“The Fastest Man On Earth”:

How Col. Dr. John Stapp Revolutionized Space Medicine

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Last year, over Fall Break, I watched the film *The Right Stuff* with my family. It follows the early test pilots slowly evolving into astronauts, specifically the Mercury program. I hope to be a physicist someday, and this view of the early space program intrigued me. When I delved further into the topic, I discovered one man behind many of the safety technologies used by these test pilots and astronauts: Col. Dr. John Stapp. It soon became apparent to me that without his innovative research and development, made possible by his singular courage and initiative, America never could have won the Space Race.

In my research, I utilized many resources, including the Library of Congress's *Chronicling America* archive of newspapers. I used it to gather primary sources supporting my discussions of Stapp's legacy and impact. I also utilized other primary sources, including books, autobiographies, interviews, and technical manuals. I used secondary sources to provide more support for my analysis. Detailed information, however, was difficult to find, as much of Stapp's classified research was never made public.

I decided to write a paper, because I felt other media would not provide enough room to encompass the depth and complexity of my topic. I felt confident with this medium, because I have prior experience writing papers, and I have competed in many essay contests, including NHD.

My historical argument is that the scientific advancements made by Col. Dr. John Paul Stapp as part of the supersonic flight program were the turning point that allowed Americans to achieve human spaceflight. His personal sacrifice and devotion made possible giant leaps in biomedical technologies, capable of protecting pilots, astronauts, and even drivers here on Earth. These technologies allowed America's astronauts to safely travel to the stars.

In this paper, "g-forces" refers to the inertial forces experienced during acceleration and

deceleration. 1 g is equivalent to gravity on Earth.

Introduction

> *[…] volunteering for suicide missions in the name of science on pretty much a daily basis […] A human crash test dummy who spent his ridiculously-hardcore life designing rocket-propelled death traps and then voluntarily strapping himself to these unstable jet fuel-stuffed devices […] the scientific genius and innovator behind incredible inventions that saved the lives of millions of people across the globe […]*[1]

Since the dawn of humanity, we have dreamed of visiting the stars, a dream made possible in the 1960s with the first human spaceflight[2]. This dream lives on today with a continuously inhabited space station[3], upcoming human mission to the moon[4], and space tourism[5]. Amazing achievements on every front led to space travel being possible — in engineering, math, physics, diversity, computer science, and medicine. Many of these biophysical and medical advancements can be traced to one man. The scientific advancements made by Col. Dr. John Paul Stapp, as part of the supersonic flight program, were the turning point that allowed Americans to achieve human spaceflight.

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[1] Thompson, Ben. 2012. "John Paul Stapp — Badass of the Week." Badass of the Week. https://www.badassoftheweek.com/stapp.

[2] Hines, William. 1961. "Soviet Astronaut Orbits Earth in 5-Ton Ship and Lands Safely." The Evening Star, April 12, 1961. https://chroniclingamerica.loc.gov/lccn/sn83045462/1961-04-12/ed-1/seq-1/#date1=04%2F12%2F1961&index=2&rows=20&searchType=advanced&language=eng&sequence=0&words=Gagarin&proxdistance=5&date2=04%2F12%2F1961&ortext=Gagarin&proxtext=&phrasetext=&andtext=&dateF.

[3] "About the International Space Station." n.d. NASA. Accessed February 1, 2024. https://www.nasa.gov/international-space-station/.

[4] NASA. 2019. "NASA Taps 11 American Companies to Advance Human Lunar Landers." NASA. https://www.nasa.gov/news-release/nasa-taps-11-american-companies-to-advance-human-lunar-landers/.

[5] NASA. 2019. "NASA Opens International Space Station to New Commercial Opportunities, Private Astronauts." NASA. https://www.nasa.gov/news-release/nasa-opens-international-space-station-to-new-commercial-opportunities-private-astronauts/.

Historical Background

The sound barrier was officially broken in 1947, by USAF pilot Chuck Yeager in a rocket-powered plane called the X-1, ushering in a new era of supersonic aviation.[6] (It may have been broken earlier: evidence suggests the German Me-262 fighter broke the sound barrier before 1945,[7] and the Me-163 Komet may have done so as early as 1941.[8]) It soon became clear that, at these ever-increasing speeds, the human body experienced unprecedented extremes. The supersonic flight program led into the spaceflight program, and these challenges once again showed themselves: escaping earth's gravitational pull and reentry require forces far greater than Mach (the speed of sound) and space is a cold, foreboding vacuum.

As the first test flights for the X-1 took place, John Paul Stapp, a young Air Force doctor, began his career at Wright Field in Dayton, Ohio. Born to American missionaries in Brazil, Stapp received an MA (zoology), a PhD (biophysics), and an MD. Stapp joined the military in 1944,

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[6] "[Charles E. "Chuck" Yeager oral history interview] · The Museum of Flight - Digital Collections." n.d. The Museum of Flight - Digital Collections. Accessed December 26, 2023. https://digitalcollections.museumofflight.org/items/show/49881.; "Bell X-1 | Definition, History, & Facts." 2023. Britannica. https://www.britannica.com/technology/X-1-airplane.; "Breaking the Sound Barrier: Chuck Yeager and the Bell X-1." 2022. National Air and Space Museum. https://airandspace.si.edu/stories/editorial/breaking-sound-barrier-75th.

[7] Schulz, Matthias. 2001. "Flammenritt über dem Moor." trans. Google Translate. Spiegel Wissenschaft. https://www.spiegel.de/wissenschaft/flammenritt-ueber-dem-moor-a-ad43edca-0002-0001-0000-000018535490?sara_ref=re-xx-cp-sh.; Tanner, Adam. 2001. "Nazi-era pilot says he broke sound barrier first." News24. https://www.news24.com/news24/xArchive/Archive/Nazi-era-pilot-says-he-broke-sound-barrier-first-20010612.; Van Wart, F. D. 1946. Me-262 A-1 Pilots Handbook. Wright Field, Dayton, Ohio: Headquarters Air Materiel Command. https://zenoswarbirdvideos.com/Images/Me262/262PilotHandbook.pdf.

[8] Käsmann, Ferdinand C. W. 1994. *Die schnellsten Jets der Welt: Weltrekord-Flugzeuge*. N.p.: Aviatic-Verlag.

attending the Air Corps' School of Aviation Medicine.[9] He almost immediately set a personal precedent of experimenting on himself, spending 65 hours in an unpressurized plane at 45,000 feet to eventually solve a form of debilitating altitude sickness pilots experienced when attempting to fly in the stratosphere. [10] Over the next two decades, he led numerous teams in developing the foundations of modern aviation medicine.

"The Fastest Man On Earth"

Rocketing him to fame and saving millions of lives, the rocket sled tests were Stapp's greatest achievement. After the success of his high-altitude oxygen tests, Stapp was assigned to study the effects of extreme deceleration on the human body. By 1947, a test pilot died nearly every week at Edwards Air Force Base[11]. Pilots ejecting from planes would come to an almost immediate stop from hundreds of miles per hour, causing extreme stresses[12]. Stapp wanted to minimize injury during these incidents. At the time, the Air Force believed humans would die at a mere 18 g. Stapp was skeptical.[13]

In spring 1947, Stapp travelled to what now is Edwards Air Force Base in California, to begin research. Construction was underway for an apparatus (the "Gee Whiz") to simulate the extreme g-forces experienced in sudden deceleration. This "human decelerator" was built on an old rocket sled used in World War II to test German V-1s. It was on a track, with four rear-

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[9] "December 10, 1954: Dr. John Stapp - Testing Pioneer." 2020. Air Force Test Center. https://www.aftc.af.mil/News/On-This-Day-in-Test-History/Article-Display-Test-History/Article/2411198/december-10-1954-dr-john-stapp-testing-pioneer/.
[10] Sparks, Nick T., and Charles F. Lombard. 2003. "Fastest Man on Earth – John Paul Stapp." *Wings and Airpower Magazine*, July 2003, 14-28. http://www.ejectionsite.com/stapp.htm.
[11] Ryan, Craig. 2016. *Sonic Wind*. N.p.: WW Norton. Kindle.
[12] *Naval Aviation News*. 1952. "Navy Uses Aft-Facing Seats." December, 1952, 3. https://web.archive.org/web/20041104193417/https://www.history.navy.mil/nan/backissues/1950s/1952/dec52.pdf.
[13] Ryan, Craig. 2016. *Sonic Wind*. N.p.: WW Norton. Kindle.

mounted rockets producing a net 20,000 pounds of thrust. Near one end of the 2,000-foot-long track was a hydraulic braking system that could halve the speed of the sled in a fifth of a second[14].

When Stapp met then-project manager George Nichols, he was introduced to the proposed occupant: a test dummy named "Oscar Eightball". Stapp reportedly patted Oscar on the head, remarking, "We're not going to use these. You can throw this away. I'm going to be the test subject."[15]

Stapp soon discovered the Army had little regard for his project. They gave him a few small wooden buildings with tar paper roofs, and no electricity. Supplies were likewise non-existent. Stapp and his team quickly managed to construct makeshift power lines from salvaged cables. To gather other supplies and get much-needed favors, he served as a doctor in his free time, taking care of soldiers' families, including Chuck Yeager[16].

Construction focused on making the sled safe for humans. A safety test-run soon was arranged for the dummy. When faced with 30 g, Oscar flew through the inch-thick wooden windshield (reportedly "[leaving] his rubber face behind"[17]), and landed 710 feet downrange.

Mere months after Yeager broke the sound barrier, Stapp decided the 35 further test-runs had given his team everything they needed to conduct human tests. In the first, Stapp stripped the sled to one rocket, facing backwards to minimize g-forces, reaching only 90 mph and 10 g deceleration. Unaffected, he added two more rockets the following day, for 15,000 pounds of thrust, reaching only 200 mph. He was barely fazed[18].

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[14] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[15] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[16] Ryan, Craig. 2016. *Sonic Wind*. N.p.: WW Norton. Kindle.
[17] Sparks, Nick T. 2006. *A History of Murphy's Law*. Kindle. Loc. 1022.
[18] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."

By August, he had completed 16 runs, testing various configurations of rockets and passenger, once experiencing 35 g, far surpassing the expected 18 g limit. He experienced "no unpleasant sensations"[19] on his first run, but in the course of the others he "suffered a number of concussions, lost a few dental filings, […] dinged his collarbone,"[20] endured "an abdominal hernia, […] broke […] his coccyx,"[21] and twice broke his wrist. On one occasion, he set his fractured wrist on the way back to his office. Stapp quickly discovered eyes to be the most g-sensitive part of human anatomy. When rapidly decelerating, he experienced blurry vision, caused by blood rushing to the back of his head, and in later runs, "red outs", from blood pushing against his retina, causing hemorrhaging.

Yet, he still considered himself far from any limit, and refused to let anyone else ride the sled. His personal experience of the run, combined with his physiological knowledge, allowed him to compose detailed and accurate descriptions of what happened to his body.

When, however, he presented his results to superiors at the Aero Medical Laboratory, they were appalled, ordering him to cease human tests immediately, and all tests above 18 g (which they still, despite his results, believed to be the human survivability limit), instead recommending chimpanzees as subjects. In an attempt to prevent him self-testing, they promoted him to Major. Stapp did not argue. He correctly believed their minds would change quickly when they read his reports. His research proved the inadequacy of existing aircraft seatbelt systems, which lethally applied all pressure to the sternum or loosely fitted around the waist, and showed massive

[19] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[20] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[21] MALNIC, ERIC. 1999. "John Stapp Dies; Onetime 'Fastest Man.'" Los Angeles Times. https://www.latimes.com/archives/la-xpm-1999-nov-22-mn-36390-story.html.

improvement in safety from backward-facing seats. The military immediately began turning seats around on transport craft, and no longer considered 18 g fatal[22].

By the time his Gee Whiz runs finished in June 1951, he had sustained 46 g with a 500 g/s onset rate. The rocket sled made 74 human runs and 80 chimp runs. Using Stapp's data, the Air Force had increased safety requirements of aircraft seats to 32 g. But Stapp was not done. The survival rate for supersonic ejections was non-existent. No one knew how deceleration forces and windblast affected bodies at those speeds. Stapp conducted tests flying an open-cockpit F-89 jet at high speeds, but was unsatisfied[23]. He needed another rocket sled.

This time, he went to Holloman Air Force Base, New Mexico, where a rocket sled had been constructed to test a new type of missile. The 3,550-foot-long track ended in a section that could be flooded: a braking mechanism[24]. Construction soon began on "Sonic Wind No. 1", an improved rocket sled that carried twelve rockets at 750 mph, supersonic speeds. It used a front-mounted scoop and carefully controlled levels of flooding to precisely control braking speed, and the rockets detached after burning up, allowing the passenger to continue further.

After testing a new dummy, "Sierra Sam", and a chimp, Stapp decided it was his turn. The newly-promoted Lieutenant Colonel boarded the sled, telling a reporter, "I assure you, I am not looking forward to this."[25] It reached 421 mph, causing him to experience 22 g (see Appendix A).

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[22] *Naval Aviation News*. 1952. "Navy Uses Aft-Facing Seats." December, 1952, 27. https://web.archive.org/web/20041104193417/https://www.history.navy.mil/nan/backissues/1950s/1952/dec52.pdf.

[23] Stapp, John P. 1954. "Whoooosh!" *Flying Safety*, June, 1954, 7. https://www.safety.af.mil/Portals/71/documents/Magazines/FSM/1950s/195406%20-%20FlyingSafetyMagazine.pdf.

[24] Bell, Brian. 1955. "Balloons and Rockets." Evening Star (Washington, D.C.), October 9, 1955, 7. https://chroniclingamerica.loc.gov/lccn/sn83045462/1955-10-09/ed-1/seq-186/.

[25] MALNIC, ERIC. 1999. "John Stapp Dies; Onetime 'Fastest Man.'" Los Angeles Times. https://www.latimes.com/archives/la-xpm-1999-nov-22-mn-36390-story.html.

His body momentarily weighed nearly two tons. Afterwards, he said, "I feel fine. This sled is going to be a wonderful test instrument. I'm ready to do it again this afternoon."[26]

Construction delays meant the next human run did not happen for another five months. Stapp wanted to learn more about windblast, so engineers built a pair of doors into the windshield, which opened partway through the ride. He was buffeted with air travelling at 500 mph before decelerating at 12 g. Sand in the wind carpet-burned and bruised his face. He called it the easiest run he ever had done[27].

In winter 1954, Stapp conducted his final run. This time, his past and future collaborator Joseph Kittinger would chase his sled in a plane and take photographs. Stapp shot off, passing Kittinger's plane "like [it] was standing still;"[28] he was traveling at 632 mph, faster than a bullet. Stapp experienced 46.2 g, and 25 g continuously for more than a second, equivalent to ejecting from a plane at Mach 1.6, or crashing into a brick wall at 120 mph. When the ground crew reached him, his eyes were completely red: almost every blood vessel had burst, rendering him completely blind. "This time I get the white cane and seeing-eye dog,"[29] Stapp said. Fortunately, his vision returned by the next day.

He soon rocketed to celebrity status as "The Fastest Man On Earth."[30] The result of his groundbreaking experiments was manyfold, improving safety in the air and on the ground, even leading him to invent the modern three-point seatbelt required today in all American automobiles.

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[26] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[27] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[28] Lombard, C. F., and Sparks, N. T. "Fastest Man on Earth – John Paul Stapp."
[29] MALNIC, ERIC. 1999. "John Stapp Dies; Onetime 'Fastest Man.'" Los Angeles Times. https://www.latimes.com/archives/la-xpm-1999-nov-22-mn-36390-story.html.
[30] *TIME*. 1955. "Medicine: The Fastest Man on Earth." September 12, 1955. https://content.time.com/time/subscriber/article/0,33009,893155-1,00.html.

The Final Frontier

After the rocket sled tests, Stapp moved on to a new frontier: Space. He created Project Manhigh, a series of experiments to "test human endurance at the edge of space."[31] America wanted to send a man to space, but nobody knew anything about human survival there. The project planned to send high-altitude balloons to the edge of space to test pressurization suits and systems. Stapp assembled a team of test pilots, putting them through a battery of physical and psychological tests. These same tests would be used on the Mercury astronauts, and for decades after. This team included Kittinger, a seasoned test pilot, who previously worked with Stapp.[32]

Pilots occupied a small, pressurized gondola attached to a balloon. Manhigh launched three balloons in total, with pilots Kittinger, David Simons, and Clifton McClure. Kittinger and McClure reached 98,000 feet, and Simons reached a staggering 101,000 feet.[33]

Manhigh was woefully underfunded, but, in light of its success, the Air Force continued with Project Excelsior, also headed by Stapp. It examined what would happen in the event of high-altitude ejections and freefall. Parachutes only work at low altitudes, meaning pilots would be in freefall until they reached a low enough altitude for their parachute, which meant spinning. In the mid-50s, the Air Force conducted experiments with humanoid dummies ejected from high altitudes and measured rotational speeds of more than 200 revolutions per minute, enough to kill a human quickly[34]. Given recently-developed high-altitude planes, they needed a safe method for pilots to

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[31] "John P. Stapp." n.d. New Mexico Museum of Space History. Accessed January 21, 2024. https://www.nmspacemuseum.org/inductee/john-p-stapp/?doing_wp_cron=1705862207.0449869632720947265625.
[32] "Audio & Video: An interview with…. Col Joe Kittinger Hon FRAeS."
[33] Kindy, Dave. 2023. "The Man Who Fell to Earth." National Air and Space Museum. https://airandspace.si.edu/air-and-space-quarterly/summer-2023/space-jumper.
[34] Kindy, Dave. "The Man Who Fell to Earth."

eject and survive high-altitude falls. The solution came in the form of a multi-stage parachute designed by teammate Francis Beaupre, which Stapp tested with Excelsior.

The new design used a preliminary, smaller "drogue" parachute that stabilized pilots until they reached low enough altitude to deploy the regular parachute. Kittinger completed three test flights in winter 1959 and autumn 1960. He ascended to the edge of space with a balloon, wearing a pressure suit, then jumped. His first jump was almost fatal: his drogue parachute deployed early and tangled around his neck, causing him to spin at 90 rpm and black out. He was saved by an automatic reserve parachute Beaupre had built in as backup. His second flight was uneventful, but on his final ascent, a glove seal failed, exposing his hand to the low-pressure, low-temperature environment of space, and disabling it for the duration of the mission. He could not deploy his parachute properly and had to rely on automatic deployment[35].

Project Excelsior was instrumental in protecting astronauts for years to come. The advancements made to pressurization technology and ejection systems proved vital for the safety and survival of future astronauts. The Mercury Seven, recognizing the importance of Project Excelsior to their own safety, sent Kittinger a telegram: "Good show, Joe, the news of your continued penetrations of the space environment are most encouraging."[36]

Stapp's Legacy

Chuck Yeager once said of the first supersonic flight: "Later, I realized that the mission had to end in a let-down because the real barrier wasn't in the sky but in our knowledge and

[35] Kindy, Dave. "The Man Who Fell to Earth."
[36] Kindy, Dave. "The Man Who Fell to Earth."

experience of supersonic flight."[37] Stapp worked tirelessly to expand the horizons of human knowledge and experience in the skies and at high speeds.

To escape the massive gravitational pull of the Earth, spacecraft must accelerate at incredible speeds, producing incredible forces. Early astronauts experienced upwards of 6 g at liftoff, and powerful deceleration forces upon reentry.[38] Stapp's high-g experiments with rocket sleds gave scientists crucial biophysical data they needed to send Americans into space safely. His work is used in aviation today, in the form of safety equipment developed and honed during his runs. Perhaps the most immediate consequence was his invention of the modern three-point seatbelt, saving millions of lives across the globe.[39] In recognition, President Johnson signed the Highway Safety Act of 1966 in Stapp's presence.[40]

The International Space Hall of Fame described Project Manhigh as helping "prepare for America's initial manned space launch in 1961."[41] The Mercury astronauts recognized his contributions to their safety, and it is likely that without Projects Manhigh and Excelsior, America never could have launched humans into space. After America's first spaceflight[42], safety technology continued to improve, and Stapp's inventions still form the basis of spacesuits and pressurization technology today.

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[37] Yeager, Chuck, and Leo Janos. 1985. *Yeager, an autobiography.* N.p.: Bantam Books.
[38] "g-force." n.d. Oxford Reference. Accessed January 21, 2024. https://www.oxfordreference.com/view/10.1093/oi/authority.20110803095850382.
[39] De Clercq, Milan. 2023. "Buckling up to save lives: UN celebrates five decades of seat belt laws." UN News. https://news.un.org/en/story/2023/06/1137412.
[40] "John P. Stapp."
[41] "John P. Stapp."
[42] Sohier, Walter D. n.d. "Alan B. Shepard, Jr. Oral History Interview – 6/12/1964 Administrative Information Creator: Alan B. Shepard, Jr. Interviewer:." JFK Library. Accessed December 26, 2023. https://www.jfklibrary.org/sites/default/files/archives/JFKOH/Shepard%2C%20Alan%20B.%2C%20Jr/JFKOH-ABS-01/JFKOH-ABS-01-TR.pdf.

The results of Stapp's experiments still protect Americans in space, in the sky, and on Earth, with aeronautical, astronautical, and automotive safety equipment.

Conclusion

As a result of the contributions of Col. Dr. John Paul Stapp, humanity's ancient dream came true: we went to space. We orbited Earth, and walked on the Moon,[43] in some of the greatest scientific achievements of the human race, but American astronauts never would have survived launch without Stapp's ingenuity. His high-altitude experiments allowed them to breathe, and his rocket sled tests prevented them from being crushed to death by pressure far greater than any experienced before. His achievements were the turning point in history that allowed us to venture beyond Earth.

[43] Wilford, John N. 1969. "Men Walk On Moon." The New York Times, July 21, 1969. https://archive.nytimes.com/www.nytimes.com/learning/general/onthisday/big/0720.html.

Appendix A

Stapp experiences 22 g. (Photographs courtesy of National Museum of the US Navy, "330-PS-6748 (111-SC-1500221)", June 1954, flickr, https://flic.kr/p/roYiSP.)

Annotated Bibliography

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"Audio & Video: An interview with…. Col Joe Kittinger Hon FRAeS." 2019. Royal Aeronautical Society. https://www.aerosociety.com/news/audio-video-an-interview-with-col-joe-kittinger-hon-fraes/.

This is an interview/lecture from the Royal Aeronautical Society with Joe Kittinger, a many-time Stapp collaborator. I used this to provide details of Stapp's experiments.

Bell, Brian. 1955. "Balloons and Rockets." Evening Star (Washington, D.C.), October 9, 1955, 7. https://chroniclingamerica.loc.gov/lccn/sn83045462/1955-10-09/ed-1/seq-186/.

This contemporaneous article discusses Stapp's rocket sled tests. I used this to provide technical details of the rocket sled.

"[Charles E. "Chuck" Yeager oral history interview] · The Museum of Flight - Digital Collections." n.d. The Museum of Flight - Digital Collections. Accessed December 26, 2023. https://digitalcollections.museumofflight.org/items/show/49881.

This is an extensive interview with Chuck Yeager, the United States Air Force pilot who officially broke the sound barrier in 1947. I used this to provide historical background for the supersonic flight program.

De Clercq, Milan. 2023. "Buckling up to save lives: UN celebrates five decades of seat belt laws." UN News. https://news.un.org/en/story/2023/06/1137412.

This press release from the UN announces that seatbelts have saved “millions of lives” around the world. I use this to demonstrate the impact of Stapp’s inventions worldwide.

Hines, William. 1961. “Soviet Astronaut Orbits Earth in 5-Ton Ship and Lands Safely.” The Evening Star, April 12, 1961. https://chroniclingamerica.loc.gov/lccn/sn83045462/1961-04-12/ed-1/seq-1/#date1=04%2F12%2F1961&index=2&rows=20&searchType=advanced&language=eng&sequence=0&words=Gagarin&proxdistance=5&date2=04%2F12%2F1961&ortext=Gagarin&proxtext=&phrasetext=&andtext=&dateF.

This is an article in Washington D.C.’s Evening Star which reports on the first man in space, Yuri Gagarin, and his flight earlier that day.

“John P. Stapp papers, 1930s-1990s.” n.d. Arizona Archives Online. Accessed January 6, 2024. http://www.azarchivesonline.org/xtf/view?docId=ead/embry/ERAU_MS018.xml&doc.view=print;chunk.id=0.

These are a collection of the papers of Major John Paul Stapp. I used these to learn about his scientific exploits and experimentation.

Käsmann, Ferdinand C. W. 1994. *Die schnellsten Jets der Welt: Weltrekord-Flugzeuge*. N.p.: Aviatic-Verlag.

This book by a former German air force pilot during World War II contains claims of German supersonic flight in 1941. I used this to provide historical background.

MALNIC, ERIC. 1999. “John Stapp Dies; Onetime 'Fastest Man.'” Los Angeles Times, November 22, 1999. https://www.latimes.com/archives/la-xpm-1999-nov-22-mn-36390-story.html.

This is Stapp's obituary in the LA Times. This includes several anecdotes about his exploits. I used this to provide evidence for my discussion of his contributions and legacy.

NASA. 2019. "NASA Opens International Space Station to New Commercial Opportunities, Private Astronauts." NASA. https://www.nasa.gov/news-release/nasa-opens-international-space-station-to-new-commercial-opportunities-private-astronauts/.

This is the press release in which NASA announces its support for space tourism. I used this to provide evidence for Stapp's legacy today.

National Museum of the US Navy, "330-PS-6748 (111-SC-1500221)", June 1954, flickr, https://flic.kr/p/roYiSP.

This is a series of photographs of Stapp riding the rocket sled and experiencing 22 g. I used this as a visual aid to demonstrate the effects on the body of high g-forces that he researched.

Naval Aviation News. 1952. "Navy Uses Aft-Facing Seats." December, 1952, 27. https://web.archive.org/web/20041104193417/https://www.history.navy.mil/nan/backissues/1950s/1952/dec52.pdf.

This article in an official Navy magazine describes safety changes undertaken in naval aircraft as a result of Stapp's findings. I used this to provide evidence of Stapp's effect on aeronautical safety.

"Reporting on The Explorers Club Interview with Mercury Astronaut John Glenn : Reporting on The Explorers Club Interview with Mercury Astronaut John Glenn." 2013. StarTalk Radio. https://startalkmedia.com/reporting-on-the-explorers-club-interview-with-mercury-astronaut-john-glenn/.

This is an interview with early astronaut John Glenn. I used this to provide historical background on the early space program.

"Rocket Sled, Sonic Wind I." n.d. National Air and Space Museum. Accessed January 16, 2024. https://airandspace.si.edu/collection-objects/rocket-sled-sonic-wind-i/nasm_A19680015000.

This is one of the rocket sleds John Stapp used to conduct his experiments on the effects of high g-forces on the human body. It is at the Smithsonian Air and Space Museum.

Sohier, Walter D. n.d. "Alan B. Shepard, Jr. Oral History Interview – 6/12/1964 Administrative Information Creator: Alan B. Shepard, Jr. Interviewer:." JFK Library. Accessed December 26, 2023. https://www.jfklibrary.org/sites/default/files/archives/JFKOH/Shepard%2C%20Alan%20B.%2C%20Jr/JFKOH-ABS-01/JFKOH-ABS-01-TR.pdf.

This is an interview with Alan Shepard about his life and career as an astronaut, and the first American in Space. I used this to provide historical context.

Stapp, John P. 1954. "Whoooosh!" *Flying Safety*, June, 1954, 7. https://www.safety.af.mil/Portals/71/documents/Magazines/FSM/1950s/195406%20-%20FlyingSafetyMagazine.pdf.

This article by Stapp himself, in the *Flying Safety* trade magazine, discusses his rocket sled tests and their results. I used this to provide details of the tests and his background.

TIME. 1955. "Medicine: The Fastest Man on Earth." September 12, 1955. https://content.time.com/time/subscriber/article/0,33009,893155-1,00.html.

This contemporaneous article describes Stapp's rocket sled runs in colorful detail. I used this to provide some details and anecdotes of his runs.

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This is an Encyclopedia Brittanica article on the history of the X-1 experimental supersonic plane. I used this to provide historical background for the scientific zeitgeist of Stapp's time.

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This article contains information on the early supersonic and space programs. I used this to provide historical background and context.

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Ryan, Craig. 2016. *Sonic Wind*. N.p.: WW Norton. Kindle.

This is an extensive biography of Stapp. I used this to provide details of Stapp's experiments and anecdotes of his life.

Schulz, Matthias. 2001. "Flammenritt über dem Moor." Translated by Google Translate. Spiegel Wissenschaft. https://www.spiegel.de/wissenschaft/flammenritt-ueber-dem-moor-a-ad43edca-0002-0001-0000-000018535490?sara_ref=re-xx-cp-sh.

This is an article in which a former German pilot in WWII claims to have broken the sound barrier in 1945 while flying an Me-262. It also provides some evidence to back up this claim. I used this to provide historical background. (See Van Wart, F. D., *Me-262 A-1 Pilots Handbook* for more supporting evidence.)

Sparks, Nick T. 2006. *A History of Murphy's Law*. Kindle.

This is a book about Stapp (popularizer of Murphy's Law.) I used this to provide quotes about his rocket sled.

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This is a biography of Stapp from the Stapp Crash Conference, which he founded as a group of "automotive engineers, trauma surgeons, and other experts to examine how people died in car crashes," and is still held today in his honor. I used this to provide biographical information and details of his research.

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"Test Pilots: Faster, Higher, Farther." n.d. National Air and Space Museum. Accessed December 26, 2023. https://airandspace.si.edu/whats-on/events/test-pilots-faster-higher-farther.

This article discusses the post-WWII supersonic flight program. I used this to provide historical background and context.

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This article gives a compelling description of Stapp's extraordinary life, and his feats of great personal sacrifice to save millions of lives. This is part of what began my interest in Col. Stapp.

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