

Clearing the air (inside your car)

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Did you know that your biggest daily exposure to air pollutants comes while driving your car to work?

Until manufacturers start making intelligent vehicles that automatically keep the car cabin's air clean, the ventilation settings on your car's

dashboard are the best way to protect your health. Fan speed, ventilation mode, and cabin air recirculation options can help protect your respiratory health, but how do you know what the best combinations are?

Research led by the University of California, Riverside, has the answer.

Cabin air filters were originally designed to remove relatively large particles like pollen and dust and are not very good at filtering out the much smaller, submicrometer particles from vehicle emissions. Gases like [carbon dioxide](#), which is exhaled by passengers; and nitrogen oxide, which infiltrates the cabin from [vehicle emissions](#), aren't usually filtered and can impair decision making, make people sleepy, or exert adverse health effects. Cabin air quality can be affected by heavy or stop-and-go traffic, ventilation fan speed, vehicle speed, pollutants in outside air, and the number of passengers in the car.

Over the course of a long drive, your car's cabin can accumulate levels of particulate matter and gases that are very unhealthy to breathe. If you drive a lot, as many commuters do, your respiratory system is exposed to substantial pollution.

The car cabin is like a box with small holes for gas exchange. That means the air in the cabin will eventually be ventilated, or equilibrated, with the outside air. But that can take anywhere from a minute to an hour depending on fan speed, ventilation mode, and cabin air recirculation.

Vehicles differ in their ability to filter air pollutants and maintain clean cabin air quality, yet until now there has been no standard test method or index to quantify these toxins.

Heejung Jung, a professor of mechanical engineering in UC Riverside's Marlan and Rosemary Bourns College of Engineering and the Center for

Environmental Research and Technology, studies how outdoor pollution gets inside cars, and identifies ways to improve cabin air quality.

Jung worked with consultancy firm Emissions Analytics to develop a standard test method, which took its first step toward regulatory agency approval at a European Committee for Normalization workshop in November 2019. The team tested 100 vehicles and is using the data to build a database that will help drivers protect their respiratory health by including cabin air quality among factors to consider when buying a car.

Closing the windows and choosing the recirculation setting of the car's ventilation system reduces particulate matter concentration.

Recirculation, using a low fan speed, removes most of the ultrafine nanoparticles that are particularly good at penetrating human lungs.

Unfortunately, this setting increases accumulation of carbon dioxide, a normal byproduct of breathing that increases when more than one person is in the car. Few cars have technology to reduce cabin carbon dioxide.

Jung's group has developed a way to open the recirculation flap door at specified angles so that it can control the extent of exchange between recirculated and fresh air. This method can reduce carbon dioxide while keeping particulate matter at acceptable levels.

Car manufacturers could incorporate this method, known as fractional air recirculation, into improved air filtration systems that would minimize particulate matter, carbon dioxide, and nitrogen oxide.

For now, however, drivers can experiment with fractional recirculation on their own. How often they need to switch modes depends on how fast the car is going, the number of passengers, how well sealed the car's body and windows are, and how efficient the car's cabin air filtration system is. The latter is something drivers can estimate for themselves

when Jung and Emissions Analytics unveil a database that will eventually consist of up to 2,000 car models.

"When you see polluted [road conditions](#) such as a congested road or lots of trucks in front of you, then choose recirculation mode and adjust the fan speed. Full recirculation at the lowest fan speed should not be used for more than a few minutes as carbon dioxide will quickly build up within the cabin," Jung said.

If recirculation mode is required for longer than a few minutes, Jung recommends increasing the ventilation fan speed. Vehicle air cabin systems are not airtight for safety reasons, and a higher fan speed results in a bit more ventilation than low [speed](#). But it is noisier, and Jung said that auto manufacturers should incorporate fractional recirculation into their ventilation designs.

"This principle applies to all enclosed environments such as airplanes, buses, trains, subways, and buildings," Jung said. "We can significantly reduce exposure to [air pollutants](#) in some environments where people spend the most time with air circulation systems that include fractional recirculation."

Provided by University of California - Riverside

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