Astronauts will have to depend on the crew inside the spacecraft to monitor their progress during EVAs."

"Spacewalks are planned for years in advance and very scripted, but they're highly unpredictable and require real-time intervention by a host of people—both in-space and on the ground," said Miller, who graduated this past August. "They'll be even more unpredictable on another planet. We need to develop better technology that monitors and updates timelines autonomously, preferably in a way that allows the crew inside the spacecraft to focus on other essential duties."



Georgia Tech alumnus John Young pushing the speed limits of the lunar rover during the "Grand Prix" demonstration on April 21, 1972. Credit: NASA.

Apollo Moonwalks Timeline



Credit: Georgia Institute of Technology

Provided by Georgia Institute of Technology

Citation: Sticking to the schedule was difficult for Apollo astronauts (2018, January 19) retrieved 23 April 2024 from <https://phys.org/news/2018-01-lunar.html>

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