**How Auto-Tune Works**

by [Tristin Hopper](http://entertainment.howstuffworks.com/auto-tune1.htm/hsw-contact.htm)

**Introduction to How Auto-Tune Works**

If you switched on the [radio](http://electronics.howstuffworks.com/radio.htm) in the summer of 1998, chances are you got a taste of Cher's "Believe," an up-tempo ode to bouncing back after a rough breakup. More than a quarter century after first rising to prominence as a 1960s folk artist, the 52-year-old Cher was once again climbing the charts. In malls, dance clubs and laser bowling alleys across the country, "Believe" played frequently. By the time the dust had settled, the song had become Cher's bestselling [recording](http://entertainment.howstuffworks.com/recording-session.htm) ever -- and one of the bestselling singles of all time.

At the time, the most notable feature of the song was an electronic modification on the vocals. The effect first appears 35 seconds into the song, while Cher sings "I can't break through." On each of the last three words, Cher's voice undergoes a bizarre electronic glitch.

The reason behind that glitch was **Auto-Tune**, a pitch-correcting software designed to smooth out any off-key notes in a singer's vocal track. Released only the year before "Believe," it was the recording industry's favorite dirty secret: With only a few clicks of a [mouse](http://computer.howstuffworks.com/question631.htm), Auto-Tune could turn even the most cringe-worthy singer into a pop virtuoso. But most [music studios](http://entertainment.howstuffworks.com/recording-studio.htm) kept it around simply to fix with the occasional wrong note.

During the recording sessions for "Believe," however, Cher's British producers had put the software into overdrive. Instead of lightly tuning the pitch of Cher's voice, they had adjusted the levels so sharply that it became an unmistakable part of the song. The effect was weird and robotic, but against a background of synthesizers and high-energy percussion, it worked like a charm. Opera singers have long been using **vibrato**, a technique of delivering a note in a constantly wavering pitch. As far as Cher and her producers were concerned, though, Auto-Tune was simply a computerized twist on the technique.

As "Believe" hit the airwaves, the producers aimed to keep the lid on their new toy. So much so, that when interviewed about the technique by a [sound engineering](http://entertainment.howstuffworks.com/live-sound-engineering.htm) magazine, they lied and said it was due to a vocoder, a well-known voice modulation device used since the 1970s [source: [Sillitoe](http://webcache.googleusercontent.com/search?q)].

But the truth eventually trickled out, and when it did, Auto-Tune's inventor, Harold "Andy" Hildebrand, was shocked. Auto-Tune was supposed to be a behind-the-scenes trick for the recording studio. The New Yorker had compared it to blotting out the red-eye in a photograph, and Hildebrand himself compared it to wearing makeup [source: [Frere-Jones](http://www.newyorker.com/arts/critics/musical/2008/06/09/080609crmu_music_frerejones?currentPage), [NOVA](http://www.pbs.org/wgbh/nova/tech/hildebrand-auto-tune.html)].

But now, Hildebrand's brainchild was making Cher sound like a [robot](http://science.howstuffworks.com/robot.htm). "I never figured anyone in their right mind would want to do that," Hildebrand told Time magazine [source: [Tyrangiel](http://www.time.com/time/magazine/article/0%2C9171%2C1877372-1%2C00.html)] Whether he realized it at the time or not, Hildebrand's electronic creation was about to become one of the largest technological influences on popular music since Les Paul invented the modern [electric guitar](http://entertainment.howstuffworks.com/electric-guitar.htm).

**Auto-Tune's Oily Origins**

Long before he was helping singers find the right note, Harold Hildebrand spent 17 years looking for oil. It was a strange career path for a man whose first love was music. Hildebrand had been playing the flute professionally since the age of 13, and he'd attended the University of Illinois on a music scholarship. But rather than looking to make his fortune in the concert hall, Hildebrand completed a degree in electrical engineering and applied for a job with Exxon Mobil.

Soon, the young whiz had developed a way to find oil using sound. Exploration crews would set off underground dynamite charges, and then, using a technique known as autocorrelation, they would measure the pitch of returning sound waves and use the data to pinpoint [oil rich areas](http://science.howstuffworks.com/environmental/energy/oil-drilling.htm). Traditionally, oil companies discovered oil at the end of a drill bit. Exploration crews would roam the seafloor and the countryside, repeatedly boring into the ground until they struck something interesting. With Hildebrand's innovation, they could now get a good idea of the subsurface long before breaking ground.

The technique saved Exxon millions of dollars, and they paid Hildebrand handsomely. By age 40, the engineer had earned more than enough cash to retire. Instead, in the early 1990s, he gathered up his petrodollars and founded Antares Audio Technologies, a quirky [music software](http://entertainment.howstuffworks.com/music-mixing-software.htm) company in the small California town of Scotts Valley. Hildebrand had learned a lot about sound in the world's oil fields, and with Antares, he aimed to channel that knowledge into the [music studio](http://entertainment.howstuffworks.com/recording-studio.htm). The company's first invention was Infinity, a program that allowed samples of music to be strung together in flawless, repeating loops. Later products included a host of voice-changers and the Microphone Modeller, a program that can mimic the sound of any microphone, be it a vintage vector microphone or a bluesy harmonica microphone.

But the company's most famous creation came about because of a jokey mealtime quip. While Hildebrand was having lunch with a sales rep, the man's wife said something along the lines of, "Hey Andy, how about inventing something that could make me sing in tune?" Intrigued, Hildebrand took her up on the challenge. He had used autocorrelation to find crude oil -- who's to say he couldn't use it to nudge a bad singer into tune?

**Auto-Tune Enters the Music Studio**

It's rare that a performer can sing flawless vocals in one take. For proof, try listening to a live recording of your favorite [band](http://entertainment.howstuffworks.com/band-equipment.htm). Most likely, some of the vocals will all be a bit off -- maybe not by much, but just enough that they sound rough when compared to the studio version. Traditionally, [studio engineers](http://entertainment.howstuffworks.com/recording-engineer.htm) obtained clean, polished vocals on a song by making the artist record the vocals dozens of times -- then, they edited the best parts together. From Frank Sinatra to Tammi Wynette, laying down multiple vocal tracks in the studio was par for the course.

With Auto-Tune, engineers suddenly didn't need to rely on endless re-recordings to obtain perfect vocals. The singer's last note was a little flat? The engineer simply calls up the full performance on a computer screen and, using a mouse, digitally "nudges" wrong notes into the right key.

Engineers have been able to change the pitch of a singer's voice ever since magnetic tape was invented. All you have to do is record your voice onto a tape recorder and play it at a faster speed. The problem is, the trick leaves your voice with a high-pitched "chipmunk" sound. The genius of Auto-Tune is that it can alter the pitch of your voice while still preserving its original quality of the overall recording. Using immense quantities of math, Auto-Tune is able to map out an image of your voice. Using that data, it can then tweak the pitch of your voice without doing too much damage to your voice's original tone and feeling.

The new program saved time and money, and, according to Hildebrand, it made for better music. Here's what Hildebrand told the Seattle Times in 2009:

"Before Auto-Tune, sound studios would spend a lot of time with singers, getting them on pitch and getting a good emotional performance. Now they just do the emotional performance, they don't worry about the pitch, the singer goes home, and they fix it in the mix" [source: [Matson](http://www.mtv.com/news/articles/1613694/jayz-blames-wendys-commercial-autotune-overload.jhtml)].

Within years, 95 percent of all [Top 40](http://entertainment.howstuffworks.com/top-40.htm) songs counted traces Auto-Tune in their production [source: [Freeman](http://www.state.ie/features/6599-a-brief-history-of-auto-tune)]. Still, purists derided the software as "cheating"; artists just weren't taking the time to record quality vocal tracks anymore. American singer-songwriter Neko Case summed it up in a 2006 interview: "When I hear Auto-Tune on somebody's voice, I don't take them seriously" [source: [Dombal](http://pitchfork.com/features/interviews/6306-neko-case/)].

Worse, Auto-Tune was also accused of filling pop music with attractive yet untalented singers. Only a few years before Cher's "Believe," the pop duo Milli-Vanilli had been charged with fraud after audiences discovered that the band's two members had actually been lip-syncing vocals performed by different musicians. Fearing a similar scandal, engineers took pains to disguise their vocal-correction footprints as much as possible.

Meanwhile, buried deep in the software was a setting known as the "zero function." One of the ways Auto-Tune makes its pitch-corrections sound natural is by putting small spaces of time in between notes. Just like a real human voice, the software will take a few milliseconds to gently ease from one note to the next. But Auto-Tune came with the option to reducing the space between notes to zero, thereby forcing the notes to change instantaneously from one to the other, giving the vocal track an eerie, computerized timbre.

It was like using Photoshop to dial up a picture to 100 percent brightness. Sure, you could do it, but it would turn your image into a washed-out mess. Similarly, engaging the zero function would transform your vocal track into a clutter of warbly, [sci-fi](http://entertainment.howstuffworks.com/sci-fi.htm) sounds. Surely, the engineers thought at Antares, nobody would ever need to use the zero function. Right?

**Be T-Pain**

In 2009, Antares cashed in on the Auto-Tune craze by releasing "I Am T-Pain," an [iPhone](http://electronics.howstuffworks.com/iphone.htm) app that allows users to be Auto-Tuned as they sing along to a T-Pain song. As long as you sing in time with the music, the 99-cent app puts you in perfect tune every time.

**Auto-Tune Takes the Spotlight**

In Renaissance Italy, every self-respecting opera house had hosted at least one **castrato** -- male singers that had been castrated at an early age to preserve their ability to sing at a high pitch. Each year, hundreds of parents sent their boys to back-alley doctors, just to give them a chance at one day making it big on the European concert hall circuit. That is, until Italy outlawed the practice in 1870. Long before Auto-Tune, it seems, musicians have gone to great lengths to modify their singing voices.

More recently, artists have been using all kinds of electronic tricks to twist, distort and modify their vocal tracks. Pete Frampton wowed audiences with the **talk box**, a modified vocoder that allows artists to "speak" through their instrument using a plastic tube. In the Beatles' 1967 hit, "Strawberry Fields Forever," John Lennon slowed down his vocal track, giving his voice a deeper, slurred sound. In the 1983 hit, "Mr. Roboto," Styx used a vocoder to simulate the sound of a [robot](http://science.howstuffworks.com/robot.htm) talking. The music studio has always been a place to experiment, and with Auto-Tune within easy reach for every major [music producer](http://entertainment.howstuffworks.com/music-producer.htm) in the United States, it was only a matter of time before someone took the software "to the limit."

Reportedly, during the "Believe" sessions, engineers had tweaked Cher's voice with the zero function purely as a joke [source: [McNamee](http://www.guardian.co.uk/music/2010/apr/06/auto-tune)]. But once Cher heard the effect, she demanded they keep it in the final cut. In their Auto-Tune manual, Antares renamed the zero function the "Cher Effect," and it quickly began making the rounds of pop music, from Daft Punk to the Black Eyed Peas. For music producers looking to spice up the new millennium with modern sounds, the Cher Effect was a breath of fresh, computerized air. And the sound was surprisingly profitable. All it took was a few minutes tweaking the Auto-Tune dials, and a song's popularity was almost guaranteed to rise. At first, using the zero function was like adding backup singers or a sitar to a recording: It would spice up the track, but it didn't dominate the song.

That is, until a little-known Florida DJ known as T-Pain bought his first Auto-Tune CD-ROM. T-Pain had been experimenting with music production ever since he was 10 years old, and Auto-Tune soon became his favorite sonic trick. So much so, that T-Pain looked to outright meld his voice with the technology. Whenever T-Pain opened his mouth on an album, he decided, he would do so through an Auto-Tune filter. T-Pain's first major Auto-Tune creation, "Buy U a Drank," rocketed to No. 1 on the charts, and soon, like a modern-day Johnny Appleseed, the young rapper was flying to all corners of the United States to lend his Auto-Tuned voice to the greater [hip hop](http://entertainment.howstuffworks.com/hip-hop.htm) community. When Kanye West wanted Auto-Tune on his 2008 album, "808s and Heartbreak," he called in T-Pain as a consultant. By the time the pair finished, Auto-Tune was on every track.

Meanwhile, Auto-Tune's telltale warble was ending up in the unlikeliest of places. Artists like Maroon 5, Avril Lavigne and the Dixie Chicks were releasing songs that didn't feature the Cher Effect but still had tinny, strained vocals. Ten years ago, those songs would have been derided for sloppy production. But now, audiences were so used to electronic hiccups that they didn't even notice.

**Death of Auto-Tune?**

According to Antares, more than 90 percent of its Auto-Tune units are in the hands of hobbyists; amateur musicians and [producers](http://entertainment.howstuffworks.com/music-producer.htm) looking to smooth out their latest basement recording [source: [Matson](http://www.mtv.com/news/articles/1613694/jayz-blames-wendys-commercial-autotune-overload.jhtml)]. As hundreds of T-Pain copycats began permeating the airwaves, homemade Auto-Tune creations began exploding across the Internet.

One of the most prominent became "Auto-Tune the News," a [YouTube](http://money.howstuffworks.com/youtube.htm) series that uses Auto-Tune to turn news clips into pop songs. Produced by Brooklyn soul band the Gregory Brothers, the videos coaxed Auto-Tuned performances out of Barack Obama, Hugo Chavez and even Winston Churchill. Their biggest hit, however, was 2010's "Bed Intruder Song." The brothers took local news footage of Hunstville, Ala., resident Antoine Dodson delivering colorful warnings to a neighborhood intruder and Auto-Tuned it to create a catchy hit that reached No. 89 on the pop charts [source: [Peters](http://www.billboard.com/news/gregory-brothers-take-antoine-dodson-to-1004110352.story#/news/gregory-brothers-take-antoine-dodson-to-1004110352.story)].

Advertisers also threw their hat into the Auto-Tune ring. In 2009, Wendy's aired their "Frosty Posse" commercial featuring a gang of office workers belting out Auto-Tuned rhymes while break dancing down the street to grab a cup of soft-serve ice cream. Watching the commercial from his Manhattan apartment, rapper Jay-Z suddenly realized that Auto-Tune had finally gone too far.

Enraged by the ad, the rapper soon penned "D.O.A. (Death of Auto-Tune)," a vicious musical attack on the digital craze. "I know we facin' a recession, but the music y'all makin' gonna make it the great depression … get back to rap, you T-Painin' too much." In interviews, Jay-Z claimed Auto-Tune was becoming a musical crutch that was spoiling otherwise good tracks. "I just think in [hip-hop](http://entertainment.howstuffworks.com/hip-hop.htm), when a trend becomes a gimmick, it's time to move on," he told a Chicago radio station [source: [Reid](http://www.mtv.com/news/articles/1613694/jayz-blames-wendys-commercial-autotune-overload.jhtml)]. Other musicians chimed in with their own Auto-Tune displeasure, most notably Death Cab for Cutie, who showed up to the 2009 [Grammys](http://entertainment.howstuffworks.com/grammys.htm) wearing anti-Auto-Tune blue ribbons [source: [Cross](http://exploremusic.com/show/the-history-of-the-scourge-that-is-auto-tune/)].

Hildebrand has declared his innocence in the Auto-Tune fight, saying it's akin to blaming General Motors for inventing car crashes. But, in response to Jay-Z, his company did publish a cheeky press release with a picture of an Auto-Tune box declaring "the reports of [its] death have been greatly exaggerated." Despite all the hype, the Cher Effect has never made much money for Antares. Most of its Auto-Tune units continue to be purchased by studios and musicians looking to use the software for its intended purpose: smoothing out the vocals in music tracks.

Even if the Cher Effect disappears entirely from the music world, as long as singers are making mistakes, it looks like Auto-Tune is here to stay.