

Pigeon Patriot

Seventy-five years ago, famed behavioral psychologist B.F. Skinner began his career at the University of Minnesota, where he devised a plan to defeat Nazi Germany in World War II that was so unusual it just might have worked.



B.F. Skinner took a teaching position at the University of Minnesota beginning in 1936. He is pictured here in 1942.

In May 1937, *Life* magazine featured an innovative University of Minnesota psychologist and his clever lab rat. B.F. Skinner had taught Pliny, a white rat, to earn and spend “money.” Pliny learned to pull a chain at the top of his wire cage in order to release a marble—the cash in this exercise. A series of photos show Pliny picking up the marble between his little paws and hopping it over to a slot in the floor of the cage. When Pliny inserted the marble, a lever triggered a mechanism that produced a bit of biscuit. Like working a vending machine, Pliny slipped his coins into the appropriate slot and got a snack in exchange. **S** The tone of the *Life* story is precious, and Burrhus Frederic Skinner, the young U of M psychology professor who devised the experiment, is mentioned only briefly—and then only to suggest that even he believes the experiment proves

merely “how much can be done with an animal if proper patience were taken.” But the article could also be counted as the beginning of B.F. Skinner’s public career and a nod to the direction psychology research would take.

Over the course of a long career that stretched for more than 50 years to the 1980s, B.F. Skinner became the most famed behavioral psychologist in the nation. Author of a popular and much-discussed utopian novel, *Walden Two*; a seminal study in the psychology of language use, *Verbal Behavior*; and perhaps his most famous work, *Beyond Freedom and Dignity*, Skinner was one of the most influential and controversial scholarly figures of his day.

In September 1971, Skinner appeared on the cover of *Time* magazine beneath the ominous headline, “B.F. Skinner Says: We Can’t Afford Freedom.” The article placed Skinner at the forefront of a popular and academic debate between critics who argued that he neglected the importance of free will in favor of a rational and overly scientific approach to the human condition. Most subtleties in his points of view were lost in the popular exchange, and Skinner’s theories became, generally speaking, associated

with cold-hearted science.

But Fred Skinner, as he was known to family and friends, was hardly a household name when he arrived at the University of Minnesota in the fall of 1936, fresh out of Harvard, where he’d been a highly regarded and brilliant young fellow. The department chair at the U of M, Richard Elliott, also a Harvard man, was pleased to land a newly minted fellow alumnus for his psychology department.

A junior faculty member interested in a relatively new form of psychology called behaviorism, Skinner was odd man out in a department primarily focused on correlating human interests with appropriate job and educational pursuits. Psychology at Minnesota in the 1930s was focused on differential and industrial psychology. Its various research projects would culminate in the creation of a slew of tests and studies, including the famed Minnesota Multiphasic Personality Inventory, designed to measure and describe personality

BY TIM BRADY



traits. Elliott had an interest in behaviorism, however, and also wanted to broaden the horizons of the psychology department. Thus Skinner was given free rein to pursue his research interests.

His antecedents in the world of behavioral psychology were Russian scholar Ivan Pavlov (1849–1936), whose famous studies of salivating dogs were first published in English in 1928, and American John Watson (1878–1958). Their work directly challenged early psychological research, which had centered on studies of human perception, cognition, and the physiology of the brain. Watson and Pavlov were interested in animal behavior instead of the internal processes of the human mind. They argued, in Watson’s words, that “psychology as the behaviorist views it is a purely objective experimental branch of natural science which needs introspection as little as do the sciences of chemistry and physics.”

While drawn to these founders, Skinner was soon taking their work one step further into something he dubbed “radical” or “descriptive” behaviorism. He would publish his first major work on the topic, *The Behavior of Organisms*, in 1938. Skinner’s idea was to create conditions in which animal behavior could be studied and modified through a process called operant conditioning. By molding exercises that featured denial and reward—offering Pliny a biscuit if he dropped a marble into a slot, none if he failed to do so—certain behaviors were reinforced and others discouraged. Animal behavior could ultimately be modified through the operant.

The first step was to create the appropriate working environment for his animals, which Skinner did as a graduate student at Harvard. He was given access to a workshop and tools and designed and constructed a space where a rat could do its thing free of distraction. This was the forerunner to the box that would house Pliny at the University of Minnesota. Novel equipment in Skinner’s early career, these contained environments, known as “operant conditioning chambers,” or Skinner Boxes, would eventually become standard equipment in behavioral scientists’ laboratories around the world.

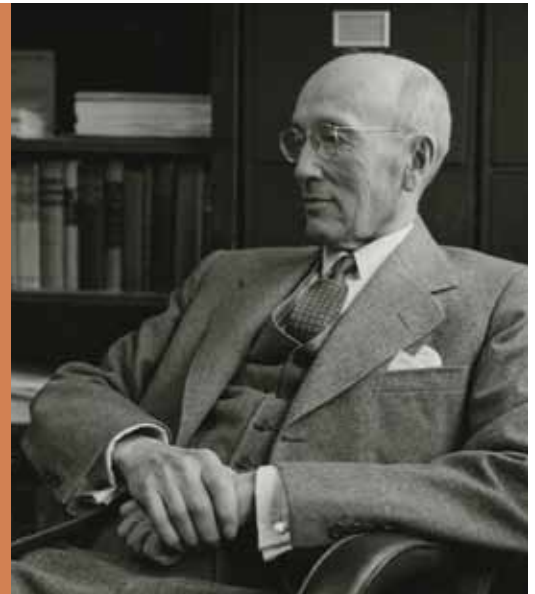
A gift for design and inventiveness characterized Skinner throughout his long career. His chatty three-volume memoirs, published between 1976 and 1983 (the second volume, *The Shaping of a Behaviorist*, details his years in the Twin Cities), are full of tales of gadgetry he invented for research, classroom demonstration, or use around the house. In preparation for the birth of his second daughter, for instance, Skinner constructed a crib-sized envi-

ronment that was designed to be a protective haven for the little girl, Debbie, while his wife, Yvonne, worked around the house. The “baby tender,” as Skinner called it, was a climate-controlled box with a large picture window, stimulating mechanisms (like rings that would sound a whistle or play music when pulled), and a 10-yard-long sheet stretched over the canvas bottom of the box that could be rolled, like a cloth restroom towel, to a clean portion when the baby wet the floor.

Later critics would see the baby tender as an extension of Skinner’s laboratory boxes and charge him with cold-heartedly experimenting on his own daughter. (Debbie was rumored to have developed deep psychological problems as an adult and to have

Above: A lab rat in a Skinner Box, a controlled environment designed to reinforce desired behavior, photographed in 1964.

Right: Richard Elliott, chair of the U’s Department of Psychology, brought Skinner to Minnesota from Harvard, which was also his alma mater.



committed suicide, neither of which is true.) To Skinner’s mind, however, the device was simply a practical household tool and he was proud enough of it to contact the *Ladies’ Home Journal* and suggest they feature the tender in an article. Despite some questions about the efficacy of the sheet roller, in particular, the *Journal* sent a photographer to the Skinner home in St. Paul and published a story in 1945.

During his years at the University, Skinner became engaged in Minnesota popular, political, and social culture of the day. Accord-



Above: B.F. Skinner built a “baby tender,” a climate-controlled playpen with a 10-yard-long roller towel stretched across the bottom so that his daughter Debbie would have a safe environment while his wife, Yvonne, kept house. Mother and daughter are pictured in 1945.

Right: Skinner with a rat in a Skinner Box, photographed in 1960.



ing to his memoirs, the inspiration for *Walden Two* came during a dinner party at the home of Alfred Pillsbury, held as World War II was nearing a close. Skinner was seated next to Hilda Butler, wife of St. Paul attorney Pierce Butler Jr. The two were engaged in a conversation about war veterans returning to civilian life. Skinner had been reading a history of utopian and perfectionist movements in American life and found himself arguing that young soldiers should take their “crusading spirit” out into American society to build a new culture. “I said they should experiment,” Skinner would later write. “They should explore new ways of living, as people had done in the communities of the nineteenth century. She [Hilda Butler] asked for details.” So Skinner went home and began to make notes for the book that would become *Walden Two*.

Skinner’s most famous work in Minnesota began in the spring of 1940. On a train to a conference in Chicago, while staring idly out a rail car window, he was pondering the war in Europe. He recalled the recent massive Nazi air raid on Warsaw, in which the Germans had employed hundreds of old and obsolete planes with no expectation that they would return, instead ending their flights as bombs in the destruction of the city. Suddenly a flock of birds appeared outside, wheeling in formation as his train car passed by. “Suddenly I saw them as ‘devices’ with excellent vision and extraordinary maneuverability,” Skinner wrote in his memoirs. “Could they not guide a missile?”

By the time he got back to Minneapolis, he was eager to test the idea. Skinner visited a local poultry store that supplied pigeons to Minneapolis’s Chinese restaurants. He bought several birds and devised a harness from a man’s sock, which restricted the pigeon’s

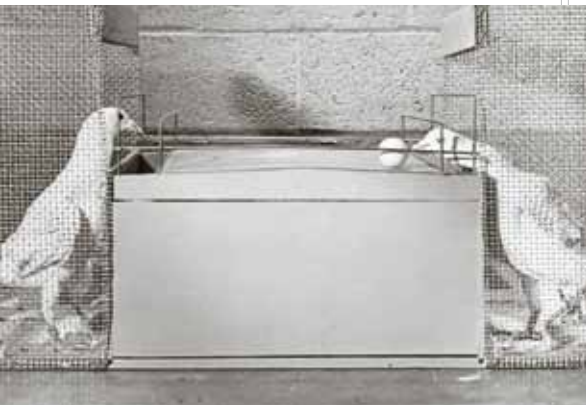
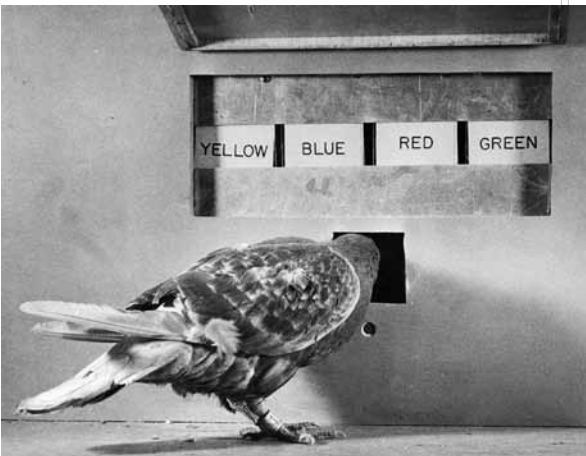
wings and legs but kept its head and neck free. Then Skinner designed an apparatus that propelled the pigeon toward a target, guided by the bird’s own vision and movements of its head and shoulders. He attached lightweight rods in horizontal and vertical lines alongside the neck of the pigeon and hooked them up to a hoist set in a track above the bird. “By lifting and lowering its head the pigeon closed electrical contacts operating [the] hoist, and by moving its head side to side it drove the hoist back and forth on [the] overhead track,” Skinner wrote later. He then put a bull’s eye on a target across the room in his laboratory. By steering with its vision and moving with the aid of the rods, the hoist, and the physical movements of its shoulders and neck—and while being rewarded with grain along the way—the pigeon was able to steer itself across the room toward the target. Again and again and again.

“In great secrecy,” Skinner says, he took the idea to a professor in the Department of Aeronautical Engineering who thought he might be able to build a model plane for the pigeon to guide in a test. Skinner also visited John Tate, the dean of U of M faculty, who came to Skinner’s office to view a demonstration of the pigeon experiment. Tate was impressed enough to contact the chair of the National Defense Research Committee (NDRC) in Washington, D.C., about the experiment. Here things bogged down when Skinner was asked how his pigeons would perform in the midst of a sky full of flak and airplanes, which had obviously not been accounted for in Skinner’s initial experiments. The NDRC could not fund further research and the pigeons were retired.

But not forever.

Skinner hauled them out again on December 8, 1941, the day after Pearl Harbor. Now enlisting the help of a pair of psychol-

BABY TENDER AND PIGEON PHOTOGRAPHS © BETTMANN/CORBIS; SKINNER WITH RAT, NINA LEEN/TIME & LIFE PICTURES/GETTY IMAGES



Top: In a 1950 experiment, one of Skinner's pigeons matched a colored light with a corresponding colored panel in order to receive a food reward.

Bottom: In another 1950 experiment designed by Skinner, two pigeons pushed a ball back and forth. If one missed the ball, it rolled into a trough and the opponent was rewarded with food.

ogy graduate students and with some aid from the University, Skinner decided to use his pigeons to steer a bomb that would be dropped on a target rather than the ground-to-air system he had first envisioned. The basic idea—harnessing a pigeon to a projectile and having its vision and muscle movement guide the missile to a target—remained, but now that bull's-eye would be straight below. Once again, the pigeons performed admirably, and by March 1942 Skinner was confident enough to again approach the NDRC. Again, he was turned down. His experiments were deemed “perhaps feasible” in Washington, but “perhaps” wasn’t good enough to secure funding.

While the idea of using pigeons to guide missiles might seem far-fetched, there were, in fact, others during World War II who were also using animals as purveyors of weaponry. A Swedish sociologist was training seals to attach defusing devices to moored harbor mines. And the Sovi-

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et Union, desperately low on anti-tank weaponry as the Nazis swept toward Stalingrad, trained dogs to attach magnetized mines to the underbellies of German tanks on the battlefield.

Virtually every major corporation in the United States was interested in developing projects that might secure government contracts during the war, and Minneapolis-based General Mills, Inc., was among them. James Ford Bell, founder and chairman of General Mills, decided to invest in Skinner's pigeons. The research division at the company gave Skinner a start-up grant of \$5,000 and lab space on the top floor of its flour mill complex in downtown Minneapolis. Skinner once again enlisted the assistance of his grad students and took a leave of absence from his work at the U.

In September 1942 they began work on a system that would allow pigeons to guide bombs toward a specific target. They advertised for birds and briefly considered using crows instead of pigeons (*Minneapolis Star-Journal* columnist Cedric Adams put out a call for birds on their behalf). That idea was abandoned when the crows proved too difficult to train.



James Ford Bell, founder and chair of General Mills in Minneapolis, invested in B.F. Skinner's pigeon project during World War II.

The device Skinner and company ultimately created began, again, with a man's sock used as a jacket over which was fitted a harness. A pigeon was placed in a tiny cockpit in a lens-tipped cone that was attached to the weapon. The target below was projected from the lens to a screen in front of the birds. Crossing beams of light signaled the spot on the screen the pigeons were trained to strike with their beaks. During training, when a pigeon pecked at the proper target, a small plate of grain swung down before the bird and reinforced its behavior.

In March 1943, a pair of engineers from Washington, D.C., came out to observe Skinner's work. Impressed, they recommended that the office of Scientific Research and Development (a successor to the NDRC) offer a grant of \$25,000—about \$325,000 in today's dollars—for continued study. Skinner and his colleagues began

perfecting the system, adding, among other modifications, two more pigeons to the cone to increase the odds of an accurate strike. "If the missile were approaching two ships at sea," Skinner explained, "all three pigeons [housed in the cone] might not choose the same ship, but at least two must do so, and the system

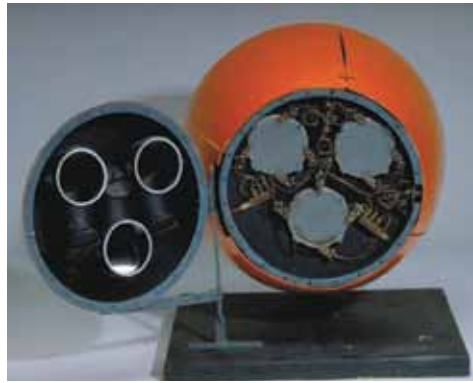
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The nose cone from B.F. Skinner's pigeon-guided missile experiments is on display in the Smithsonian Institution's "Science in American Life" exhibit.

Of his years at the University of Minnesota, Skinner later wrote, "I liked the Twin Cities, but they were not only the Midwest, they were on a spur track off the east-west routes. Under wartime restrictions I had attended no professional meetings and had lost contact with my old friends in the East. Psychologists were

could be arranged so that the third would be punished for its minority opinion and would change to the other ship."

In the end, fierce competition in the development of missile guidance systems, along with a lingering skepticism about placing bombs under the control of pigeons bound in men's socks, doomed Skinner's plan. Work on the project continued into 1944, but it had run out of steam. Skinner, who had postponed work on a Guggenheim fellowship to take up Project Pigeon, as it had been dubbed, now opted to turn back toward his scholarly work.

A year later, the University of Indiana offered the behaviorist a significant raise and the chairmanship of its psychology department. In 1946, he and Yvonne packed up their two girls and the baby tender and headed for Bloomington, staying for the next two years before he took a tenured position at Harvard, where he would remain for the rest of his career.

too busy with the war to pay any attention to rat experiments or a book like *The Behavior of Organisms*—only eight copies of which had been sold in four war years—and no one seemed to be taking up the study of operant behavior."

Skinner's great fame was yet to come. In time, his name would be as familiar as any scholar's in the nation. He would collect numerous awards and honors, including the National Medal of Science. Even his missile would find a place in American history. The cone can be viewed today at the Smithsonian Institution's American History Museum in "The Science in American Life" exhibit. Skinner died in Cambridge, Massachusetts, in 1990. He was 86.

Tim Brady is a freelance writer in St. Paul and regular contributor to Minnesota.

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