Host: Robert Frederick
Hello and welcome to The Conjectural — an experiment to figure out a better way to decide what science news is and how we should talk about science. The data for this experiment? Your feedback to TheConjectural.com. I'm Robert Frederick. In this episode, a story about the effects of noise on children, from preemies in the hospital to kids learning in the classroom.

Before you were born, this is likely what you would have heard in the womb. First, your mother's heartbeat. It may not sound like you'd expect, though. That's because in the womb, you're surrounded by your mom, and that includes the amniotic fluid. So, essentially all you hear are the lower frequencies because the higher ones are filtered out. That would happen with all sounds, including your mom's voice.

That voice is Lori Leibold of Boys Town National Research Hospital. Here's what she actually said:

Speaker: Lori Leibold
In our lab, we're interested in the ability to hear speech presented in noise all the way from infancy through adulthood.

Host: Robert Frederick
And we'll get to that a little later on. But right now, we're still not quite to infancy. You're in the womb. It's only after you're born that you start to get all the higher frequencies, too.

SFX: *It's really over? It's all over!*

But suppose you're born early—premature. And just like the rest of your body, your brain develops in stages.

Speaker: Amir Lahav
If you have a premature baby, the ultimate goal is to try to provide the baby with the optimal environment…,

Host: Robert Frederick
Amir Lahav is a neuroscientist specializing in neonatal care at Massachusetts General Hospital and Harvard Medical School.

Speaker: Amir Lahav
… allowing the brain to complete it's normal maturation without compromises even though this normal maturation is expected to occur outside the womb.

Host: Robert Frederick
But the neonatal intensive care unit — or NICU — is a very noisy place. With the greatest intentions in the world, premature babies are placed inside incubators which are supposed to be kept at under 45 decibels, or a little louder than the whirring of a computer and a little softer than the hum of a refrigerator.

But inside the incubator it's white noise — ventilators and fans — which are not at all like what a baby experiences inside the womb.

Speaker: Amir Lahav
It's more like a deprived environment or, if you like, a social cage or a neurodevelopmental dungeon where the baby is basically being placed in seemingly protected environment—secure environment—but it, that environment doesn't give the brain the mother's voice and heartbeat sounds that are so essential—almost act as the auditory fitness necessary for the brain to mature and develop because it's part of the original recipe for how we should cook premature babies up to full maturation.

Host: Robert Frederick
Or at least that's the hypothesis. To test it, Lahav and his colleagues recorded mothers heartbeats along with them reading stories, singing, and talking to their premature babies. They then filtered the sounds so it was like what the baby would have heard inside the womb. Finally, they played the sounds inside the premature babies' incubators for 45 minute segments 4 times a day for the first month of their lives.

Speaker: Amir Lahav
And what we found, there are three main findings.

Host: Robert Frederick
Now, keep in mind these studies are small: the largest such study so far published by Lahav and his colleagues has just 40 premature babies. Half got the maternal sounds. Half didn't.

Speaker: Amir Lahav
So three main findings. The first one is about growth and development.

Host: Robert Frederick
Lahav says babies exposed to these maternal sounds gained significantly more weight than those who were not.

Speaker: Amir Lahav
This helped to set them on a better and more optimal developmental track. The second finding was that babies who were exposed to mother's voice and heartbeat sounds inside the incubator improved their brain development, especially when it came to the size of the auditory cortex, which was larger.

Host: Robert Frederick
But the larger size of the auditory cortex didn't mean an increase in the total brain volume overall. It's just that the portion of the brain that responds to auditory stimulus was larger. In other words, as Lahav and his team write in one of their research papers, this one published by the Proceedings of the National Academy of Sciences — quote — "the clinical benefits of maternal sound exposure are still a matter of speculations and no firm conclusions can be drawn from the present study."

Speaker: Amir Lahav
And the last finding is more preliminary findings that have not been published yet, or that the paper has not been rejected yet.

Host: Robert Frederick
And in this study, Lahav says, he and his team tested the premature babies just before they were to leave the hospital to go home, to see how well they paid attention to human speech.

Speaker: Amir Lahav
And we found that those babies who received the daily added exposure to mother's voice and heartbeat sounds inside the incubator performed much better in their ability to attend to human speech sounds, which for us was almost an encouraging results to see that we are actually influencing something that—the way we thought— that we are influencing how the brain is going to function and handle those basic auditory skills that we think resemble third, you know, third-grade classroom settings or something like that.

Host: Robert Frederick
But there's still plenty of auditory learning and brain development that happens between going home from the hospital as a baby and third grade. Somewhere in there, kids start to learn at least one language. Speaking of which, back to Lori Leibold of Boys Town National Research Hospital. She directs both the Center for Hearing Research and the Human Auditory and Development Laboratory.

Speaker: Lori Leibold
Really the punchline, I think, of most of the research in my lab is that what a child hears in a noisy environment is not what an adult hears.

Host: Robert Frederick
Leibold says most of the previous research done has been about the effects of steady-state noise, like the whirring of a ventilation system in a school classroom.

Speaker: Lori Leibold
And we've learned a lot from those studies, but it's becoming increasingly apparent, however, that the speech perception challenges faced by children are much larger, and follow a more prolonged time course of development when the background is also speech.

Host: Robert Frederick
So, Leibold says, if you talk to children, say, with talk-radio on, or you have the television on in the background, the children are more likely to have a hard time understanding you. And you're all going to have to deal with that for a longer period of your lives.

Speaker: Lori Leibold
These new findings from the lab indicating these prolonged and pronounced effects we think propose a significant problem given also recent survey data that indicate that children spend most of their days surrounded by competing speech—so these are the environments that we expect them to learn and listen and develop language and speech in.

Host: Robert Frederick
Such as daycares, pre-school, kindergarten, and classrooms.

Speaker: Lori Leibold
And while we know that these effects in competing speech in particular are large for children with normal hearing, it turns out that they pose an even greater problem for children with hearing loss even when they're fitted with appropriate prostheses.

Host: Robert Frederick
So, says Rochelle Newman, who chairs the Department of Hearing and Speech Sciences at the University of Maryland, turn off the television, turn off radio, and, yes, even turn off this show if you're right now trying to talk with children—and have them listen and understand you.

Speaker: Rochelle Newman
This is really important, because if we as adults find a situation too noisy, we can do something about it: we can turn down the TV or radio; we can move to a quieter room. Children can't do that as well. They depend on us to do it for them. But we're likely only to make changes when the noise level is difficult for us, and it seems that children have difficulty in situations that we would likely not find problematic.

Host: Robert Frederick
In other words, Newman says, because young children are still trying to learn language, they have a greater need for understanding the speech around them. But because young children are still trying to learn language, they're less able to benefit from language — and so they don't know to ask us to turn off the television, or tell us that their daycare is too loud for them to learn in.

Speaker: Rochelle Newman
Recent data from our laboratory suggests that young children can recognize speech in noise, but only at relatively soft noise levels, and often they fail to do so at the noise levels approximating those found in typical daycare settings. Moreover, children under the age of 2 seem to have particular difficulty when there's just a single person talking in the background and they can't make use of some of the cues that adults use to keep different voices apart and keep them separate from one another.

Host: Robert Frederick
So when does this problem of too much noise end? Well, that's an open question, too. Do you remember when you learned to ask, "Hey, this place is too noisy — can you turn that off, or maybe we can go somewhere else?"

Speaker: Rochelle Newman
There have been measurement studies that talk about the level of noise in different environments, and certainly…

Host: Robert Frederick
Again, Rochelle Newman.

Speaker: Rochelle Newman
…lower socioeconomic environments tend to be noisier because they're more likely to be near train tracks, to be under the flight paths of airlines.

Host: Robert Frederick
Yes, even airline traffic makes a difference.

Speaker: Rochelle Newman
It's not just correlative because there've been some studies where the flight paths changed and a school that hadn't been in the pathway now suddenly was, and there were grade drops in terms of student performance.

Host: Robert Frederick
But not all of this research ends up how you'd expect regarding socioeconomic status. Sometimes well-intentioned modifications—like making open-plan classroom environments with only a few number of walls—can really increase the amount of noise in the school environment.

As for we adults, what's all the noise doing to us, say, in an open-plan newsroom, or cubicle-type office setting?

Newman says the noise is stressing us out.

Speaker: Rochelle Newman
As for noise being an environmental stressor, it is clear that it is, but most of the work on that has really focused on adults, not on children.

Host: Robert Frederick
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