EMBO reports

The FBI and biohackers: an unusual relationship

The FBI has had some success reaching out to the DIY biology community in the USA, but European biohackers remain skeptical of the intentions of US law enforcement

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In 2009, the US Federal Bureau of Investigation came knocking on the door of the biohacking community: The agency sponsored a booth and workshop at the 2009 iGEM (International Genetically Engineered Machine) competition in Cambridge, MA, USA, and stood alongside US biohacking community leaders at a FBI-sponsored synthetic biology conference "Building Bridges Around Building Genomes" held near San Francisco in 2010. The FBI acknowledged that their presence at and sponsorship of these conferences might seem unusual, with one agent noting in his slideshow, "We're with the U.S. Government [...] and we're here to help. Really" (https://www.synbioproject.org/site/assets/files/1260/you_presentation.pdf). Since, the agency has organized more such meetings in 2011 and 2012 FBI agents have generally been welcome in the amateur biology scene in the USA.

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Jason Bobe, co-founder and director of the website DIYbio.org, said that the discussions between the community and the FBI have educated both sides. "[FBI agents] need to be educated about the realities of the community and new technologies", he said. "I think it was hugely valuable for us to engage and educate them. I think it became obvious to them that we are not the enemy". Craig Fair, an assistant special agent at the FBI, who was in charge of counterterrorism in the San Francisco Bay Area and has a doctorate in microbiology, told the FBI-sponsored "bridges" meeting in 2012: "[We] want to show the international community that this model [of cooperation between the FBI and DYIbio] is safeguarding your practice, and that's to our mutual benefit" (http://diyhpl.us/wiki/transcripts/fbi-diybio-2012/intro/). Bobe, who operates a volunteer hotline for biosafety education, contrasted this "new" FBI, represented by scientists with a PhD with the "old" image of crew-cut G-men decked out in blue suits.

New FBI or not, many biohackers, especially from Europe, had long memories of the "old" FBI who raided the home of an early performance artist-biohacker. They well remember Steve Kurtz, an art professor at the State University of New York at Buffalo (NY, USA) and founder of the Critical Art Ensemble that used DNA and other biomaterials to encourage a political debate, who became the target of a FBI raid in 2004. Agents in biohazard suits raided his home and seized his equipment and samples of harmless bacteria. Kurtz was initially charged with bioterrorism, but later indicted for mail and wire fraud. The government dropped the charges in 2008, only a year before the FBI began to reach out to the biohacker community.

Cathal Garvey, a pioneering do-it-yourself biologist from Cork, Ireland, represented this feeling when he stressed that the FBI had no legal standing to tell European biohackers what they could or could not do. In contrast, he said, he would be open to speaking with Irish authorities.

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Todd Kuiken, a senior research associate at the Wilson Center in Washington DC, USA—a quasi-governmental agency that researches emerging technologies—commented that he too was initially skeptical whether the FBI could build a relationship with the hacker community. "But I actually think, at least in the US, it's been an extremely symbiotic relationship", he said. However, the FBI was less successful in extending its invitation to European DIY biologists at the 2012 outreach meeting. "We were very honest, upfront, about what was happening; that this was an FBI-sponsored meeting. We did not want to mask that it was anything beyond that", Bobe Kuiken, who prepared the conference invitation list, said. "We had some calls to try to talk about it beforehand so people could ask questions about what was going on. Why the FBI was doing this. Why they wanted the European groups there. People who were comfortable came, and people who weren't didn't, and that was fine either way".

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European biohackers and Kuiken said about half of the European biohackers contacted did not respond to the invitation and some expressed their reservations about what they regard as an intrusion of police authorities into their private lives. Pieter van Boheemen, founder of the Dutch DIYBio community, who leads the Fablab Amsterdam, Open Wetlab and Open Design Lab at the Waag Society, said he was put off by the FBI presence. "In our society, we hardly ever deal with this type of authority. We never interact with them", he said. "We collaborate with all safety agencies and stick to those rules, best practices and standard operating procedures, but have no interest in maintaining a relationship with security agencies and contribute to the creation of a paranoid society. A free and open society is what's dear to us".

Both Kuiken and Bobe have some sympathy for the negative reaction to the FBI from some Europeans. "I would say there would be a similar reaction from the US groups if all of a sudden the French FBI came over here and said, 'Hey, we're the French FBI, and we're here to help'". Kuiken said. "You've got this law-enforcement agency that doesn't necessarily have the greatest history regarding protecting civil liberties and then it's also a foreign institution". Bobe, who is also Executive Director of PersonalGenomes.org and a faculty member at Icahn School of Medicine at Mount Sinai in New York City, NY, USA, can also understand the reservation: "NSA, CIA and FBI are not winning friends by spying on citizens. Europeans are far more upset about this".

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Van Boheemen thinks that the FBI is earnest in its outreach, but doubts its value. "The question is whether you can actually prevent something or not. And what exactly are you trying to prevent? And at what cost?" he said. "The risks of DIYBio have nothing to do with security, it is more a safety concern. Yes, accidents are likely to happen, but intentional terrorist attacks from the DIYBio community are a fantasy. [...] Do you really believe that the interaction between a security agency and a group of artist, hackers and amateur scientists is going to make our society more secure? Do you really believe it is going to prevent excluded minorities like disadvantaged youngsters in Brussels from joining an organisation like Islamic State?"

Alexander Murer, founder of OLGA—Open Biolab Graz, the Austrian biohackerspace—was also skeptical: "There is no relation or connection whatsoever between terrorism and biohacking. Biohacking evolved around community labs (biohackerspaces), which can't be used for illegal activities due to their openness. Methods and equipment used by biohackerspaces have been available to any well-funded organisation like terrorist groups, the military and corrupt countries long before. So if there's a potential threat, it is coming from them, definitely not from some biohackers having fun in their basements with cheap equipment".

Murer's laboratory cooperates with the local health and safety agency, but not with the police. "It's definitely not their business what we do perfectly legally in our free time", he said. "I see a big risk for free Western countries coming from surveillance and the curtailment of civil rights, even democracy by law enforcement/intelligence services as a false, helpless reaction to terrorist activities. Therefore, I am concerned about the cooperation between US biohackers and the FBI, especially considering the roots of the biohacker movement in computer hackerspace culture, [which is] traditionally strongly against surveillance. The willingness to cooperate partly seems to come from their fear that the law enforcement/intelligence services might end biohacker activities in the US, rather than seeing them as their friend and helper".

William So, a program and policy specialist at the FBI's Weapons of Mass Destruction Directorate, who has a doctorate in environmental toxicology, said that cautious reactions are not unexpected, but he insisted that the FBI "just wants to ensure that science is conducted safely and of course for our mission, securely". He added that the Biological Countermeasures Unit's mission is to prevent misuse or illicit acquisition of materials, technology, and expertise in the life sciences by would-be terrorists. "As a scientist working in the FBI, I think it just makes perfect sense for the two communities to be working together. We have similar missions. We want to ensure the safety and health of the public, the environment, animals, plants, so why not just join the forces and figure out how to do it together?" So said.

The FBI outreach to the biohacker community should therefore be seen as an attempt to network: "If you're talking about the chemical sectors, that's the person you go to; they are also the people to go to for bio-matters. They know their local law enforcement. They know their public health officials", So said. "That's why we have been working with [biohackers] to see where we can and how we can protect each other". His unit is also reaching out to Interpol, a network of police agencies in countries worldwide, and Europol, which works with the member states of the European Union.

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Ellen Jorgenson, a molecular biologist turned biohacker and co-founder of Genspace, the world's first community biolab in New York City, accepts the FBI presence in the biohacking world as inevitable. "The FBI has been at iGEM every year since 2009", she said. "It's a very positive thing because there's nothing like having [the FBI] tell everybody that there's nothing to fear from us. I'm a professional scientist, and I've been part of this community for 7 years, and I've never even heard a whisper of anything dangerous". Jorgenson told the FBI at one meeting: "Our capabilities are overestimated and our ethics are underestimated".

In Europe, however, the idea of the police looking over the shoulders of hobbyists raises fears borne of the continent's experience with totalitarian regimes. Hanno Charisius, Richard Friebe, and

Sascha Karberg are a trio of German freelance writers who trained as biologists. They co-authored a 2013 book, "Biohacking: Gentechnik aus der Garage", in which they explored the DIY scene in the USA and Europe. "There was a cultural difference between the Americans and Europeans", Charisius recalled. The Americans generally agreed that they would report to the FBI any individual who showed an interest in dangerous pathogens. "The Europeans were reminded of the European past, where denunciations took place. The idea of reporting someone to the FBI more or less creeped them out", Charisius commented. "I know a biohacker from Eastern Germany. He was really offended by these ideas".

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During the research for their book, Charisius, Karberg, and Friebe tried to interview an official from the Bundeskriminalamt, the German version of the FBI. Something comparable to the FBI outreach program did not exist, a spokesperson told them. The BKA and other police agencies in Europe did not respond to queries for this article.

The media has also played a role in trying to raise concerns about how DIY biologists could potentially meddle with pathogenic organisms. In 2006, the British newspaper *The Guardian* created a fake company and successfully ordered a 78-bp segment of smallpox DNA with three modifications to render it harmless. The Royal Mail delivered the package to a residential address. After the appearance of the article, there were calls to ensure sure that ingredients for deadly biological weapons could not be bought over the Internet.

Charisius and his co-authors set out to find how difficult it would be to set up a biohacking laboratory in an office in Berlin. They bought a used PCR machine for 300 euros on eBay from a man who said he had found it abandoned in a hallway of his university. They easily obtained most of their other supplies from eBay, Amazon, and other online shops. The only obstacle was acquiring tiny resin balls to isolate DNA. "This is harmless material that we didn't find a shop that was willing to sell it to private people like us", Charisius recalled. "Those vendors of chemicals have this policy because they also have very dangerous stuff like red phosphorous. [...] They just sell to professionals". Finally, Charisius found a pharmacy willing to act as a proxy and order the resin for them.

They also had some difficulty obtaining PCR primers. One laboratory called them to ask why they wanted to buy DNA. Charisius explained they were journalists doing an educational experiment. "We got approved. And from that moment on we were able to order any kind of DNA primers from that vendor". They ordered primers to isolate the gene that codes for the toxin ricin in the castor plant. "We stopped once we knew we had everything in our hands [...] We just wanted to show that we can get this gene if we want to without having ordered it at a company that is producing artificial genes", Charisius said. "If we ordered this whole sequence for the ricin gene from the company, we would have raised an alarm. We didn't want to raise that alarm so we decided we would just order those primers and isolate the gene from the plant". It proved more difficult than they had expected, but they nonetheless obtained everything they needed, providing "proof of concept that there is no regulation that was standing in our way to stop us from doing this".

Marcus Graf, managing director of Thermo Fisher Scientific Geneart GmbH in Regensberg, Germany, a subsidiary of a US corporation based in Waltham, MA, and the largest producer of oligonucleotides in Europe, thinks that the national police agencies in Europe ought to be taking similar steps. "[The FBI] has done the right thing. I have a contact person from the FBI. And I'm German and located in Germany and in a German company", he said. "They're not saying, 'Oh, there is a big risk and let's find more stringent laws to contain that', because that would actually increase the risk because it would slow down science". He added that he also knows whom to contact in Germany and elsewhere in Europe if something suspicious is detected. "But I have hardly seen any of these guys at conferences at Europe or reaching out to potential biohackers", he added.

> *"... Schaade thinks that a discussion is needed to forecast whether the technology can advance to the point of creating pathogenic viruses and bacteria in critical amounts"*

The FBI and other biosecurity experts emphasize that biohacking does not pose a risk, but that there might be a possible threat in the future. Virologist Eckard Wimmer at the State University of New York at Stony Brook, who published the first chemical synthesis of a viral genome capable of infection and subsequent production of live viruses, contended that damage from synthetic biology is a possibility. "If a kid wants to make a dangerous virus, the probability is that he or she is unaware of the danger of how contagious this is and how little you can do once you got infected by it. The probability is there", he said. However, doing something dangerous in the USA is difficult: "In the US, if you order from any decent company a piece of smallpox, they drill every order through computers and they will call you back and say why do you want to do that", Wimmer explained. He added that it would also be a very complex mission for an amateur to recreate a virus from scratch. "Fortunately, it is so difficult to make mischief to society", he commented. "It is easier if you blow up something".

Lars Schaade, Vice President and Head of the Centre for Biological Threats and Special Pathogens at the Robert Koch Institute in Berlin, Germany, agreed that bombs and guns are a greater threat than bioweapons. "[If] you are not at an institution with really well-equipped laboratories, it's not easy to create toxins or pathogenic organisms. It's possible to do that but only in small amounts. At least at this time". Nonetheless, Schaade thinks that a discussion is needed to forecast whether the

technology can advance to the point of creating pathogenic viruses and bacteria in critical amounts. "We have to be careful with the knowledge that we publish", he said. "It is critical to find a way not to hinder the scientific movement or scientific freedom, but on the other hand, avoid creating information that will in the future be misused by such groups".

Murer commented that theoretically biohackers could cause harm, but he considers that highly unlikely. "That's as likely as a bunch of physicists building an atomic bomb in their basement", he said. "Groups in our biohackerspace use CRISPR/Cas9 amongst other state-of-the-art techniques to modify life and we have been (or still might be) the only biohackerspace in Europe to have the governmental S1 license for that, but our understanding, as well as possibilities, are way too little to cause any serious harm, whether on purpose or accidently". Most of his laboratory members are current and former molecular biology students, but also curious students as young as 10 years old. Current projects in his hackerspace involve the knockout of yeast genes and simple plasmid cloning.

Peter Clevestig, a Senior Researcher with the Chemical and Biological Security Project of the Stockholm International Peace Research Institute Disarmament, Arms Control and Non-proliferation Programme in Solna, Sweden, does not view biohackers as a threat because they work almost exclusively with non-pathogenic organisms. "In Europe the legislation has been quite strict when it comes to this, but many people in DIY bio circles in Europe are concerned that it's too restrictive", he said.

Tom Hodder, a biohacker and a director of the London Hackspace, UK, welcomed the FBI or representatives of any regulatory agency to attend his group's regular Wednesday meetings. "I have a lot of sympathy with the government agencies who have to assess risk, because while I think these specific risks are negligible at the present time, the future is unpredictable. It is difficult to find a balance between public safety, and overregulation (which restricts commercial development of synthetic biology and impedes scientific progress)", he said.

