

Science AMA Series: We are Jimmy O’Dea and Josh Goldman, here to talk about self-driving cars and what the science says about their potential impacts on our economy and environment. AUA!

ConcernedScientists¹ and r/Science AMAs¹

¹Affiliation not available

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Abstract

Hi Reddit: we are two researchers at the Union of Concerned Scientists. We work on a variety of transportation issues, including how self-driving cars will impact our economy and environment. We just published a short report that outlines seven “principles” for autonomous vehicles, meant as a basic guide for shaping how policymakers, companies, and other stakeholders approach this transformative technology. We want to ensure that self-driving cars create a clean and safe transportation system for everyone. Josh Goldman is a senior policy analyst at UCS, where he has led analytical and policy efforts on vehicle electrification, biofuels, and fuel economy; he previously worked for the EPA, the International Union for the Conservation of Nature, and the New York State Department of Environmental Conservation. Jimmy O’Dea is a vehicles analyst at UCS, where he works on vehicle and freight policy. Dr. O’Dea holds a Ph.D. in chemistry from the University of California, Santa Barbara, and worked for Senator Brian Schatz during a AAAS Science & Engineering Congressional Fellowship. Ok, that’s it for us (~3:08pm eastern). This was great! Thank you.

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CONCERNEDSCIENTISTS [R/SCIENCE](#)

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What's the plan for self driving cars in areas where there is lots of snow, ice and harsh winter weather?

Will they all be driving by gps considering the roads are snow covered? This is a question I always wondered about living in Canada.

[Bandit750](#)

The snow/ice question is a good one. A lot of the world lives in places with snow.

High precision maps (1 cm even!) are one solution, but don't solve problems from things that aren't on maps like a fallen tree or pedestrian. Ford is using LiDAR coupled with hi-res maps to detect fallen trees and pedestrians. “Smart” infrastructure like sensors in lane dividers is another solution, but will take time and money to install and isn't something a car can rely on if it isn't everywhere.

AVs won't be ready for every road condition at once, just like a 16 year old with a fresh driver's license probably isn't ready for all conditions despite their license saying so.

The key issue is how will AVs handle hazardous situations they aren't ready for. The safest option is for self-driving cars or 16 year olds to not take trips they can't handle (though road conditions can go from good to bad fast in a storm).

TL;DR: not quite there with the snow/ice challenge, but self-driving cars will improve in this area

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-Jimmy

How do you see city landscapes change as autonomous vehicles become widely adopted?

[charles_aneu](#)

Though there is general agreement that city landscapes WILL change because of self-driving cars, how, exactly, they will change is up for debate. I'll give both the optimistic and pessimistic view of what could happen, and will start with the optimistic.

If self-driving cars are used by ride hailing or ride-sharing services, like Lyft or Uber, they will likely make these services cheaper and more attractive than owning a personal vehicle. In fact, [one study](#) found that Car2Go (a car sharing service) reduced vehicle ownership by 7-11 vehicles per shared Car2Go; these vehicle-reduction benefits are expected to continue if Lyft / Uber really start to dominate transportation. So, in this scenario, city planners will have the luxury of planning for fewer vehicles, meaning that more space can be devoted to bicycling, walking, or public green space. Fewer personal vehicles would also alleviate the need for so much public parking, and would allow cities to focus more on parks, businesses, or residential zoning. Los Angeles, for example, has about [200 sq. miles for parking](#) - and a lot in prime areas that could be better served by almost anything instead of parking.

On the other hand, self-driving vehicle technology, if deployed in personal vehicles rather than shared ride services, will certainly make driving a whole lot easier and attractive. A 2 hour commute in bumper-to-bumper traffic may not seem so bad if you could sit back and eat cheetos and watch netflix. In this scenario, city planners will likely need to focus even more on roads and vehicle infrastructure, since cars would be used more instead of public transit or other forms of transportation. This means bigger roads with less space for bikes or walking, more highways, and an increased focus on the personal vehicle, rather than a shared transportation economy. -Josh

How do you see self-driving cars impacting the auto insurance industry? Who will be liable if a self-driving car crashes into a non-self driving car, or two self-driving cars hit each other?

[MemberFDIC72](#)

That's not really an area we have delved into. It's complicated, and like most things related to AVs, very uncertain at this point. Wish I had something better for you! -Josh

Will they be able to raise speed limits? Should they? Will there be new construction projects to implement "driver-free" lanes only?

[ComputerWiz77](#)

In a world filled exclusively with self-driving cars that sport cat-like reflexes and 360 knowledge of the environment around them, there's some cases where these vehicles could safely travel at faster speeds than today's speed limits.

Self-driving or not, there's always going to be limitations on braking distance for a given car's weight, speed, and road conditions.

Faster cars, even if they are better drivers, wouldn't be good for communities. Who wants to sit on their front porch as cars speed by?

Increased speeds on highways wouldn't affect someone sitting on their porch, but would have negative consequences for energy use and air pollution (higher at faster speeds).

Driver-free lanes could solve some problems in a world with a decent amount of both self-driving and human-driven cars but would come at the expense of existing lanes or expanded roads. -Jimmy

How does the risk of hackers exploiting the systems found self driving cars pose a challenge to the spread and impact of self driving cars? I'm aware that many modern cars on the market that are in some ways controlled by a computer can be exploited by a knowledgeable and committed enough hacker in ways that aren't possible with a car that a computerless car. Is the risk and impact of hackers similar to what we see there?

[zhegames](#)

To the extent the public perceives hacking as a threat, it could impede the rollout of self-driving cars. Like a lot of technologies, however, we use them despite hacking threats whether out of convenience or unawareness. Car companies know it is in their best interest to have vehicles be as safe as possible -- one accident related to hacking could make a lot of people wary of setting foot in a self-driving car.

The OP makes a great point -- cars on the market today have vulnerabilities related to hacking. These vulnerabilities just get amplified the more driving responsibilities that are shifted to a computer. No one wants the blue-screen of death equivalent for a self-driving car. -Jimmy

Many people cannot drive and are deprived of the benefits and freedom which people who can drive (and can afford cars) enjoy. Can you expound on the extent to which these people will be able (or unable) to enjoy access to the benefits and freedom of making use of self driving cars? For example, will children be allowed to use them without adults on board? Aged people without licenses? Will licenses be required of at least one occupant?

[Dhylan](#)

The freedom and mobility offered by self-driving cars is really inspiring. So much of the quality of our life is being able to get places. A future where people can get to a doctor's appointment more easily or to a job more easily motivates so much interest in self-driving cars.

For someone with a physical limitation that keeps them from driving, there could be smaller challenges about that person being able to get in a vehicle or the last 100 feet to their destination once the car arrives. These are solvable, but as the OP noted, these rely on someone without a license being able to use a car. This will be possible with autonomous self-driving cars.

Our transportation system/city design is pretty inequitable today, i.e. depending on which part of a city you live in, you may have better or worse access to jobs, or essential services like healthcare. Self-driving cars could remove some of these inequities by servicing areas without good public transportation or by being cheaper than existing car ownership. We have to be careful that self-driving cars aren't used to justify reduced public transit though.

The kid angle is interesting. There will be great interest by (some) parents to save a trip to X practice with a self-driving car, but there are still questions about monitoring the child in the car etc. A rough rule of thumb to me is that if a child is old enough and mature enough to use public transportation on their own, they'd probably be ok in a self-driving car. -Jimmy

How do non-US countries feel about self driving cars? For example, is China looking into self driving

cars for their cities?

[wallyhartshorn](#)

Honestly, I'm not sure. Great idea for a blog post though! I'll dig into this and will post it back to [/r/science](#). - Josh

Do you have any estimates on how many jobs would be displaced once automated shipping becomes mainstream? Not just for truck drivers though, I'm curious about other industries that support them like rest stops, diners, motels, etc.

[spacejr](#)

Wish there were good numbers to share with you, but unfortunately we don't have them--it's all speculative. They will likely be large: [the Bureau of Labor Statistics](#) counted nearly 1.8 million tractor-trailer truck drivers alone in 2015. However, it won't happen over night and there will be a period, perhaps a long one, where a driver is still needed and the automated features enhance the human truck driver experience. As you note, there will be implications for related industries, but we just don't know the extent of it.

-Josh

When do you think self-driving cars on the road will exceed general cars and do you think that this moment will even exist, given that there might be a certain emotional connection people will have with driving themselves which could keep them from buying a self-driving car?

[Fabian vo](#)

It's hard to predict when self-driving cars will exceed good ol' human operated cars, in part because there are different levels of self-driving. If we're talking full self-driving vehicles with no steering wheel or pedals, then I think it's going to be awhile. The technology needs to come down in cost and improve safety performance before really taking off in the personal vehicle market. It will likely be introduced first as taxis or trucks and then expand to personal use.

I find the second part of your question really interesting, and have given it some thought. I'm a car guy. In college, instead of Bob Marley and Belushi posters, I had shrines devoted to Subaru WRX's, Toyota Supra's, and Nissan GT-R's. I still take highway onramps in my 140hp Subaru Outback like I'm rally racing in France. So I get that car culture is ingrained in many American lives (and lives around the world for that matter).

Like me, some people may never want to give up the privilege or joy of driving, but I think those people will be the minority. Given millennials' decreased preference for [car ownership](#) and the fact that shared, autonomous vehicles will be a pretty cheap way to travel (maybe as low as \$0.30 cents per mile), I think most people will be content to hop in a self-driving car in lieu of dealing with personal vehicle maintenance, capital expenses, and other associated costs. If you can get a self-driving car to take you and as many other passengers anywhere for less than what it would cost to drive yourself, then there won't be much of an incentive to own a personal vehicle other than the "cool" factor. So maybe the GT-R will survive, but the Sentra will be done for. - Josh

It seems like SDC's are always five years away. Realistically, when will a car be released that will allow me to sleep while it drives me to a distant location?

[vicegripper](#)

Longer than the news cycle would lead you to believe.

But, self-driving tech has come along way since 2004 when not a single self-driving vehicle completed the first DARPA Grand Challenge (US Dept. of Defense). Self-driving cars aren't just a thing being studied in academic robotics labs or by the military anymore; there are big time venture capital firms and major automakers involved.

The Globe and Mail had a nice article last month summarizing the [state of deployment](#). Level 3 autonomy is what you hear about coming from several companies by 2020 (still need a human to take control in some situations but more advanced than today's version of the Telsa Autopilot). Mercedes says level 5 autonomy (fall asleep and ride) is more of a 2030 thing from their perspective. Time will really tell. Technology can make surprising advances in a short amount of time. -Jimmy

What would you say to the people who rely on driving vehicles to receive income, such as taxi drivers, truck drivers, etc.?

[randomfactgirl](#)

I'd say now is the time to try and make your voice heard! Part of our work on self-driving cars will focus on telling policymakers and regulators that the "self-driving revolution" won't just impact transportation safety and emissions. It will also impact people and our economy. The trucking and taxi industries employ millions of Americans, and these jobs will be lost pretty quickly once companies roll out self-driving trucks and taxis.

Government has a really important role to play in regulating self-driving cars, and should have programs in place to help the people who are displaced by this automation get training to compete in a new sector. UCS is trying to get those programs off the ground, but we can use all the help we can get. There's no easy answer to this problem. The most important thing we can do today is flag the potential job loss consequences of self-driving technology before it's too late. - Josh

Will self driving cars lead to more congestion on roads thanks to more people being willing to make longer commutes, or do you see a decrease in congestion due to ride sharing minibus/taxi services instead?

[FappyDaffy](#)

In the near term, highly autonomous vehicles will be prohibitively expensive. Google's self-driving car, for example, is estimated to [cost \\$300,000](#), though costs are expected to come down as this technology develops. So, ride sharing / new-age taxi services are likely to be the first to deploy highly autonomous vehicles, with the personal autonomous vehicle catching up over the longer term. If Uber / Lyft / Google or some other player can really knock self-driving ride-sharing out of the park, meaning that it's cheap, easily accessible, safe, and reliable, then I think personal vehicle ownership can decline and congestion may be somewhat alleviated. Of course, self-driving vehicles can also "platoon," meaning tailgate, to increase fuel efficiency and cram more cars on our roads, which can also alleviate congestion - though it would take a pretty high penetration of self-driving cars to make a meaningful difference.

Now, assuming that a personal self-driving car is affordable, which may happen given that Tesla's already offer an "autopilot" mode and other traditional automakers are working toward self-driving vehicles, then yes, congestion might worsen because commuting via vehicle will become so much easier. You won't care as much if you're sitting in traffic, so long as you don't have to drive. -Josh

What will some of the secondary effects of autonomous cars be? Example: people will no longer need 15 minute parking, their car can just circle for 15 minutes.

[Fewwordsbetter](#)

Fewer parking lots is one secondary effect. But if there are fewer parking lots and the same number of cars, are the roads more crowded (in a dystopian world where self-driving cars aren't shared)?

Other secondary effects:

- Needing a lot more space in front of buildings to accommodate dropoff and pickups.
- Living farther from work because the commute is easier if you're not driving.
- Ditching your personal car.
- Reclaiming roads as public spaces if there are less cars are on the road.
- Expanded roads because there are more car trips from the convenience of self-driving cars.
- More electric cars, because the lower maintenance and fuel/electricity costs of electric vehicles would be attractive to fleets operators making rational business decisions.
- For the hygiene folks out there, not having a driver in a taxi could mean you get a dirty taxi if it weren't cleaned between rides. And many others raised by other posters!

-Jimmy

A lot of analysts and commentators seem to conclude that the rise of self driving cars will lead to a continued fall in car ownership and continued movement towards ride sharing. What's your view on this? Thanks.

[woowoo293](#)

We hope self-driving cars lead to more ridesharing. And by ridesharing I mean more than one passenger in a car. If today's car trips are just replaced one-for-one with self-driving taxis, there will be a lot more miles being driven due to so-called dead-head or zombie miles when the taxi is traveling without a passenger. This would be bad for congestion and energy use.

A [recent study](#) showed that NYC's 13,000 taxis could be replaced with 3,000 4 person shared taxis. There's a lot of human behavior questions around getting four people in a taxi though. If you increase the taxi to a 10-person shared vehicle, only 2,000 taxis were needed. At some point, though, we might as well be talking about a bus and how adding more buses could meet taxi demand.

The degree to which people share a ride with three other people in a passenger car comes with decisions around added time, reduced costs, and willingness to be in close quarters with strangers.

Getting cars off the road due to ridesharing and self-driving cars would be a fantastic boon for our cities and public spaces so long as those cleared roads aren't just filled with more cars from induced demand, which has been shown to happen time and time again with road expansions.

Self-driving cars could get people to think about whether they need their own car or not and instead just rely on a self-driving taxi when needed. The calculus for this will be very different for people living in cities vs. suburbs or rural areas that don't have great public transportation.

If you don't have a car, you are less likely to use it—but if self-driving taxis are cheap and convenient, they could also lead to increased vehicle use. -Jimmy

Hi

Thanks for giving us your time and helping us out with this AMA.

Since your title refers to the economy and environment, I will ask a question for each topic.

1. Economy - once all cars become autonomous, do you believe that people will no longer need to own cars - that they will be generic devices, like elevators, that you just call when needed? If so, what would happen to the professional drivers displaced, especially truck drivers, bus drivers etc.?
2. Environment - there is ongoing debate that self-driving cars, that tend to be electric, actually are actually negative for the environment, due to the cost of manufacture and the need to have batteries made and disposed of. Any comment about this? Ultimately I think it will be about improving battery efficiency and technology, but interested in your thoughts.

That's it for now, thanks for participating!

[mvea](#)

Thanks for the Q. I think the economy piece has been answered in our other responses, but I'll tackle the environmental question as that is a huge point of debate and contention in the scientific and advocacy community right now.

First, note that transportation recently became the largest source of GHG emissions in the U.S., so it's more important than ever that we ensure self-driving cars don't exacerbate transportation-related pollution. To do that, we need to make sure that (1) self-driving cars are electric cars and (2) self-driving cars are shared as much as possible. Neither of these are guaranteed outcomes, however.

Second, let's assume that self-driving cars will be first deployed by taxi services like Uber or Lyft, and not for personal ownership as they will likely be pretty expensive (Google's self-driving car is \$300k). Though there is a strong market case for shared self-driving vehicles to be electric (cheaper operating and maintenance costs and quieter ride), shared ride services are not necessarily going to choose electric cars for their self-driving fleets. Uber, for example, has partnered with Volvo to deploy self-driving cars in Pittsburgh, but they are gas-powered SUVs - not electric at all. And Ford is testing self-driving technology with a gas-hybrid that gets good fuel economy, but still uses gas. Policy may be needed to give a little nudge (or penalty) to ride sharing companies to go electric and also help minimize "zombie" or "dead-head" miles, which are vehicle miles driven without any occupant. There is also some talk of businesses buying self-driving trucks to just drive around all day with their stuff instead of paying to store it in a warehouse or for parking. That would be pretty disastrous for emissions and congestion.

Whether electric cars are beneficial or harmful to the environment is pretty settled. UCS analysis (and other analysis) has found that over their lifetime, a battery electric vehicle is responsible for half the emissions of a comparable gasoline vehicle - and [an electric vehicle's environmental performance is only getting better as we switch to more renewable forms of energy generation in the U.S.](#) Even when considering the increased emissions from lithium ion battery production, an EV is still cleaner than driving on gasoline. And, many are beginning to choose rooftop solar, which would allow an electric vehicle to operate nearly emission free.

Also [check out this cool emissions tool](#) that will allow you to compare the emissions of an electric vehicle based on your electricity grid. -Josh