



5 DRONE STARTUPS CHANGING THE WORLD **P.6**

# drone360

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WITH UAS LEADER  
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# ARMING UP

Weaponized drones may instill fear — but they can be used for more than causing harm

by Zara Stone

**D**uring the summer of 2014, 22-year-old Houston resident Austin Beaulier was feeling hot, cranky, and a little bored. While restlessly channel surfing one day, he came across an episode of the robot combat series *Battlebots*. Growing up, he'd loved the show — and looking around his living room, he realized he might be able to one-up the bots on screen.

A couple of hours later, his DJI Phantom FC40 swooped around his backyard, a Nerf Combat Attacknid tied onto its frame. "I had no soldering skills at the time, so it's basically taped together," he says.

At first, instead of 12 foam darts machine-gunning out of the drone,

it veered left and crashed into a tree. After a little rewiring, it was airborne again — this time with a lighter load. Out pummeled the darts, each pinging into the air with a satisfying snap. But Beaulier didn't have long to play, as the extra weight cut the drone's battery life down to a pathetic three minutes.

An aerial strike with a Nerf gun is unlikely to injure anyone, but the ease with which Beaulier mounted the foam-dart slinger highlights the potential for adding more dangerous weapons. This was demonstrated by Connecticut-based Austin Haughwout, 19, (yes, another Austin) who took Beaulier's maker-style project to the extreme.

In July 2015, Haughwout mounted a remote-controlled, semi-automatic handgun to his homemade multicopter

«Marque Cornblatt's Aerial Sports League puts drones under some intense combat conditions — like this quadcopter flying through flames. But don't worry, it's all in good fun. ■ AERIAL SPORTS LEAGUE

and recorded video of it firing rounds in his wooded backyard. The FAA caught wind of the video — which currently has 3.8 million views on YouTube — and hauled Haughwout in for questioning.

Whether his actions were illegal is yet to be proven. FAA spokesperson Les Dorr says Haughwout is under investigation for potentially violating recklessness regulations — but he's sparked a global discussion about whether weaponizing UAS is appropriate. While we can all agree that aerial semi-automatic handguns are clearly a public health hazard (if not necessarily illegal), the issue gets murkier when looking at the consumer market for weaponized toy drones.

In 2016, Parrot launched the Mambo, a palm-sized, 2.2-ounce drone with a "cannon" attachment that shoots tiny pellets hard enough "to pop bubbles," according to its promo video. And China-based Wingsland's new S6 drone comes with a "BombGun" attachment that fires 0.3-inch orange bullets. These are the first weaponized drones to the consumer market, but probably not the last — another China-based drone company, PowerVision, says it would produce a BB-gun-style attachment for its PowerEgg drone if there was enough demand.

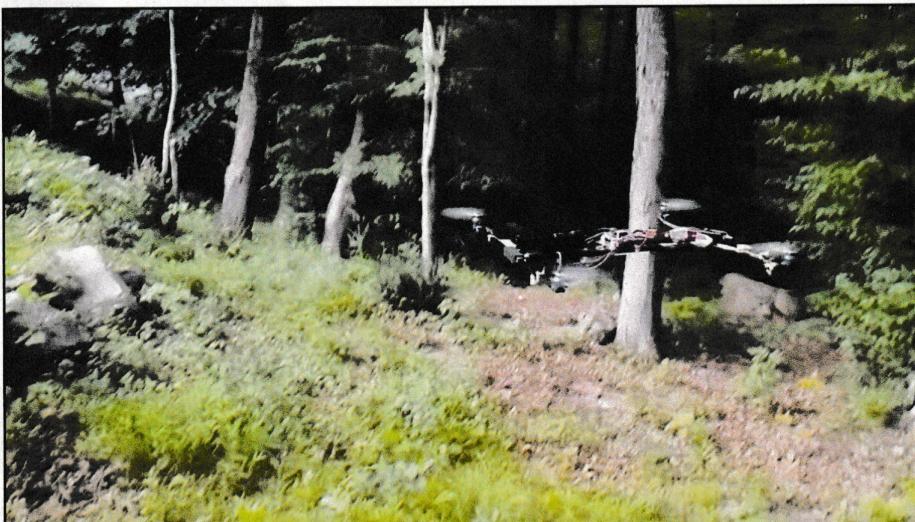
But how do you identify the harmless from the hazardous when it comes to mounted weapons? What seems obvious to the everyday person often doesn't translate when it comes to regulation. After all, it took years for the FAA to agree on Part 107, a time during which,



rightly or wrongly, the government effectively grounded thousands of pilots. And, as is often the case with new technology, weaponized drones are a mix of good ideas that might be put to malicious ends.

### Competitive drone combat

You hear Marque Cornblatt's drone combat matches before you see them — a metallic din of whirring motors, whistling propellers, and awkward crunching sounds. Get closer and you see drones buzzing inside a netted cage, their pilots furiously working their controllers.



Austin Haughwout's handgun-equipped drone is arguably the most well-known instance of an armed consumer drone — but it's certainly not the only example.  YOUTUBE/HOGWIT

Austin Beaulier's innovative spirit drove him to attach his Nerf Combat Attacknid toy (pictured) to a consumer drone — but as UAS technology improves, attempts to weaponize drones may grow increasingly dangerous and nefarious.  NERF/AMAZON.COM

"It's always fun to smash toys together," Cornblatt explains — both on a visceral human level and as an engineer. "Developing a drone for this purpose is a challenge that never ends."

The game is simple: Each player starts with three points, losing one every time their craft hits the floor. Once downed, a pilot has 90 seconds to get airborne again, or forfeit the match. The first to reach zero points loses the match.

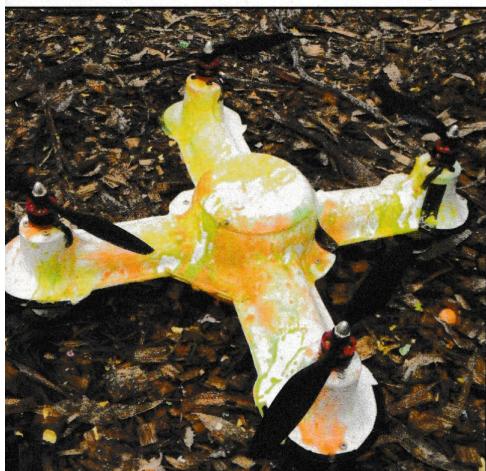
As founder and CEO of the Aerial Sports League, Cornblatt holds drone combat events across the U.S. Birthed from San Francisco's hobbyist engineering community in 2011, the sport grew from garage gatherings to 250,000-spectator events in 2015.

Cornblatt is also infamous for his videos wherein a drone-mounted paintball gun splatters him with yellow paint. "It's our own version of aerial robotic dog fighting," he says. These paintball stunts took place on private property with safety precautions and goggles — and he has no plans to resurrect them soon.

For now, his primary focus is on gaining visibility for drone combat. His most recent Drones & Drinks event at San Francisco's Palace of Fine Arts introduced aerial combat to a cocktail-sipping crowd, kept safely out of range, of course. Cornblatt is emphatic about safety, but he recently fought two Californian bills trying to outlaw weaponized drones.

"I have no issue with legislation that restricts people from illegal things, but broad and overreaching [laws] would have made our games a criminal activity," he says, adding that most of his events are family friendly and encourage children to enter into STEM fields. Both bills were eventually dismissed.

Sally French, *MarketWatch* reporter and drone blogger at *The Drone Girl*, explains, "With drone combat, there's adrenaline, it's fun to do, and there's skill involved." French uses drones for photography, but sometimes finds the scope limiting. "Combat is always



**A little paintball never hurt any drone — this quadcopter has clearly suffered a few direct hits.** ■ AERIAL SPORTS LEAGUE



**Small but mighty, this ultra-light micro drone modified with a single-shot Estes rocket launcher is just one example of how ingenuity can turn consumer UAS into weaponized aerial machines. Luckily, this little guy was made for fun, not war.** ■ AERIAL SPORTS LEAGUE

changing, you're modifying the drone, upgrading it, playing against different people," she says.

### The (legal) flying force

Local law enforcement officials are also beginning to grapple with the use of weaponized drones. While federal agencies have used drones in combat and search-and-rescue overseas for some time, UAS are a new technology for most state and local departments.

In 2015, North Dakota became the first state to legalize weaponized police drones, with the proviso that they be "less than lethal." This means tear gas, rubber bullets, and tasers (which have, in fact, killed people) are fair game.

In a strange turn of events, the very bill that ushered in the use of these weapons was originally intended to outlaw *all* weaponized drones in North Dakota. But an amendment supported by the state's police union hamstrung that ambition.



**Nowhere to hide: a heavy-lift drone, mounted with a high-capacity automatic paintball gun.** ■ AERIAL SPORTS LEAGUE

Other states continue to struggle with the question of weaponized UAS. In June of last year, Michigan Rep. Jon Hoadley introduced a bill to make any type of weaponized drone illegal. Connecticut is trying to pass a bill that makes weaponizing drones illegal for civilians, but OK for nonlethal use by police. And Oregon made it a Class A misdemeanor to operate a weaponized drone — whether this applies to Parrot's Mambo could be down to the temperament of individual officers.

While French doesn't want to see weaponized drones in the sky, she says

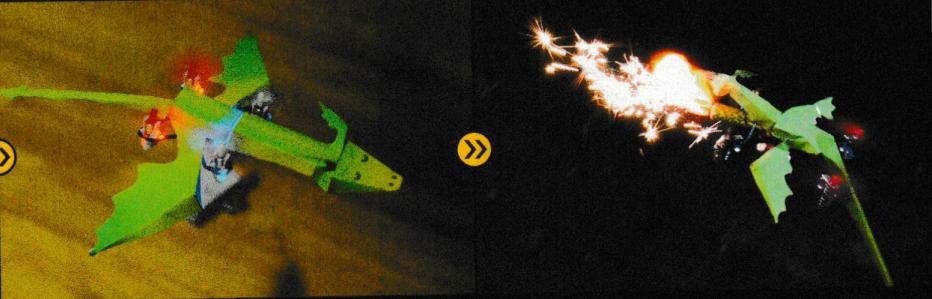
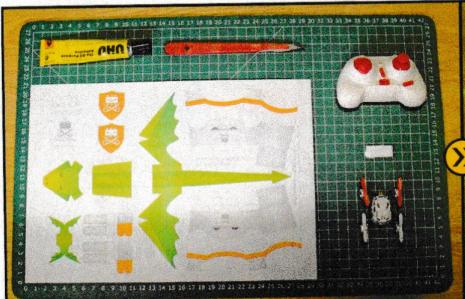
it's probably inevitable — where there's technology, there's a way.

But she wants to curb the urge to create new regulations. "We've had a drone witch hunt, and there's [already] a lot of legislation," she says.

Even though weaponized consumer drones have not yet caused any mortal injury to people in the U.S., guns alone killed more than 13,000 U.S. citizens in 2016, according to the Gun Violence Archive. And while it would seem the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) would



**Watch out! The Wingsland S6 can be equipped with a toy gun.** ■ YOUTUBE/ STEPHANE C. LORIA (ABOVE); WINGSLAND



Ross Atkin's CraftyRobot initiative focuses on helping children create simple robots without coding or robotics experience. After creating one version of the dragon robot, he received requests for a fire-breathing version. Undeniably, Khaleesi would be proud. ■ ROSS ATKIN (3)

have jurisdiction, that's not necessarily true. Special Agent Christopher J. Arone says the ATF has "no regulatory authority over drones, as that falls under the FAA." The FAA's Dorr says the agency is "concerned about anything that can impact aviation safety."

And it's hard to argue that armed drones don't pose a threat to safety, both in the air and on the ground. In 2012, Boston resident Rezwan Ferdaus, 26, was sentenced to 17 years in jail for plans to bomb the Pentagon with a consumer fixed-wing drone packed with C4 plastic explosive.

### Drone-maker movement

It's dark, and the sky is silent and still — until a small green dragon flies by, tail shaking in the wind, sparks shooting from its mouth. There's a flash and a bang, and the dragon slowly lands in Ross Atkin's back garden. Before scooping it up, Atkin checks that the flames are extinguished: He attached a firework candle and paper exoskeleton to his micro drone. Atkin is a British-based technologist who's turned his passion for hacking into a career. By day, he runs CraftyRobot, a startup that helps children build basic robots without knowledge of coding.

He's just finished flying version two of his dragon drone; the first flew in flame-free circles. But Atkin received so many requests for fire breathing that he updated the design.

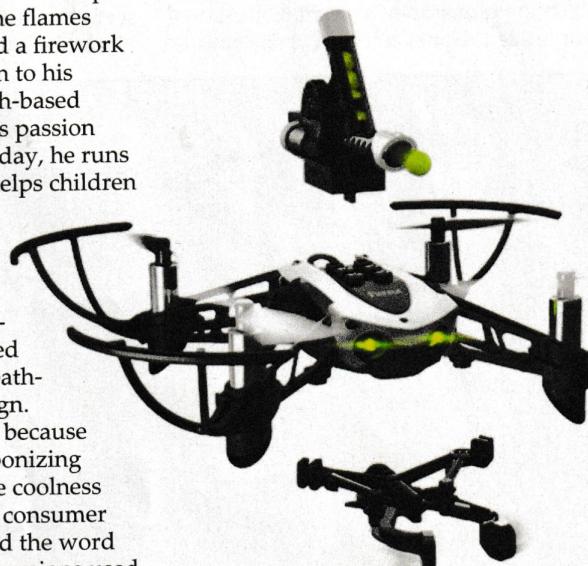
"Initially, I was skeptical, because it sounded too close to weaponizing the drone, but eventually the coolness won out," he explains. "The consumer drone industry has reclaimed the word *drone* from the weaponized versions used in assassinations."

Atkin is part of the maker generation: The large group of people who view a piece of tech as the beginning — rather

than the end — of their experience with it. Makers are a diverse group, made up of engineers, tinkerers, roboticists, and most anyone else willing to experiment with technology. President Obama declared America a "nation of makers" in 2014 — there are an estimated 135 million makers in the country today. With drone prices dropping, this versatile tech is an inviting playground.

YouTube is full of makers displaying novel adaptations to their drones, from a BB gun attached to a multirotor to a chainsaw-equipped hexacopter. There are some troubling clips of machine guns sitting atop quads, but these — excepting Haughwout's contribution — are viral stunts, like one created for Activision's *Call of Duty* franchise.

On the lower end of the maker spectrum sit Parrot and Wingsland's toy drones with their LEGO-like snap-on



Parrot's Mambo drone can be customized with a cannon attachment, making the little guy more annoying to its targets. ■ PARROT

attachments. For now, these consist of emoji lights, tiny pellet guns, and claws — but it's not a stretch to imagine people modifying them.

"It's sick to introduce kids to weapons at a young age," says Zoe Stumbaugh, a professional drone racer. "Kids play with a toy gun and then join the military." But not everyone agrees.

"It's hardly a revolutionary idea," says Hugh Langley, news editor at [wearable.com](http://wearable.com), a wearable technology website. "This is for kids on Christmas Day who will use the claw to lift [their] grandma's hat off her head."

He adds that he's sure Parrot assessed the Mambo drone for safety, but says that sticking pellet shooters on drones doesn't help regulatory concerns.

Parrot and Wingsland did not respond to requests for comment.

### Weaponizing for social good

As strange as it may sound, equipping drones with weapons may have far-reaching benefits. For instance: A fire-starting drone seems like a dangerous idea, until you start thinking of what it could do in the right hands. At the University of Nebraska-Lincoln, scientists have been creating a drone that can carry out controlled burns. Over 50,000 wild-

fires blazed in 2015 — many of which could have been prevented by burning away dry material. Most controlled burns involve using helicopters, which is expensive and dangerous.

Fire-starting drones are equipped with powder-filled pingpong-style balls. These balls are injected with liquid glycol before release, which causes them to ignite as they land at specific, pre-programmed drop sites. So far, researchers have successfully tested the fire-drones on 20 acres and are pleased with the tests.

But Werner von Stein, who runs SF Drone School, is concerned that



With a name like KillerDrone, what could possibly go wrong? A hexacopter equipped with a chainsaw spelled certain doom for these unsuspecting snowmen.  YOUTUBE/NOODLEDETAIL (2)

this could go too far. "It's scarier if someone puts some gas or liquid on the drone and sprays it," he says. "A gun is one shot — a spray is the nightmare."

However, von Stein says in some instances, weapons can be helpful. He references a friend who uses mounted lasers to scare birds from airports — aerial bird strikes can cause significant damage, and have killed at least 255 people since 1988.

"[The lasers are] technically a weapon," von Stein says. "You don't know where the boundaries are, what's playful and what's not."

### A fighting future

While we've seen very few instances of intentionally malicious drone operators, the mere suggestion of such a threat is enough for many civilians and legislators.

In July 2015, almost 21,000 people signed an open letter from the Future of Life Institute calling for a ban on autonomous weapons. Signatories included Elon Musk, CEO of SpaceX and Tesla Motors; Steve Wozniak, co-founder of Apple; and theoretical physicist Stephen Hawking.

The letter stated, "Starting a military AI arms race is a bad idea, and should be

prevented by a ban on offensive autonomous weapons beyond meaningful human control."

But those involved with drones know this technology's potential.

"There are definitely bad drones out there," says Cornblatt. "But because of some bad usages, that doesn't make them bad technology."

He points to the popularity of drone racing — flying around courses at speeds up to 80 mph, these drones could easily cause injury. But ESPN's investment and airing of The Drone Racing League in September is proof to Cornblatt that perceptions have changed.

"Two years ago, any time the media mentioned drones, they were negative," Cornblatt says. "Drone sports speak to broader uses and benefits."

And just because new toys are available, that doesn't automatically translate to people purchasing them. Langley says, "Personally, I'd prefer a drone with a water gun on it. That would give Super Soaker fights an interesting new dimension."

Beyond the holiday season, demand for these drones will determine if consumers are embracing flying bubble poppers ... or not. And that may set the pace for the future of commercial weaponized drones, for better or worse. 

## FIRESTARTING A DEBATE

**THE QUESTION OF WEAPONIZATION** extends beyond just aerial vehicles. Ground-based remotely operated vehicles (ROVs) are also a contentious issue — as the American public learned after the lethal use of an ROV by Dallas police in July 2016.

During a peaceful protest as part of the Black Lives Matter movement, a gunman fired at police officers, killing five and injuring nine others. After officers attempted to negotiate with the shooter, a bomb disposal robot (the Remotec ANDROS Mark V-A1) armed with C4 explosives was used to kill the suspect.

This incident marked the first time U.S. law enforcement officials used an unmanned robot to kill a suspect.

"We saw no other option but to use our bomb robot and place a device on its extension for it to detonate where the suspect was," said Dallas Police Department Chief David Brown in a press conference.

While ethical debates abounded, no revised legislation resulted from the lethal ROV. Until formal laws are written to guide weaponized ROV use, the application of robots by law enforcement for lethal force remains murky.