



#210: Not just the King's speech: Stuttering and its causes

VOICEOVER

Welcome to Up Close, the research talk show from the University of Melbourne, Australia.

DYANI LEWIS

I'm Dyani Lewis, thanks for joining us. Now here's a question. What do Marilyn Monroe, Porky Pig and Lewis Carroll all have in common? They all spoke with a stutter. Humans are unique in the animal world for our ability to use complex languages of words and expressions to communicate our ideas to others. We are intensely social creatures and for most of us learning to build words into phrases and phrases into sentences is as natural as learning to walk and then to run. But for people who stutter everyday communication can throw up invisible and frustrating hurdles. Today on Up Close, we are joined by Professor Nan Bernstein Ratner, Professor and Chair at the Department of Hearing and Speech Sciences at the University of Maryland. Nan has degrees in child development, speech pathology and psycholinguistics and is the co-author of *A Handbook on Stuttering* which is generally considered to be the bible on stuttering. Nan is at the University of Melbourne as a Miegunyah Distinguished Visiting Fellow. Welcome to Up Close, Nan.

NAN BERNSTEIN RATNER

Well it's nice to be here.

DYANI LEWIS

Now at what stage in a child's development does a stutter typically emerge and what are the classic symptoms?

NAN BERNSTEIN RATNER

It's interesting because unlike other communication disorders that appear in childhood stuttering is not there from the moment a child starts to talk. When children have articulation or language problems they're pretty evident from the very first moment they start talking. But stuttering seems to have its onset most frequently at about two-and-a half to three years of age around the world. And that makes it unusual and of course has led some people to hypothesise that because children were talking well and then started to stutter that something in their environment might have prompted that, but we know that that's not correct. The main symptoms of stuttering are primarily, although people imitate stuttering by repeating lots of things, the main symptom of stuttering that is most bothersome to both children and adults who stutter is what's called blocking. To open your mouth to try and say something and to feel blocked and not be able to get your words out and that's a very frightening kind of behaviour for anybody to encounter. Most of us never encounter the sense of opening your mouth and not being able to get words out except in a nightmare. So that would be the primary symptom we'd be most concerned about but children do repeat.

They repeat sounds, syllables, whole words and they may draw out certain sounds like "s-s-s-stuttering" by drawing out the s.

DYANI LEWIS

Stuttering is known as a fluency disorder. Can you explain what that actually means and how stuttering fits in with other types of language disorders?

NAN BERNSTEIN RATNER

Right, so it's called a fluency disorder because you pronounce your sounds properly and you put your grammar together properly but it doesn't come out fluently. It doesn't come out running smoothly. There are interruptions and blockages in your speech or re-tracking over what you've already said, and so that's considered a fluency disorder. The only other major type of fluency disorder that we commonly see in children and young adults would be something called cluttering, which actually is a disorder that's somewhat complicated. It does have features of articulation and language formulation as well. And it tends to come out as rushes of very fast speech rather than being blocked as a person who stutters experiences.

DYANI LEWIS

And people might be familiar with the term stammering as well. Is that the same thing as stuttering or is there a difference?

NAN BERNSTEIN RATNER

It's just a difference in vocabulary from some countries like Great Britain and Australia perhaps to stay stammering for stuttering. The word stammer just doesn't get used as much in the United States but they're actually the same disorder.

DYANI LEWIS

How common is stuttering?

NAN BERNSTEIN RATNER

It affects about one per cent of the population, about four per cent of human beings go through a stage at which people think they might be stuttering in childhood. But about three-quarters to four-fifths of them outgrow it spontaneously, usually, as far as we can tell, within about a year of starting to stutter. So when parents do come to me with a child that they are afraid is beginning to stutter that's one of the very first positive things that I can tell them is that the vast majority of children who start to stutter actually stop. They seem to do it on their own without any intervention.

DYANI LEWIS

You mentioned before that there were some ideas about stuttering coming from the environment or being induced by the environment that a child is being brought up in. So what kind of misconceptions are there around how stuttering starts?

NAN BERNSTEIN RATNER

Well Freudian psychologists thought they were doing us a great justice by pointing out that since stuttering wasn't there at the very beginning of being able to talk that perhaps there was something in the environment that was triggering it, which seemed therapeutically like a nice track to pursue. Because it meant that maybe you could figure out how to fix the environment or fix the individual. These days we know that although stuttering may start at around the time that a child experiences certain upheavals in their life. Like at two-and-a-half most children get a new sibling or they're being toilet trained or brought to day-care for the first time that there are no common features in children's environments that seem to trigger the onset of stuttering. There are also folk myths about stuttering in the part of the country that I come from. In the Appalachian region not too far from my university there is a sense that if you tickle a child, a very young child, on the feet that you can cause them to start stuttering. There are other folk myths like that and they're not quite right.

DYANI LEWIS

What about catching stuttering from someone? If you've got a parent who stutters are they going to have a stuttering child because the child imitates them for example?

NAN BERNSTEIN RATNER

You're not going to catch it from other people but you may very well get the gene for it from your parents or from relatives. One of the reasons that we know that stuttering is not imitated is that actually when stuttering starts in very young children it doesn't quite look like more developed stuttering. Many people who have been stuttering for a long time have obvious speaking fears and tense reactions to speaking that are not necessarily seen in young children when they begin to stutter. So behaviourally there is not a whole lot of good overlap between stuttering that you see in adults and children which leads us to believe it's not imitation. We also have twin and adoption studies which indicate that the genetic pre-disposition to stutter is in fact more of a concern to us than any chance that you might have started to stutter by imitating someone else.

DYANI LEWIS

Nan, to an outsider stuttering appears to be a problem of controlling the mechanics of speech, so coordinating the muscles to be able to articulate. Is that what's happening?

NAN BERNSTEIN RATNER

To some extent it is but it's not probably the underlying cause of what stuttering is. That's always been its more popular kind of impression including the research that's been done on it since the very earliest days. Even the Greeks and Romans were interested in stuttering. But these days given new scientific technology we are able to do brain-imaging studies of individuals who stutter. What we're increasingly finding is that they have differences in how they not only produce speech but how they formulate language and how they even understand language when it's spoken by other people. So we actually have some very good research that shows us normal patterns of language processing when people are listening to one another in conversation. And the areas of the brain that are typically activated are activated differently in people who stutter. So it leads us to believe that the problem of stuttering transcends just the motor behaviours that you see at the very end as people who stutter talk, but that there are problems that they have before

that as they attempt to formulate the message.

DYANI LEWIS

So when you say that the brain is responding differently, is it different areas are responding or they're not responding at the same level for example?

NAN BERNSTEIN RATNER

There are actually lots of different findings that are beginning to emerge, they're quite recent in the general history of stuttering research. But in general we find number 1: that people who stutter use more of the brain when talking that's typically a sign that something is much more effortful. So when more of the brain has to be engaged to do something it means that it's a harder task. It's also true that some other areas of the brain get activated that are not typically activated in people who speak more fluently. It's actually even true that some areas of the brain are less activated when people who stutter talk. They seem to have some problems in the circuits in the brain that listen to ourselves as we talk. We're not sure if that problem comes about as people who stutter grow, because we don't have very much brain-imaging on children who stutter, behaviourally they're a lot harder to study. So we're not sure if that problem is there at the beginning and is part of the cause of stuttering, or it's something that people who stutter have learned to do living with a stutter throughout their lives.

DYANI LEWIS

Right, so looking at an adult brain is it hard then to separate those cause and effect?

NAN BERNSTEIN RATNER

It really is. Even when we look at older children at stutter we're looking at a fair degree of learning. We know that young children even two-and-a-half year olds who begin to stutter may sometimes start to actually exchange the words that they intend to say. They swap out intended words for substitute words if they think that they will have problems with them, we've seen that even in a two-year-old. So our ideal kind of study would take a two-and-a-half year old and do brain-imaging studies of them but that would not be very feasible these days. Because getting a two-and-a-half year old to lie in a scanner and do what you want them to do is pretty nigh on to impossible.

DYANI LEWIS

This is Up Close coming to you from the University of Melbourne. I'm Dyani Lewis and in this episode we're talking about stuttering with Professor Nan Bernstein Ratner. Nan, you mentioned before that there were some genetic components to stuttering. Have any of those components been identified?

NAN BERNSTEIN RATNER

Yes, there are a lot of candidate genes that have been identified. A lot of this work is being done in the United States by researchers at our National Institutes of Health. They've found a number of genes that seem to be missense mutated in families that have a lot of people who stutter. The problem that we currently have is that most of the geneticists who work in this area do believe that it is a polygenetic kind of problem that more than one gene is probably involved. Unfortunately some of the target genes that have been found in some families are not easily identified in other families. It's an interesting area of research.

And part of what we know about stuttering being genetic is actually affirmed when we look in certain communities where we have very large families, a lot of inter-marriage and somewhere along the way stuttering got in there. A number of research studies take place in Cameroon where there are a lot of families who have stuttering relatives. There are places in the United States, communities in the United States like the Hutterites who have a higher degree of stuttering than we would normally find. It seems to be because the stuttering gene has really circulated within an inter-married family.

DYANI LEWIS

I guess one of the common ways for genetics' research to progress is to model a disorder in an animal system. I mean it seems like a language disorder would be very difficult to have a model system for?

NAN BERNSTEIN RATNER

Yes, it's tough to model communication disorders in animals. We actually do have an ongoing study in the United States, Dr Dennis Drayna of the National Institutes of Health has managed to make a transgenic mouse who has a variant of one of the genes in which they've found a missense mutation in some of these families. Now the interesting thing about mice is that although this study is really in its infancy and we don't have any findings from it, mice have very systematic vocalisations. So it will be interesting to see if families of mice that have this gene spliced into their DNA actually manage to produce vocalisations that differ in some aspect from those that are typically described in mice.

DYANI LEWIS

Right, so they could potentially have a stuttering squeak?

NAN BERNSTEIN RATNER

Yes, we really might have a stuttering mouse at some point. That was very big news for the AAAS, for the American Association of the Advancement for Science in 2011 when it was first announced.

DYANI LEWIS

Right, that's fantastic. With the gene that was identified, was this a gene that seemed to make sense to people or was it something that you sort of think, well that's odd?

NAN BERNSTEIN RATNER

It was a bit odd. Actually the genes that had been identified up until that point had actually been located or were in proximity to genes for other communication disorders. The thing about the gene that was identified by Drayna's team in 2011 was that it was a missense mutation of a gene primarily associated with something called lysosomal storage. In human beings when that gene is really impaired, it tends to result in very fatal consequences. And what was found that this family had a missense mutation in that particular gene such that they were physically healthy enough but they did have this high degree of stuttering in the family tree. That's what has made the problem in trying to make a transgenic model a little bit difficult. That there were efforts to start that process with the mice and it actually - various versions of that gene were in fact fatal to them. So that's why this work is proceeding slowly but it's exciting. And certainly one of the things we have to come to grips with, I think, for most disorders is that just because something is genetic doesn't really tell us very much about what it is. Because genes code for a lot of basic functions and it may

be something extremely basic about wiring in the brain that is somehow coded by this particular gene. And it's not entirely clear that if we simply find out what the gene does whether or not we can take it and use it immediately to help anyone who stutters.

DYANI LEWIS

That's right because lysosomal storage is actually just a very normal part of cellular metabolism, isn't it?

NAN BERNSTEIN RATNER

Yes, so that's what we're finding with a lot of genes that have been identified in communication disorders. They may not reflect really high level functions of the human brain but actually small basic level functions like how neurons fire.

DYANI LEWIS

Now, Nan, one of the areas of your work is in how linguistics or language structure influences stuttering. So why did you decide to investigate this?

NAN BERNSTEIN RATNER

I really fell on it as a student by mistake. I had a professor who was very much convinced that stuttering was a speech motor problem and having been a student of linguistics I was sort of determined just to make him angry at me. So I set up a study to look at whether or not children who stuttered seemed to do so randomly. That work actually started me down a path which has proven to be quite rewarding because it turns out that there are extreme linguistic regularities to stuttering when it starts and across childhood. And in fact we know that we can affect the frequency of stuttering quite easily by giving children things to say that are more or less difficult linguistically. One of the interesting bodies of research that's been emerging over the years, in concert with my own, is work done at Purdue University by Dr Anne Smith. In some of the more interesting work she's done she's shown that in both children and adults who stutter, the motor system is more easily de-stabilised by increasing linguistic demand. That would make stuttering a quite unusual communication disorder but one which is very fascinating, which is why I like to study it, in that it would involve both the speech motor system and the language planning systems together. Somehow the way they interface in people who stutter is not maximally efficient.

DYANI LEWIS

To do this you're focusing on children at the very onset of stuttering, is that right?

NAN BERNSTEIN RATNER

Yes, we sort of want to get them before they have self-learned fears about stuttering. It's very hard actually to get them before that emerges. As I said we've seen children at the age of two, who when they feel physically that they're blocked and can't get speech out, this frightens them. And as a result they start trying to bypass those words and substitute and use other words. For somebody like me who wants to look at their normal behaviour that turns out to be quite a problem. And it's not as evident in young children as it is in older adults, but that tends to be why I study young children more often than you find me studying adult behaviours because the adults tend to be affecting their own stuttering in various ways. That's very understandable, it's not a problem, but it makes harder for me to get back to the roots of what the stuttering

problem originally looked like.

DYANI LEWIS

And so when you look at kids who stutter do they have the same language abilities as other children do?

NAN BERNSTEIN RATNER

They basically have normal language abilities but they are not quite as good as carefully matched non-stuttering individuals. So in all of the work that I've done and in most of the work that's been reported in the literature, people who stutter have very decent and average language skills. But if they're closely matched with individuals of the same age, gender, socioeconomic background, whatever they often score just a little bit lower. So some of us term this problem a sub-clinical language weakness. It's not going to be evident unless you have them in a laboratory experiment or in large numbers of standardised tests for which they're matched against non-stuttering individuals. But they don't seem to have the linguistic proficiency that non-stuttering individuals do as a group, that's just a group characterisation.

DYANI LEWIS

So what sort of deficiencies do they have?

NAN BERNSTEIN RATNER

It's pretty much across the board in many of the research studies. Slight deficits in vocabulary, slight deficits in comprehension of grammar or slight deficits in the quantity of spoken language under certain circumstances. Although that one is problematic, because certainly if somebody stutters they're less happy giving you a lot of language in an experiment.

DYANI LEWIS

How can you test some of those effects in a laboratory sort of situation?

NAN BERNSTEIN RATNER

In some of the studies what we do is we engage in rather fast and speeded responses. So in the studies that I was describing at Purdue Dr Smith and one of her colleagues, Dr Chris Weber-Fox, actually have people trying to respond very quickly to grammaticality judgements. If a sentence contains an error for instance like - 'the boys is running?' - and at the same time that they make individuals very quickly judge whether those sentences are well formed or not, they're actually taking what we call event-related potential readings from them that show brain wave responses to well and mis-formed sentences. What we see in people who stutter is that when put under a lot of pressure they make a few mistakes on even such a simple task. When we look at their brains, their brains are responding differently than those of non-stuttering individuals. So their brainwaves are somewhat delayed in latency and they seem to be somewhat suppressed in amplitude. We do have, this is a little technical, the brain does have different responses to listening to say a grammatically badly formed sentence as opposed to a sentence that contains just nonsense words. So if I say something like, I like to drink my tea with sneakers, for instance, the brain has a typical response to a silly word like sneakers stuck at the end of that sentence. What we see in individuals who stutter is somewhat of a merging of the typical responses that we see in non-stuttering individuals. Usually brainwave responses look different for things like a grammatical error or what

we call a vocabulary or semantic error. In the case of people who stutter they seem to show one undifferentiated response.

DYANI LEWIS

Right, so they know that something is not right?

NAN BERNSTEIN RATNER

Yes, something is wrong but they're not exactly sure what. Well we know that they know what's wrong, their brain is responding in an interesting quick way that shows us that somehow they're having difficulty processing.

DYANI LEWIS

Right and are these deficits also seen in adults who stutter then?

NAN BERNSTEIN RATNER

These studies are done on adults actually.

DYANI LEWIS

Oh I see.

NAN BERNSTEIN RATNER

So even that simple kind of task is done with an adult usually.

DYANI LEWIS

I'm Dyani Lewis and my guest today is speech pathologist and researcher Professor Nan Bernstein Ratner. We're talking about speech pathology and stuttering here on Up Close coming to you from the University of Melbourne. Now, Nan, there's been quite a focus on bilingualism research recently and perhaps how bilingualism is advantageous for keeping your brain healthy as you age and that sort of thing. But having the complexity of an additional language, does that affect a person's stutter?

NAN BERNSTEIN RATNER

People have asked the question for a long time whether trying to manage two languages makes you more or less likely to develop a stutter. There was a study that was done a few years ago at the University College in London that indicated that bilingualism might be a risk for stuttering. A lot of us were not quite happy with the methodology of that study. In general we don't find in any field of communication disorders that being bilingual puts you at additive risk for having a communication problem. One of the problems with bilingualism as it's studied in most cultures is that it is also linked to other variables that are harder to control such as socioeconomic status. We know that most communication disorders are elevated in people who have lower socioeconomic status for a multiplicity of reasons. And so I think I would want listeners of this podcast to come away with the impression that bilingualism is generally a good thing and we don't normally think that a child who is bilingual is at risk for developing communication disorders. If they have a

communication disorder, if you stutter, for instance you're going to stutter in both of your languages. You're not going to be fine in one language and stuttering in the other. We don't have any examples of that. Likewise, you can be language disordered in more than one language although it might look a little different in the two languages. So bilingualism is, I think, a healthy thing. When I get older I hope to study more languages to stave off dementia and I would not want parents to make the decision to make their child less bilingual because they're afraid of a communication problem.

DYANI LEWIS

How does our understanding of language affect the way that stutterers are treated?

NAN BERNSTEIN RATNER

I think most of the initial applications of my work have been to try and encourage therapists who treat stuttering to understand that stuttering is done while you're formulating language. And in the case of young children who are still developing language and who find some things much harder to say than other things in terms of language demand, if you simply treat stuttering as a speech motor problem and you ignore for instance how easy or difficult a particular type of sentence is for a child to say, or what's going to happen under more generalised language demand when you have to speak more quickly, formulate more complicated language to get a more complicated thought across. So we're trying to get at least American speech language pathologists and around the world when we talk to them to sort of not consider stuttering only to be a speech problem, especially when they are working with children, but to plan their lessons, so-to-speak with an eye towards starting the child off learning how to do things that are more fluency-enhancing at a low level of linguistic demand but be very structured in how they bring the child through increasingly more difficult levels of language demand in mastering these skills.

DYANI LEWIS

In the 2010 movie *The King's Speech*, the therapist Lionel Logue used singing to improve the King's speech. Is this approach effective and is it at all used?

NAN BERNSTEIN RATNER

Well I'm not sure how many of your listeners remember the cartoon *Mighty Mouse*. *Mighty Mouse* sang, he sang opera and most of us cannot go through life singing in order to communicate. Basically, while people find it interesting that stutterers don't tend to stutter when they sing, I would actually find it interesting if they could pull that off. That's because when we sing, we tie our words together very nicely. We don't leave lots of spaces and gaps between words. We tend to sing at a slower rate than we talk. We tend to use our voice in a very gentle and easy fashion and we don't tend to make up the lyrics as we go along. When you add the inverse of that into the mix that people who stutter often are trying to say one word at a time with effort, because they're afraid that they might stutter, what you get is people having trouble producing speech in a fluid way and also trying to do the simultaneous task of essentially developing the lyrics and trying to figure out what they want to say. So singing works, but it's not a very practical long term solution to stuttering.

DYANI LEWIS

What about drugs, have there ever been drugs developed for stuttering?

NAN BERNSTEIN RATNER

There are some drugs that have been developed and trialled. Most recently in the past few years in the United States primarily, I believe, something called Pagoclone which actually seems to reduce the frequency of stuttering somewhat. It doesn't eradicate it but it reduces its frequency somewhat. However, the trials did not meet criteria for follow-up. Most of the other drugs historically that have been used to combat stuttering also don't remove it, they simply reduce it. Typically they have very undesirable side effects. Many of them are anti-psychotics for instance and people have had very bad reactions. Other people have felt sedated, experienced weight gain or other complications. In the end we don't have too many drugs that seem to be useful for managing stuttering that don't have worse trade-off side effects. The other important thing that is very, very critical for any listener to understand is that no drug therapies have been trialled on children who stutter. We actually have absolutely no data on that. So use of drug therapies in children who stutter would be extremely ill-advised.

DYANI LEWIS

And I have also read about devices that you can use, delayed auditory feedback devices. Can you explain what these devices do?

NAN BERNSTEIN RATNER

Delayed auditory feedback devices, one is marketed under the name SpeechEasy present the listener back his own speech or her own speech at a slight time delay sort of like an echo. And sometimes additionally change the frequency of the speech to make it deeper or higher. So you might hear yourself at a slight delay sounding just a little bit more like Minnie Mouse. Those devices are interesting. They seem to work for a minority of people who stutter temporarily. So in a laboratory experience for instance about half the people that we might bring in might show a reduction in stuttering under that kind of feedback. Of those people a large number seem to show what we call adaptation, that is they learn to ignore the signal back to their ears, their stuttering gradually increases back to its baseline level. Additionally a lot of people really find the signal kind of maddening. One of the more interesting research experiments or studies that was done in the past few years down in New Orleans at Tulane University by Dr Anne Foundas did discover that people who did get benefit from delayed auditory feedback actually had slightly different brain anatomy than people who didn't find much use in those products. It seems as though we may at least have two subsets in the population of people who stutter. One of whom is helped, at least temporarily, sometimes long term by wearing a concealable feedback device and others who aren't. In the end most of the long term studies tell us that very few people find long term help from some of these devices. Although some people may use them temporarily to get an improvement in fluency say for a very important event like giving a public talk.

DYANI LEWIS

Just one final question, where do you see the field heading from here?

NAN BERNSTEIN RATNER

Well I think it's still very big news for most people wandering down the street the lay person to understand that stuttering might in fact be a genetically pre-dispositioned disorder of brain function for speech and language processing. I think we still have a lot of misconceptions out there about people who stutter. Movies like The King's Speech help a little, but they don't help a lot in a sense that the movie was true to

its time. Even Lionel Logue believed that King George stuttered because of bad upbringing experiences, bad parenting, trauma in seeing an older sibling die. So I think we have a lot to do to create a better understanding of stuttering in the public eye. Then there are certainly new therapies for stuttering that come out over and over again that do help individuals who stutter in different ways. I think one of the more hopeful things about stuttering therapy is that we do see evidence that it can be effective at any age that what works for one person may not necessarily work for another person. But with enough investigation and enough patience and enough intelligent management with a good therapist people who stutter can actually speak quite fluently and be perfectly comfortable speaking in the long term. But it's not the kind of problem that I think we're going to develop an immediate fix to any time in the near future.

DYANI LEWIS

Nan Bernstein Ratner, professor and chair at the Department of Hearing and Speech Sciences at the University of Maryland, thank you for being our guest on Up Close today and taking us through the science of stuttering.

NAN BERNSTEIN RATNER

Thank you for having me.

DYANI LEWIS

Relevant links, a full transcript and more info on this episode can be found at our website at upclose.unimelb.edu.au. Up Close is a production of the University of Melbourne. This episode was recorded on 31 July 2012. Our producers for this episode were Kelvin Param and Eric van Bemmelen, additional associate producing by myself, Dyani Lewis, audio engineering by Gavin Nebauer. Up Close is created by Eric van Bemmelen and Kelvin Param. Until next time, good bye.

VOICEOVER

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