Survival Probability Analysis of the D.B. Cooper Hijacking using Historical Parachuting Data
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Abstract

The D.B. Cooper hijacking is the only unsolved air piracy case in U.S. history. Understanding the true probability of Cooper surviving the jump out of Northwest Orient’s 727 is a key obstacle in understanding both who Cooper was and what happened after the crew lost contact with him. By comparing the jump to similar bailout situations during WWII by RAF bomber crews, an approximate survival probability of at least 80% is found. An analysis of the drop zone as it pertains to Cooper’s survival is included, and the Tena Bar money find is discussed in regards to this new understanding of the jump.

Introduction

On November 24th, 1971, a man calling himself Dan Cooper jumped out of the back of a Northwest Orient Airlines 727 with $200,000 strapped to his body, never to be seen or heard from again. Interviews with thousands of suspects, over four decades of searching by the FBI and others, in one of the largest and most expensive manhunts in history, has resulted in nothing conclusive about Cooper’s identity or fate. Most of the lead FBI agents in the case believe Cooper died in the jump [1].
Without hard evidence such as a body, the assessment of the survivability of Cooper’s jump has been left to skydiving experts, drawing from their personal experiences alone [2]. This is problematic for a number of reasons, including a lack of access to their experiences and an inability to measure their biases created by their training and experience. Instead, an independent analysis done using the largest available dataset of inexperienced jumpers available will bypass any biases. There is such a dataset, thousands of aircrews were forced to bail out of their damaged planes during World War Two.

The Jump

Skydivers in the United States experience a fatality in every 150,000 jumps. Main canopy failures happen approximately once in every 750 openings [3]. This an exceptional safety record produced by diligence and regulation. Equipment is carefully maintained and packed, jumps are generally done under controlled conditions and in good weather. There are numerous safety regulations in place, and skydiving businesses have an obvious incentive to make every jump done at their drop zones as safe as possible. These were definitely not the conditions under which Dan Cooper jumped.

Instead, Cooper faced a range of more challenging circumstances. He jumped at night, in cold weather with high winds, rain, limited visibility, without a working reserve parachute and laden down with a bulky canvas sack of money tied to his waist or to his parachute harness [4]. His level of parachuting experience is unknown, but the ease with which he was seen putting on the NB6 parachute he chose suggests he had some training, most likely from the military [5]. It is unknown if Cooper had any jumping experience beyond this, so the following analysis assumes he only had the most basic military training, which is congruent with the evidence.

During WWII tens of thousands of airmen had to bail out of damaged aircraft under difficult conditions, without reserve parachutes, using equipment they did not pack or maintain themselves, in cold weather, with little training and no prior practice jumps, and not under the supervision of experienced jumpers. In particular, the RAF Bomber Command (RAFBC), operating almost exclusively at night, will give the closest analogy for the survivability of Cooper’s jump.

From the broadest perspective, approximately 25% of RAF Bomber Command airmen shot down during the war were captured or successfully evaded [6]. This gives us our minimum boundary. Cooper’s survival chances are no lower than 1 in 4. However, many RAFBC casualties were from training missions, and their crews generally never wore their emergency parachutes. British bombers had very small emergency hatches, which often hindered crewmen trying to bail out. Another problem of bomber design made it especially difficult for pilots to get out of their aircraft, resulting in pilots staying with their aircraft all the way down to ground impact [7]. Many crew were killed and
wounded by bullets and ack ack and never jumped. Taken together, we can assume Cooper’s survival chances were much higher than this 25% number.

How much higher? An example of a typical bailout situation, described by a surviving Mid-Upper Gunner [8] in a RAF Lancaster bomber, involved the pilot staying with the aircraft, the crew scrambling for parachutes, six of seven crewman bailing out at 4500 feet above the ground, and five of the six finding themselves alive on the ground. The canopy opening was described as painful, and the landing caused injury to the mid-upper gunner, but he was still able to walk away and seek refuge. This was one of over a dozen RAF nighttime bailout scenarios collected for this paper. In total, thirty-four survivors were found for forty-three reported bailouts, a 79.1% survival rate [9].

Because they flew at night, there are very few firsthand RAF accounts that are useful, so getting a bigger sample size will require more complicated calculus. Since we know the approximate bailout rates for bomber crews [See note 9], we can test the bailout rate against survivors on the ground and get an estimate for the survivability of these wartime combat jumps. Then, especially in the case of American bombers, we can test these estimates against actual eyewitness reports.

The 91st Bombardment Group will be used in this first test [10]. American daylight bombers had a 50% bailout rate and the B-17 had a crew of ten. The 91st lost 97 aircraft in combat and had 959 POWs. Simply multiplying the number of aircraft by the number of crew per aircraft and the bailout percentage will gives us the expected number of survivors on the ground, assuming a 100% success rate in the jump. Doing so gives us 985 expected survivors. Thus, from this method we get a baseline survivability rate of 97.4%.

A 97.4% survival rate for battlefield jumps may seem high, but it aligns closely with a review of American after-action reports. Because Americans bombed during the day, there is eyewitness testimony available to see how often airmen were able to pull the ripcords on their parachutes. During the most deadly missions of the 91st, after-action reports showed nearly 90% of observed airmen successfully deploying their canopies [11].

Using the same method for RAFBC is not as straightforward. Publicly available data is more difficult to find, so individual bomber groups cannot be used. This is problematic for one primary reason: the RAFBC used several different heavy bombers, including the famous Avro Lancaster, the Handley Page Halifax, the Short Shirley, the Avro Manchester, the Mosquito, and several others including American B-17s. The Halifax, Shirley, Lancaster and Manchester bombers had crews of seven. The Mosquito had a crew of two, while B-17’s had a crew of ten. These different aircraft also had different bailout rates. In order not to overstate Cooper’s chances at survival, conservative estimates for every variable will be used.
On the whole, RAFBC had a 21.3% bailout rate and lost 8,325 aircraft. Assuming six crew members per aircraft [12], the initial estimate for survivors is 10,640. In actuality there were 9,838 RAFBC POWs. The actual survival rate for bailing out using this method is 92.5%. This gives an approximate range of 79% to 93% for surviving a night time combat jump during World War II. This range overlaps with the numbers from the U.S. 91st Bomb Group, suggesting similar success rates for combat jumps regardless of if they were done in the daytime or at night.

**The Parachute**

A possible confound in this analysis is the parachute itself. Cooper used a heavily modified NB6 parachute harness with a 28 foot canopy, owned by Earl Cossey [13]. The rip cord was moved from the left side to under the right armpit, somewhat hidden in a pocket. It would take two motions to deploy the canopy, first pushing the rip cord out from the chest, then sweeping the arm over the head. There is much conjecture over why Cossey modified the parachute to make it harder to deploy, but the likely reason was to avoid accidental deployment while in an aircraft packed with inexperienced skydivers [14]. It cannot be known how much these modifications would change Cooper's survival rate [15]. However, as is evidenced by the survival of thousands of RAF airmen, the difficulty of deploying a parachute while in free fall is negligible. Other than the specific location of the ripcord, the survival factors experienced by RAF night bomber crews is nearly identical to Cooper’s. These WWII airmen jumped in the dark, after being exposed to freezing temperatures for many hours, with unfamiliar equipment and no jump training. The ability of these young men, who were under enemy fire, stumbling to fit through small emergency hatches in the dark to survive these circumstances, is strong endorsement of the human capacity to survive. While open to personal interpretation, the placement of the ripcord on the harness must pale in comparison to the difficulty of bailing out under the presented war scenarios.

**The Drop Zone**

An important factor in considering whether Cooper survived the jump is his actual drop zone. If Cooper landed in the deep woods of the Cascade Mountains or in Lake Merwin or another body of water, his survival chances go down precipitously. During the Normandy invasion, several groups of paratroopers were accidentally dropped offshore in the English Channel and drowned (Ryan, p 121). If Cooper lands on a pasture near a road within walking distance of a town, the reverse is true. While the exact landing spot can not be calculated with any certainty, a general drop zone can give insight into the Cooper mystery.

Much information about the flight path of 305 and the possible Cooper drop zone has either been lost or never existed. The FBI released a flight path, probably recorded by someone watching live radar data during the hijacking, and several independent Cooper investigators have analyzed the data
One of the findings was a missing minute of a flight data, resulting in Cooper jumping between three and fifteen miles farther south than the original FBI search grid (Gray 2011, p 214 & 260). There is much debate about the significance of the “Missing Minute” so it will be used here only as an error estimate.

An air traffic controller stated firmly that 305 stayed in the Victor 23 corridor, which is about eight miles wide [17]. A small placard from flight 305 was found in the woods along the Victor 23 corridor. At 8:10pm the flight was near Ariel, WA. By 8:15pm, they were very near Portland, OR [18]. The plane was going approximately 190 mph and was traveling 3.1 miles per minute, ground speed. From crew testimony, we know the last communication was made with Cooper around 8:04 pm. After that, there was an oscillation, then a pressure bump around 8:13pm [19].

Using the FBI flight path, and adding in the forgotten minute, we get an approximate Cooper jump point near Battle Point [Figure 1]. Based on simple calculations using Google Earth, at 3.1 miles per minute, the Placard fell out of the plane around 8:03pm. Cooper and the cockpit communicated through the airplane’s phone at around 8:04pm and the crew reported having difficulty hearing him due to the wind (Tosaw 1984, p35). Before this time, it appears Cooper was having difficulty lowering the stairs because he did not know you had to walk on to the stairs to counteract the force of the slipstream outside the plane (Gray, p 99-100).

While very scant, the evidence is in congruence with eyewitness testimony. Based on where the placard was found, Flight 305 was in Victor 23. Assuming the placard came out soon after Cooper learned “the trick” to the airstairs, the crew’s timeline of events appears to be right. The 8:11 event represents a distinct feature of Cooper’s walk down the stairs. As the stairs bumped up and down when Cooper worked his way to his jumping position, there were changes in pressure and flight characteristics, noted by the engineer. The final pressure bump, reproduced by the FBI in a later experiment, happens last, a few minutes after the oscillation. Generally assumed to happen sometime around 8:14pm (Rataczak, 2010).

The original FBI assessment, regardless of the missing minute, is accurate enough to eliminate the possibility of Cooper dropping in the Washougal watershed. It also makes it highly unlikely Cooper landed on the Tena Bar itself. Cooper likely left the aircraft between Orchards and Battleground, WA. This leaves the Tena Bar money find a perplexing event to describe through natural mechanisms alone. This also eliminates the Tena Bar find as definitive proof of Cooper’s demise, unless some other evidence can bridge the gap between the crew’s testimony and the find (see discussion).
Figure 1. Estimated jumping point marked by red star; approximate landing zone outlined in black. Detail taken from FBI released flight path, from Citizen Sleuths website.

**Discussion**

The probability that Cooper survived his jump is much higher than previously suggested. The experiences of thousands of RAF bomber crews in WWII show both the high danger of nighttime bailouts and the reliability of parachutes in those dangerous situations. Despite questions over the modifications of the parachute and how difficult pulling the ripcord would be for a novice in the dark, by underestimating Cooper’s survival chances we are doing a disservice to the truth.
Understanding the high probability Cooper lived is also extremely important to interpreting other aspects of this case, especially the 1980 Tena Bar money find.

If the drop zone analysis is correct, Cooper landed farther south than the original 1971 estimate. He would have been within ten miles of Vancouver, in areas of flat farmland, not heavy woods or wilderness. The new drop zone increases the probability Cooper survived, assuming he pulled the ripcord, as it negates the need to survive and travel in the Northwest timber forests. A fit middle-aged man should be able to comfortably walk ten miles in day without taxing himself. Cooper would have thus been within walking distance of both bus and train stations. Since he got on Flight 305 at Portland, he likely was familiar enough with the area to transport himself away, just as he was able to transport himself to the area.

Though not the focus of this paper, the Tena Bar money find should be noted as it relates to Cooper's survival. Prima facie, it appears to be a contraindication of Cooper's survival. As Himmelsbach points out clearly, the money was the point of the whole adventure (Himmelsbach 1986, p 129). However, this assumes the money stayed with Cooper. In fact it is completely possible Cooper and the money separated during the jump. Once again, World War Two provides a clear illustration of the problem Cooper would have parachuting with a heavy bag of money.

Before the Normandy invasion, American paratroopers were given leg bags, also known as drop bags, just prior to their departure. They were not instructed how to properly use the bags, which were to be disconnected from the leg and lowered by the attached rope after their main canopy deployed. Many US paratroopers simply kicked the bags out of the aircraft as they jumped; when their main canopies deployed, the bags came loose and fell to the ground. Considering Cooper's improvised method for attaching the original money bag using paracord from one of the spare parachutes, it's not beyond reason to suggest the money was ripped from his harness when his canopy deployed [20].

The simplest explanation for the Tena Bar find, an explanation that requires the fewest non-natural elements to move the money from the drop zone to the sand bar, would be for the money to splash down in the Columbia River upstream from the original find. While it would take a major re-examination of the original timeline to get Cooper over the Columbia River at the time of the jump, it must be remembered the timeline is based mostly on eyewitness testimony. It is definitely possible, however unlikely, the crew was not accurate in their timing or misinterpreted the pressure events [21].

This is only conjecture, but if Cooper himself landed in water, even if he had pulled the ripcord on his parachute, his chances of surviving the jump are drastically lowered. Water landings, if a jumper is unprepared for them, are very lethal. Also, Cooper would have had to jump somewhere over
Portland to land in the Columbia, and the crew generally believes Cooper was gone well before they crossed over the Columbia River. Regardless, since it is very possible that Cooper became separated from the money when his canopy deployed, the fate of the money is separate from the fate of Dan Cooper.

Since the money may have found its way to Tena Bar through any number of mechanical, natural or human processes, the crew testimony should take precedence over the money find when calculating a drop point. To use the money as the sole piece of evidence to dictate Cooper’s drop zone is an example of the petitio principii fallacy. Until more facts are known, considering the intense investigation of the pressure bump event at the time, the initial assessment of a drop zone between the major water hazards of the jump are affirmed herein. Cooper’s survival probability has not been adjusted to include a water landing.

**Conclusions**

There were numerous Cooper copycats, four of whom actually jumped out of their hijacked aircraft. All four hijackers survived their jumps. In particular, Robb Dolin Heady’s jump was especially difficult; it was made while the aircraft was traveling, at his estimate, almost 300 miles per hour. It was his first night jump, and his first jet jump, and he only had a single reserve parachute [22]. In contrast, Cooper’s aircraft was being held at a steady altitude, just above stall speed, and the pilots actually made adjustments at Cooper’s request. Cooper’s jump was done under close to ideal conditions. Of the five total 727 hijacking jumps, he would have been the most likely to survive.

The FBI assumption that Cooper died in the jump is based on poor data. Cooper jumped in conditions that thousands of RAF crewman survived during WWII. He jumped wearing a functional parachute, out of an aircraft the CIA was using to surreptitiously airdrop personnel and supplies. All four of his copycats survived their jumps. At a minimum, his survival chances were likely the same as the RAF bomber crews and they could be much higher. Based on everything noted so far, there is between an 80% and 90% chance Cooper pulled the ripcord on his parachute and landed safely somewhere along flight 305’s path.
Bibliography


Notes

1. Ralph Himmelsbach, the first case agent, has stated this numerous times in many popular publications and in his book Norjak. Case agent Larry Carr also implies this strongly in his many postings under the handle “Ckret” in the famous Drop Zone Cooper Forum (http://www.dropzone.com/cgi-bin/forum/gforum.cgi?post=3110098;sb=post_latest_reply;so=ASC;forum_view=forum_view_collapsed;guest=155049508); A collection of Carr’s posts on that forum are available as a pdf (http://collections.washingtonhistory.org/details.aspx?id=121550). Other case agents have not been so vocal, but the common narrative since at least the Tena Bar money find has been Cooper died.

2. The Drop Zone Cooper Forum is a monster, totalling over 2000 pages with some 56,000 individual posts. It is difficult to navigate, and very hard to verify stories and expertise. However, it contains some of the best information available anywhere on the details of Cooper’s jump, his equipment, and historical skydiving.

3. These statistics were taken from the Wikipedia article on parachuting. And yes, I did check the original sources... And you can too: http://www.uspa.org/AboutSkydiving/SkydivingSafety/tabid/526/Default.aspx

4. Seriously, literally every Cooper book references the jump conditions.

5. Both Tosaw and Gray emphasize this fact in their books, whereas Himmelsbach mentions it only in passing. The case is strong, Cooper chose a military harness over a civilian model, and the FBI investigated 14,000 skydivers, and went undercover in Canadian skydiving competitions. If Cooper didn't get experience at a civilian facility, the assumption was he got it through the military. But we
can’t really be sure of anything; Tom Kaye points out the contradictions in understanding Cooper’s jump experience rather elegantly: “He requested “front and back parachutes” = novice. He turned down instructions on how to use the parachute = experienced. He picked the non-steerable military parachute = novice. The military chute could better withstand the exit speed of the plane = experienced. He put the parachute on like he knew what he was doing = experienced. He took the reserve chute that was sewn closed and non-functional = novice.”

RAF Bomber Command had casualties on par with WWI trench warfare. Source: http://www.elsham.pwp.blueyonder.co.uk/raf_bc/

A discussion of the bailout differences between the various WWII bombers can be found in a 1979 book by Freeman Dyson called “Disturbing the Universe” which is a far reaching personal memoir encompassing Dyson’s entire life. But… getting back to the point, this is a quote from his book on the hurdles facing RAF crews: “I shared an office at Command headquarters with a half-Irish boy of my own age called Mile O’Loughlin. One of the things that Mike was angry about was escape hatches. Every bomber had a trap door in the floor through which the crew was supposed to jump when the captain gave the order to bail out.A far larger number died because they were inadequately prepared for the job of squeezing through a small hole with a bulky flying suit and parachute harness, in the dark, in a hurry, in an airplane rapidly going out of control. The mechanics of bailing out was another taboo subject which right-thinking crewmen were not encouraged to discuss. The actual fraction of survivors among the crews of shot-down planes was a secret kept from the squadrons even more strictly than the odds against their completing an operational tour.”

Complete story at http://www.veterans.gc.ca/eng/remembrance/those-who-served/diaries-letters-stories/second-world-war/watson, here’s a snippet: “The flames were causing the seam aft of the starboard inner engine to melt and the pilot was informed of this, who then ordered everyone to collect their parachutes. The aircraft continued to lose height and the flames had enveloped most of the wing and half of the seam had melted, the pilot was informed of this and he ordered everyone to bale out. I then plugged into the intercom system and informed the pilot that he was bailing out and that the rear gunner was still in his turret and he would let him know we were getting out. The captain’s last words to me were ‘Yes, OK, but hurry, we’re at 4,500 feet, if he’s not hit he might make it. So long Ron, good luck.’”

All data from my studies of RAF nighttime bailouts can be found here: (https://docs.google.com/document/d/1PZ7JHAGeWGupOZLihwJ9TG3kkrJW3qqg9wMmt-qBkPA/pub). This will also include any future data collections. Also, see note 7 too. And to belabor the point, here’s another good article: http://www.express.co.uk/news/uk/399883/The-Lancaster-Bomber-that-magnificent-flying-machine

Chosen for the availability of data online. Source: http://en.wikipedia.org/wiki/91st_Bombardment_Group

In particular, missions 98, 229, 248, 275. After action reports (available at http://www.303rdbg.com/missions.html) showed 63 chutes for 70 observed bailouts.

Full breakdown of RAFBC’s aircraft are here: (https://docs.google.com/document/d/1PZ7JHAGeWGupOZLihwJ9TG3kkrJW3qqg9wMmt-qBkPA/pub).

Cossey’s ownership of the parachutes, and thus the nature of the modifications, is in dispute. http://themountainnewswa.net/2011/10/25/db-cooper-case-heats-up-again-with-controversy-over-parachutes/

And you can find this discussion in the Drop Zone forum. Over like 2000 posts. Guru312 is the user handle of the person who described the possible reasons why Cossey modified his parachute.

Skydivers display all the classic elements of being a clique, and I believe that is a large factor in why they underestimate Cooper’s survival chances. On the skydiver forums, there is a lot of discussion
about the difficulty of pulling a ripcord while in free fall. They make it sound as though it is impossible to do unless you have paid $4000 for instructions on how to do so with a certified instructor. Whereas I believe this is mostly a product of Skydiver culture. Every RAF crew anecdote I read said they received absolutely no instruction on parachuting or pulling the ripcord in free fall. And yet most of those guys still pulled their ripcords. The debate factor is very high, but the central thesis of this paper is that the difficulties RAF crews faced were at least equal to, and probably much greater than the obstacles Cooper faced in his survival. Personally, I don’t think Cossey’s extensive modifications to the parachute would have changed Cooper’s chances at all.

16. Like, all of them.
17. http://www.citizensleuths.com/flightpath.html
19. The separation of the pressure bump from the oscillation is conjecture on my part., mainly done to rectify the cockpit reports with the Tena Bar find. Rataczak does not report two distinct events, however the flight engineer might have reported a pressure change and an oscillation. The eyewitness testimony isn’t clear.
21. My personal opinion is along these lines. Cooper jumped, lost the money when he pulled the ripcord, and was forced into hiding for the rest of his life. The money lands in the Columbia, where it quickly sinks to the bottom and gets slowly pushed along until a dredge chops up the bag and forces the two or three bundles of cash to the surface, where they remain buried for years. The dredge is not a popular mechanism based on Tom Kaye’s findings, but evidence that the money was dredged comes from the fact money fragments were found all around Tena Bar, in depths of up to four feet: From around page 635 of the DZ forum: “In that initial search they found “thousands of teeny shards of money the size of a man’s fingernail, up to the size of a silver dollar.” Dorwin said the pieces were well-preserved and layered in clean sand. “No matter how deep we dug we found money – homogeneously mixed to a great depth.” Dorwin said that most agents were digging at a depth of 1.5-2 feet deep and that they dug at least four holes “at least four deep.” He said they found shards in most holes and evenly placed all the way to the depth of four feet.” From an interview with Bruce Dorwin, FBI man on the site. Posted by snowman’

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