Brains On (APM) | Brains On! Traffic: Phantom jams and chicken soup (Road Trip pt. 4)
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MOLLY BLOOM: On August 21, the moon passes between the sun and Earth, creating a total solar eclipse. The sun is so bright you need special protection to watch the eclipse. Get your very own eclipse viewing glasses when you donate in any amount to support *BrainsOn.* Make a gift today at brainson.org/donate.

GABRIELLA HOPPER: You're listening to *Brains On,* where we're serious about being curious.

[THEME SONG] Someone's in the back seat, near and far. It's a*Brains On* road trip in the car.

MOLLY BLOOM: The wheels on the car go round and round, round and round, round and round. The wheels on the car go round and round on our awesome road trip.

GABRIELLA HOPPER: Are we there yet?

MOLLY BLOOM: Oh, you mean the beginning of the show? Yes. Yes, you're right. I was just trying to kill time because today is all about getting stuck, going nowhere in a traffic jam.

GABRIELLA HOPPER: That sounds frustrating.

MOLLY BLOOM: It is, but I promise you it will be much more exciting than sitting in an actual traffic jam. So buckle your seatbelt, get in gear, and join us for a very slow ride.

GABRIELLA HOPPER: Keep listening.

MOLLY BLOOM: You're listening to *Brains On* from American Public Media. I'm Molly Bloom. And with me again is our co-pilot for this road trip series, Gabriella Hopper. Hi, Gabriella.

GABRIELLA HOPPER: Hi.

MOLLY BLOOM: Gabriella, if you could imagine a new way to transport yourself from one place to another, what would it be?

GABRIELLA HOPPER: Probably like where you step into a portal and then it immediately takes you where you want to go.

MOLLY BLOOM: So it just kind of like zaps you there?

GABRIELLA HOPPER: Yeah.

MOLLY BLOOM: I would like that, too. Do you ever just walk or ride a bike?

GABRIELLA HOPPER: Sometimes I ride my bike around the neighborhood, but I've never actually rode it somewhere. And I've never actually walked. Well, I've walked, but I've never actually walked to like school or anything.

MOLLY BLOOM: So what is the main way you get around?

GABRIELLA HOPPER: Bus or car.

MOLLY BLOOM: There are a lot of different kinds of vehicles on the road. And the vast majority of Americans use cars to get around. And that makes for a lot of traffic-- about 4 billion hours of delays each year. That's an average of about 40 hours a year for most people. That's like going to work for a week and just sitting in traffic.

GABRIELLA HOPPER: That causes pollution and it costs people a lot of time and money, plus, it's super boring.

MOLLY BLOOM: So today we're going to figure out where traffic comes from and what it would take to make it finally go away. To help us out with this, we're joined by producer Meghan McCarty Carino. She's pretty much an expert on traffic because she lives in Los Angeles, the city with the worst traffic congestion in the country. Hi, Meghan. Meghan? I thought she was supposed to be here.

[CELL PHONE VIBRATING]

Hello? Oh. Yeah. OK, bye. OK, bye. Gabriella, she's running a little late. You know, she's stuck in traffic.

[CAR RUSHING TO PARK]

MEGHAN MCCARTY CARINO: Hey, guys. Sorry I'm late. You better get in quick. We're barely going to make it to this movie.

GABRIELLA HOPPER: What movie?

MOLLY BLOOM: We better just get in.

[CAR DOORS CLOSING]

MEGHAN MCCARTY CARINO: All right. Let me just pull up my handy traffic navigator app. Take me to the drive-in.

COMPUTER VOICE: I'm sorry. I don't know what driving is.

MEGHAN MCCARTY CARINO: Drive-in.

COMPUTER VOICE: There is an eight-minute slow down ahead. You should really have planned this better.

MEGHAN MCCARTY CARINO: Thanks a lot.

NARRATOR: Disclaimer. *Brains On* does not condone speeding, swerving, or reckless driving to get to movies, because that's dangerous. *Brain On* does condone always getting popcorn at the movies though, because that's delicious. Now back to the show.

MOLLY BLOOM: Oh, I think I see the sign up there.

COMPUTER VOICE: Turn around, then turn around again and go back.

GABRIELLA HOPPER: I don't think this is helping.

MEGHAN MCCARTY CARINO: I'll just take this shortcut.

[TIRES SQUEALING]

Whew! Made it.

GABRIELLA HOPPER: Do you have snacks or a drink?

MEGHAN MCCARTY CARINO: No. I could drive and get some.

MOLLY BLOOM: Actually, no. No, we're fine. Thanks.

GABRIELLA HOPPER: What is this movie about? It's called *Trafficus Maximus.* It's like one of those Roman epics with gladiators and chariot races, but with more traffic.

DRIVUS ALOTUS: I am the noble Drivus Alotus. And I challenge you to a race around the city.

MOLLY BLOOM: Wait. They had traffic in ancient Rome?

MEGHAN MCCARTY CARINO: Yep. Traffic has pretty much existed as long as we've had roads in cities.

GABRIELLA HOPPER: But they don't even have cars.

MEGHAN MCCARTY CARINO: No, but they had horse-drawn carts and lots of people on foot. Rome was one of the biggest cities of its day. It had more than a million inhabitants. And all of them were trying to get around on narrow winding streets.

DRIVUS ALOTUS: Alas, I could have been the fastest charioteer the gods have ever seen, were it not for this infernal traffic. Emperor Caesar, I beseech you. Do something.

[THROAT CLEARING]

CAESAR: I hereby decree that no man shall drive his chariot inside the walls of the city while daylight shines upon these streets.

[MIXTURE OF CHEERING AND COMPLAINING]

GABRIELLA HOPPER: Whoa. So ancient Rome had traffic laws?

MEGHAN MCCARTY CARINO: Yeah, they even had a police force to make sure nobody broke the laws and drove in the city during the day.

ROMAN COP: I hereby cite you for violation of Roman traffic law LXXIV. Please surrender your reins and prepare to fight the lions.

MOLLY BLOOM: Why would anyone want to live there?

MEGHAN MCCARTY CARINO: Living in big crowded cities like Rome has its benefits. I mean that's why humans have been building them for so long. It allows us to work together, to build things, protect ourselves, innovate new technology, and provide plenty of food. But it means we have to deal with crowds, especially on the roads. Oh, wait. Shh. Here's the good part.

ROMAN: I am but one man, chosen to fight for our freedom from traffic. Throw off your chariots, good men, and walk. Walk into the glorious streets.

GABRIELLA HOPPER: That was a great movie. I'm glad we can get around in cars these days.

MOLLY BLOOM: Speaking of cars, maybe we should get out of here before the traffic starts again.

MEGHAN MCCARTY CARINO: Oh, good idea. Let's sneak out this side exit.

[OPEN/CLOSE FIRE EXIT]

MOLLY BLOOM: While we're headed back to the studio, let's pass the time with the mystery sound.

[WEIRD NOISE]

[WHISPERING] Mystery sound.

Here it is.

[MYSTERY SOUND]

Any guesses from you, Gabriella?

GABRIELLA HOPPER: Sounds like water, kind of.

MOLLY BLOOM: Excellent. Meghan, what do you think? Do you have any guesses?

MEGHAN MCCARTY CARINO: It kind of sounds like water going out of a barrel underwater.

MOLLY BLOOM: OK we have a consensus of water.

MEGHAN MCCARTY CARINO: There's a lot of water going on.

MOLLY BLOOM: We'll be back with the answer right after this.

GABRIELLA HOPPER: Our next versus episode is coming up in July. And we want to know which side you're on.

MOLLY BLOOM: Which do you think is cooler-- deep sea or outer space?

GABRIELLA HOPPER: Send your argument to hello@brainson.org.

MOLLY BLOOM: It's your answers, questions, and mystery sounds that make this show possible.

GABRIELLA HOPPER: And in order to thank all the kids who share their energy and ideas with us, we started the Brains honor roll.

MOLLY BLOOM: Listen for the most recent group to be added to this illustrious list at the end of the show.

GABRIELLA HOPPER: And if you're looking for some more fun to keep you busy in the car, you should subscribe to our newsletter.

MOLLY BLOOM: If you do, we'll send you some downloadable activity sheets dreamed up by the *Brains On* team that will help you pass the time in style.

GABRIELLA HOPPER: You're listening to *Brains On* from American Public Media. I'm Gabriella Hopper.

MOLLY BLOOM: And I'm Molly Bloom. It's good to be back in the studio and not in the car. Today's episode was inspired by some questions sent in by our listeners.

ZACHARY: My name is Zachary from Brookfield, Wisconsin. And my question is, how do traffic lights work?

KIDS: Our names are Noah, Grace, and Audrey. And we're from Oak Park, Illinois. Our question is, what causes traffic when there's not a car accident?

JONATHAN: Hi, *Brains On.* I'm Jonathan from San Bruno. My question is, how do traffic lights work? Thanks.

MOLLY BLOOM: Our friend Meghan McCarty Carino lives in LA, the US traffic capital. She's here to help us answer these questions. And before we find out where all this traffic comes from, let's go back to another puzzle-- the mystery sound. Here it is one more time.

[MYSTERY SOUND]

Any new guesses?

MEGHAN MCCARTY CARINO: Kind of sounds like a frog language, too.

MOLLY BLOOM: Oh, a frog language.

[LAUGHTER]

What do you think, Gabriela.

GABRIELLA HOPPER: Like water being put into, I don't know, like a water bottle underwater. And then being poured out underwater again. Kind of like Meghan's.

MOLLY BLOOM: Yes. By frogs.

[LAUGHTER]

All right. Here with the answer is Claire from Ashburn, Virginia.

CLAIRE: Wow. It was windshield wipers on a rainy day.

MOLLY BLOOM: So you're close. There was water, but just the windshield wipers were moving it around. So that's what it sounds like in the car when her windshield wipers are going.

[SHOW TRANSITION] Ba ba ba ba ba ba ba ba ba ba*Brains On*

So Meghan, where does all this traffic come from?

MEGHAN MCCARTY CARINO: Traffic jams can be caused by lots of things, like a crash on the road or construction that closes lanes. In fact, construction was one of the main factors that caused what's considered to be the worst traffic jam in history.

MOLLY BLOOM: Let me guess. It was in LA.

MEGHAN MCCARTY CARINO: No, actually. It happened in China in 2010 on a highway near Beijing that's always full of big trucks. But a big construction project shut down half the lanes and blocked the trucks from moving, so no cars could get around. Drivers were stuck for several days on the road, moving less than a mile a day.

GABRIELLA HOPPER: They had to spend the night in their cars? How did they eat?

MEGHAN MCCARTY CARINO: The local townspeople came out to the highway. They started selling water, instant noodle soups. People were taking goods off the trucks. It took almost two weeks to clear up.

MOLLY BLOOM: So that traffic was caused, in part, by construction. But what about those times when you're driving and all of a sudden the car slowed down, and then they speed up again, and you have no idea why?

MEGHAN MCCARTY CARINO: Right. That's pretty common. Researchers who study that phenomenon call it a phantom traffic jam.

GABRIELLA HOPPER: Is it caused by ghosts?

MEGHAN MCCARTY CARINO: No, there's nothing supernatural about it. It all has to do with physics. Researchers explain it by comparing traffic flow to a liquid. It's a concept called fluid dynamics. Think about making a soup. Gabriella, have you ever made a soup before?

GABRIELLA HOPPER: I like making like chicken noodle soup.

MEGHAN MCCARTY CARINO: Well, say you start with a liquid base. In your case, chicken broth. It's all liquid so you can just slosh it around. Pour it into a glass if you want. Maybe you want a pea soup or a chicken noodle soup, so you start adding some peas or some noodles to the soup. Those are like cars in traffic.

Now if you only add a few peas or noodles to the soup, it still sloshes around, flows like a liquid. Just like if only a few cars are on the road, they still flow freely. But add a few more peas, maybe some potatoes and carrots, onions, celery, little pinch of garlic, you get the idea, and the soup starts to get thick. It doesn't slosh around anymore like it did before. Now it's more like a solid, and it stops flowing as smoothly. It doesn't easily pour into a glass.

GABRIELLA HOPPER: Eww, that sounds messy.

MEGHAN MCCARTY CARINO: Exactly. And that's how traffic jams start. The more cars you add to the road, the more dense the traffic becomes until it stops flowing. The reason is that when cars are packed in so close together, every little move by each individual driver has an outsized effect.

So say you step on the brakes because you hit a bump, or someone cut in front of you, or you were looking at your cell phone, which is very dangerous. Those little random fluctuations cause a ripple effect. So the guy behind you brakes a little. And the lady behind him brakes a little more. And on and on until you have a traffic jam.

GABRIELLA HOPPER: Now we've learned about the history of traffic jams and the science behind why they happen. And if so many people study them, there must be something we can do to avoid them. Right?

MOLLY BLOOM: Traffic is pretty hard to get rid of. That's why it's been with us for centuries. But you are right. There is lots of research and technology now to help us make traffic flow better. One way is being pioneered in Meghan's home city of Los Angeles. It's the first major city in the world to synchronize all of its traffic lights. And they're controlled from a single room deep under Los Angeles City Hall, where Meghan takes us on this field trip.

MEGHAN MCCARTY CARINO: OK. So I'm here at a place called ATSAC, which I assume stands for Awesome Traffic Super Amazing Center.

JEFFREY SHU: Hi. Yeah, welcome to ATSAC Center. It stand for Automated Traffic Surveying And Control Center.

MEGHAN MCCARTY CARINO: That is Jeffrey Shu, a supervising engineer with what is actually called the Automated Traffic Surveillance And Control Center, a super high tech place four stories underground where all of the traffic lights in Los Angeles are controlled.

It's kind of like we went down into the James Bond lair where you are masterminding the traffic for LA. It's like the brain of traffic.

JEFFREY SHU: Right. It's kind of like a hidden place. Not many people who understand or know what we're doing. We have a capability to modify the timing to make the traffic flow better.

MEGHAN MCCARTY CARINO: Great. Let's go check it out.

When we enter the control room, it looks kind of like a spaceship, with an entire wall of video screens, more than 20 of them showing intersections all over the city.

JEFFREY SHU: Yeah. As you can see, we have a lot of monitors. And we also have a lot of computers. The engineer that today is working, Leticia, she is the console engineer.

MEGHAN MCCARTY CARINO: So one person is here controlling everything?

JEFFREY SHU: Yes. We have a lot of signals. Why we just need one person? Because it's called automating.

MEGHAN MCCARTY CARINO: Yeah. Remember how this is called the Automated Traffic Surveillance Control Center? Well, automated means things happen automatically, controlled by computer. Every single traffic signal at the 4,600 intersections in Los Angeles is hooked up to the computers in this center.

And they're all programmed so that the lights stay green for the optimum amount of time based on the amount of traffic. So if it's 3:00 in the morning, the green light will be shorter because fewer cars will be driving through the intersection than say, 9:00 AM during rush hour.

The system knows how much traffic is on the streets because there are sensors called loops installed on the road. And when cars drive over them, they tell the computers how many cars have passed and how long they've been waiting.

So before this system was in place, how did traffic lights work in the city of LA or elsewhere, and how did this change how they work?

JEFFREY SHU: Years ago, before we had this system, if we want to change a traffic signal, engineer has to drive all the way out to the intersection to manually change the signal. With our system, everything's all interconnected and everything's all connect to the controller. We have second-by-second communication. We can actually modify timing as needed.

MEGHAN MCCARTY CARINO: So it's almost like, with all of this technology, it's like you have somebody at every intersection in Los Angeles saying, this one should be green for this one, based on the conditions. But you also have the eye of the universe to see how every intersection affects the rest of the city.

JEFFREY SHU: Oh, yeah. In addition, we also have a system to monitor in case if the signal lost power, we have engineered to fix the system.

MEGHAN MCCARTY CARINO: So you don't have a special button that you keep with you that you can make the light turn green when you're driving home.

JEFFREY SHU: No, we don't have such a button. But we on a daily basis, We try to understand the traffic circulation throughout the city.

MEGHAN MCCARTY CARINO: How's it looking right now?

JEFFREY SHU: The traffic speed moving pretty good today.

MEGHAN MCCARTY CARINO: Cool. Thanks for showing me around.

JEFFREY SHU: You're welcome.

MOLLY BLOOM: That was cool. Did you get to push any buttons?

MEGHAN MCCARTY CARINO: No. For some reason they didn't let me.

MOLLY BLOOM: Oh, bummer.

GABRIELLA HOPPER: So if LA has this amazing technology, why do you still have the worst traffic?

MEGHAN MCCARTY CARINO: Well, there's just a lot of people who want to use the roads all at once and not enough space.

MOLLY BLOOM: So why don't you make the roads bigger or build new ones?

MEGHAN MCCARTY CARINO: That's actually not a bad idea. And in fact, that's what a lot of cities have tried to do for a long time, until they figured out it doesn't work.

GABRIELLA HOPPER: Why not?

MEGHAN MCCARTY CARINO: I'll let a real expert answer this. I talked to Professor Matthew Turner at Brown University, who co-wrote a study called the *Fundamental Law of Road Congestion.* Do you know what a fundamental law is.

GABRIELLA HOPPER: Like gravity?

MEGHAN MCCARTY CARINO: Yeah. It's a concept that applies to everything in the same way no matter what.

MATTHEW TURNER: The fundamental law of road congestion is something that we observe in the world, which is that when we add highway capacity to a city, we see traffic increase at exactly the same rate. So if we double the amount of highways, we double the amount of miles that people drive in a year.

GABRIELLA HOPPER: Wait a minute. If the traffic wasn't there before the road was, where does it come from?

MEGHAN MCCARTY CARINO: Basically, creating more road space creates more demand to use that space. So say there's really bad traffic on the main road in town between 4:00 and 5:00 PM. So your mom decides she's not going to go to the store then. She's going to wait until rush hour dies down. Or maybe she'll walk to the store because it's only a few blocks away.

But then one day the city adds another road or another lane to the busy road that makes it easier to get around. So your mom decides she is going to drive to the store, maybe even drive to a few stores. And when you multiply that by thousands or millions of people in a big city, boom, you get more traffic. It's called induced demand because the extra road space is inducing or encouraging people to drive more.

MOLLY BLOOM: OK. So if building more roads doesn't get rid of traffic, what does?

MEGHAN MCCARTY CARINO: Well, you could use an alternative form of transportation like walking or taking the bus. That doesn't really get rid of traffic, but it makes it so you don't have to sit in it. Or we could design our cities in a different way so everything is closer together.

That also doesn't get rid of traffic, but it makes it so you don't have to sit in it so long. And it makes it easier to use alternatives like walking or biking. But according to Matthew Turner, and a lot of other people who have studied this, the only way to really get rid of traffic is to stop making the roads free.

MATTHEW TURNER: I think maybe rather than thinking about roads, we could talk about hamburgers for a little bit.

MEGHAN MCCARTY CARINO: Do you guys like hamburgers?

GABRIELLA HOPPER: I do. I love them.

MOLLY BLOOM: Me too.

MEGHAN MCCARTY CARINO: OK, good.

MATTHEW TURNER: So in the same way as if you made any other thing available for free, then people will use more of it. So if you were to reduce the cost of hamburgers, people would have more hamburgers.

MEGHAN MCCARTY CARINO: Because you won't think so much about, should I really eat this hamburger? Am I actually hungry? Should I wait? Or should I eat something healthier? But if you charge a lot of money for hamburgers, people will really think about their decision. And the same logic applies to roads.

MATTHEW TURNER: And the way that works is to charge people, usually a small toll, to be on the roads at the times that they're really busy. And what that does is that discourages people from taking trips at the busiest times. And that spreads out the times when people take their trips, and traffic moves a lot better.

MEGHAN MCCARTY CARINO: A number of cities around the world have tried this like Singapore, London, England, and Stockholm, Sweden. In Central Stockholm, they've seen a traffic reduction of 20%. And that's just enough to make traffic flow freely again. Remember that pea soup and how it stayed pretty sloshy and liquid up to a point?

GABRIELLA HOPPER: Then it goes splat.

MEGHAN MCCARTY CARINO: Right. Well, cities like Stockholm are using tolls to avoid that mess.

MOLLY BLOOM: What about driverless cars? Aren't they going to change everything?

MEGHAN MCCARTY CARINO: Driverless cars will make a big difference in how traffic flows because, unlike humans, they can maintain a very steady speed. They don't need to look at their phone, and they don't overreact to the driver in front of them. That could eliminate phantom traffic jams and let traffic flow like water.

GABRIELLA HOPPER: Hooray. Bring on the robots.

MEGHAN MCCARTY CARINO: But not so fast, literally. Remember what Matthew Turner said about how increasing capacity increases the demand to use the road?

GABRIELLA HOPPER: Yeah.

MEGHAN MCCARTY CARINO: Well, making traffic flow better with autonomous cars is just another way to increase capacity. It's not building a new road, but it's opening up new space on an existing road.

MATTHEW TURNER: We have a lot of experience with capacity expansions. And it's not clear that the capacity expansion that we get from autonomous cars is going to be different than the capacity expansion that we get from adding lanes.

MEGHAN MCCARTY CARINO: So just like adding lanes induces more people to use the road, driverless cars might, too. And there's still a limited amount of space on the road. That means people will have to wait in line to use it.

MOLLY BLOOM: Thank you so much for being here with us today, Meghan, and increasing our traffic knowledge.

MEGHAN MCCARTY CARINO: You bet. Thanks having me.

MOLLY BLOOM: Traffic has been an issue as long as we've had roads and cities.

GABRIELLA HOPPER: And the flow of traffic itself acts kind of like a liquid.

MOLLY BLOOM: The more cars you add, the slower they move on the road.

GABRIELLA HOPPER: But adding more roads just means more cars driving on them.

MOLLY BLOOM: Asking people to pay to use them might make the roads less congested. That's it for this episode of*Brains On.*

GABRIELLA HOPPER: *Brains On* is produced by Marc Sanchez, Sanden Totten, and Molly Bloom.

MOLLY BLOOM: We had engineering help this week from Corey Schreppel, Veronica Rodriguez, and Roger Smith. Many thanks to Kenneth Weber, Carolyn Hopper, Tom Crann, Steve Steric, Mike Mulcahy, and Lauren D. OK Gabriela, looks like there's a lot of traffic ahead of us. So while we're waiting, let's read the most recent group of listeners to be added to the Brains honor roll.

GABRIELLA HOPPER: All right.

[LISTING HONOR ROLL]

MOLLY BLOOM: We'll be back with the final episode in our road trip series next week. Until then, you can keep up with us on Instagram and Twitter. We're at brains_on and we're on Facebook, too. You can find the rest of the episodes in our road trip series at our website brainson.org or wherever you get your podcasts.

GABRIELLA HOPPER: Thanks for listening.