Traffic jam mystery solved by mathematicians

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Mathematicians from the University of Exeter have solved the mystery of traffic jams by developing a model to show how major delays occur on our roads, with no apparent cause. Many traffic jams leave drivers baffled as they finally reach the end of a tail-back to find no visible cause for their delay.

Now, a team of mathematicians from the Universities of Exeter, Bristol and Budapest, have found the answer and published their findings in leading academic journal *Proceedings of the Royal Society*.

The team developed a mathematical model to show the impact of unexpected events such as a lorry pulling out of its lane on a dual carriageway. Their model revealed that slowing down below a critical speed when reacting to such an event, a driver would force the car

behind to slow down further and the next car back to reduce its speed further still.

The result of this is that several miles back, cars would finally grind to a halt, with drivers oblivious to the reason for their delay. The model predicts that this is a very typical scenario on a busy highway (above 15 vehicles per km). The jam moves backwards through the traffic creating a so-called 'backward travelling wave', which drivers may encounter many miles upstream, several minutes after it was triggered.

Dr Gábor Orosz of the University of Exeter said: "As many of us prepare to travel long distances to see family and friends over Christmas, we're likely to experience the frustration of getting stuck in a traffic jam that seems to have no cause. Our model shows that overreaction of a single driver can have enormous impact on the rest of the traffic, leading to massive delays."

Drivers and policy-makers have not previously known why jams like this occur, though many have put it down to the sheer volume of traffic. While this clearly plays a part in this new theory, the main issue is around the smoothness of traffic flow. According to the model, heavy traffic will not automatically lead to congestion but can be smooth-flowing. This model takes into account the time-delay in drivers' reactions, which lead to drivers braking more heavily than would have been necessary had they identified and reacted to a problem ahead a second earlier.

Dr Orosz continued: "When you tap your brake, the traffic may come to a full stand-still several miles behind you. It really matters how hard you brake - a slight braking from a driver who has identified a problem early will allow the traffic flow to remain smooth. Heavier braking, usually caused by a driver reacting late to a problem, can affect traffic flow for many miles."

The research team now plans to develop a model for cars equipped with new electronic devices, which could cut down on over-braking as a result of slow reactions.

Source: University of Exeter