

Abstractions



FIRST AUTHOR

Humans, plants and animals are vulnerable to the harmful effects of ozone when exposed to high levels of the air pollutant. Since the 1970s, scientists have been

monitoring ozone levels in the atmospheric boundary and free troposphere over western North America. Previous studies had shown that surface ozone is on the rise, but could not identify the sources responsible for this, whereas studies in the free troposphere, 2–12 kilometres above Earth's surface, showed no increase. Owen Cooper at the University of Colorado in Boulder and his colleagues gathered more data and revisited the problem (see page 344). Cooper tells *Nature* more.

Why did you conduct this study?

There were conflicting results on whether tropospheric ozone was increasing, and whether pollution from east Asia, the fastest-growing producer of ozone-causing emissions, was playing a part. Ozone levels in the atmosphere vary a great deal — in part because ozone is a highly reactive molecule that doesn't last long before breaking down — and I suspected that the free tropospheric studies didn't have enough data. So we decided to conduct an expanded study to determine whether ozone levels in the troposphere had been rising.

What did you find?

We compiled springtime ozone data from various platforms, including weather balloons [ozonesondes] and research and commercial aircraft. We found that from 1995 to 2008 there was a 14% increase in ozone concentrations above western North America, and from 1984 to 2008 there was a 29% increase.

Where is the ozone coming from?

I can't pin down any one nation as the source. However, we know that the level of ozone is rising in the air coming into North America from abroad, and that the rate of increase is highest when the transport is coming from south and east Asia. Global shipping is another source that needs to be considered because it's estimated to produce some 10–15% of the world's emissions of nitrogen oxides, which are ozone precursors.

Has your study affected environmental research?

This summer, the US National Oceanic and Atmospheric Administration plans to launch ozonesondes in six coastal locations in California to measure ozone levels and air quality. That information will be used to calculate an ozone budget for the state — if ozone levels increase, policy-makers may have to decide whether local emissions need to be reduced as a result. ■

MAKING THE PAPER

Ernst Fehr

Testosterone's 'bad guy' image is rooted in folklore, not fact.

Testosterone does not have a good reputation where social skills are concerned. Many associate high levels of the hormone with antisocial, egotistical and even aggressive behaviours. "We believed it ourselves," admits Ernst Fehr, an economist at the University of Zurich in Switzerland. But when he set out to test the effect of testosterone on human social behaviour, he was surprised to find that he had been too quick to judge.

Fehr is interested in the role of biological substances on social interactions. In 2005, he reported that giving people the hormone oxytocin in a nasal spray makes them more likely to trust others (*Nature* 435, 673–676; 2005). "Most of our colleagues had predicted we would not be able to find anything because they thought a single biological substance could not have an effect on such complex behaviour," says Fehr.

Encouraged by the oxytocin results, Fehr and his colleagues decided to tackle testosterone because studies in rodents had clearly shown that the hormone promotes aggression. They tested the effects of testosterone on social interactions using a game, played between two people, called the ultimatum game. The first player has ten banknotes and has to offer the other player five, three, two or none of those banknotes. The second player can accept or reject the offer. If the offer is accepted, the two split the money according to their agreement. If it is rejected, both players receive nothing.

The researchers then asked how testosterone would affect the bargaining choices made by the players. For example, would the hormone lead to more offers being fair — at five banknotes — or unfair, at three, two or none? Fehr and his co-workers predicted that the latter would be more likely. But they also



e-mailed several researchers in the field to ask their views and two replied that "people with high levels of testosterone want to be leaders, so would want to induce cooperation because this would legitimize their leadership", Fehr recalls. This alternative view predicted that the hormone would increase the number of fair offers.

Given that there was already evidence that a single, low dose of testosterone has cognitive and biological effects in women, Fehr and his colleagues put the predictions about the hormone to the test in a group of 121 women. Half the women received a placebo, the other half a testosterone pill. Four hours later, they got to play the game. The results, described on page 356, show that women who received the testosterone bargained more fairly.

And this wasn't the only unexpected result. After playing the game, participants were asked what kind of pill they thought they had been given. Women who believed they had received testosterone — regardless of whether they actually had — had behaved more unfairly than women who thought they had been given the placebo. Thus, ironically, the negative perception of testosterone as a substance linked to aggression may have affected women's behaviour in a negative way, even though the hormone itself had a positive effect on social interactions.

Will the findings be enough to clear testosterone's reputation? Fehr is uncertain. "I think it will take a long time to change the view of testosterone, because it is so widespread." ■

FROM THE BLOGOSPHERE

If you've ever wondered what it's like to do science on Earth's southernmost land mass, you can follow an Antarctic field trip at the In the Field blog (go.nature.com/4Bk1kn).

Student journalist Chaz Firestone of Brown University in Providence, Rhode Island, is travelling across the "seventh continent" and interviewing researchers working there. Firestone takes readers from

getting outfitted for the extreme cold weather to experiencing a 'boomerang' flight from New Zealand, and his final landing on the ice-strip at Pegasus Field.

"The Sun never sets here, but just spins around the sky, casting gorgeous shadows on the distant mountains," he says of his surroundings. "The horizon appears to wrap 360 degrees around you, the way it might if you were on a small

island ... And the landscape is so uniform and textureless for miles on end that it is difficult to estimate distances."

At the South Pole, astronomers are searching for galaxy clusters and astrophysicists are trying to capture elusive evidence of neutrinos. And in the arid Dry Valleys, Firestone will interview geologists peeling clues about Mars from canyon walls. ■

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