

Professor Judith Kroll & Professor Zhang - Does Speaking Two Languages Delay Dementia?

Welcome to this episode of Exploring the Humanities, Women's Voices from the Hong Kong Polytechnic University. Our podcasts allow us to showcase the exciting and innovative work being done by our colleagues in the humanities. Intersecting with fields as varied as aviation, mental and physical health, virtual reality, Gen AI, design, neuroscience...

I am Renia Lopez from the Faculty of Humanities.

Today, we are very lucky to have with us not one, but two speakers. One of them is Professor Judith Kroll. Professor Kroll is a distinguished professor at the School of Education at the University of California, Irvine. She specializes in psycholinguistics, focusing on second language acquisition and bilingual language processing. Thank you for being here with us.

We also have with us a second professor, Professor Zhang [Haoyun]. She's an assistant professor at the Center for Cognitive and Brain Science at the University of Macau so, much closer to us. Welcome to you both and thank you very much for being here with us. To start with, could I ask you to briefly tell us what it is that you actually work on? Professor Kroll, please see if you could start.

- **K:** Thank you and thank you so much for having us today. We are language scientists who are interested in what happens in the mind and the brain when people learn and use two languages. Until recently, the idea of being bilingual, especially for those of us who are living in the United States, was seen as being a special thing, something that was very complex and different from being a monolingual speaker of English. What we've learned in the last three decades is that not only is bilingualism and multilingualism common in most places in the world, but we've learned that the mind and the brain accommodate the presence of two languages in an absolutely natural way, that this is not an addition, it's not a complication, it is something that is natural and something that we are prepared to do.
- **Z:** Yeah, thank you for having us today and it's an honor to be here. I was a former

student of Judy, so of course I do very similar things to what Judy has said. In addition to that, I also do cognitive aging. For example, how language functions, in particular, how language production changes or declines with age. If you are a bilingual, how do your two languages change with age? And also, more importantly, how a lifelong experience of using multiple languages will give you, or your brain, benefits or advantages or good effects to your brain or protect you from aging.

Excellent, so we can talk about how children learn two or more languages, I suppose, and we can also talk about older people and what happens to them. Can I go back to something you mentioned earlier, at the beginning, when you were talking about people being monolingual, that we assume that that is the norm, to be monolingual, and yet, I suppose, there's a very small percentage of the world that is monolingual. Do we have any figures on that?

- **K:** I think we do. I don't know the absolute number off the top of my head, I don't know.
- **Z:** I would say more than half of the population.
- **K:** Yeah, at least half of the population in the world is either bilingual or multilingual. And of course, then we have locations where there are multiple dialects spoken of the same language, and depending on how you count, it can explode. In the US, the assumption has been that monolingualism is the norm. Critically, in the science that's been performed, until very recently, the assumption was that monolingualism was the norm. So, in fact, much of the research was based on a monolingual "native speaker" model. And what we have learned in this period is that there is no native speaker, and that's a radical thing to say. But what we've learned is that every person who uses language, which is almost everyone, is in a context where they are influenced by the languages that are spoken themselves and around them in the environment, and where they live, so that every single person speaks with an accent of one sort or the other, and there is no single pure norm of someone being a native speaker.
- **K:** And what we've learned in this period of time, and one of the findings that I think is most exciting, is that when an individual learns a second language, and when they already have a first language, their first or native language changes in response to learning the second language. So, it's not only that your ability to use your native language as a vehicle for learning a second language, which has often been studied, that certainly happens, but it's also the case that the second language comes to affect

the first language almost immediately. And so, what we see in the studies of the brain supports the idea that the two languages sit in the same place in your brain. They're not in separate locations, and what we see is that the two languages interact with each other quite actively. The problem for bilinguals is not thinking about how the languages might be used together; it's really about how on earth any bilingual can ever speak one language alone. And that's very counterintuitive to people.

And is that why we get so much code switching then?

- **K:** Well, one hypothesis is that code switching is something that's very natural, because the bilingual has both languages literally on the tip of their tongue. And it's important to emphasize that it doesn't mean that you're consciously aware of the activity of the other language. We're sitting here speaking English, and we haven't discussed which other languages anyone might want to speak. But I think the point is that the evidence and the studies show that all the languages that a person knows are active at the same time. And that seems very counterintuitive to people because it's not conscious. And typically, people think: "Well, my goodness, how could it be that the language is there if I'm not aware of it? " But the point is that study after study of behavior and of the brain shows that the two languages are percolating at the same time in your mind and brain. So, code switching becomes very natural.

Is it laziness when we code-switch?

- **K:** No, I would say that it's the opposite, that what we see is that code switching, and I've sometimes talked about it this way, is a form of mental athleticism. It's like bilingualism at the Olympics.
- **K:** You can think about code switching as something that bilinguals learn, and again, not consciously, but bilinguals learn how to control the use of the two languages in ways that are absolutely seamless. So bilinguals can go in and out of the languages they know and speak those languages with others around them who are similarly bilingual. At the same time, they can restrict themselves to one language alone.

And does this change with age? Because thinking about how people speak, I think I hear a lot less code switching in older people. You tend to hear it more with the younger ones. Am I correct in that?

- **Z:** Yeah, so I guess it also depends on what code switchers we are talking about. If they are spontaneous code switchers, say if a Spanish-English bilingual is talking to another Spanish-English bilingual, and they both speak the same language, of course they will just select whatever comes easier for them to speak. I think for those code switchers, it's more of a to save-effort action. But for other code switchers, they have to switch to another language when they are talking to another, say a monolingual or another person who does not speak the other language. So, it is more of an effort to code switch, they have to decide, "Okay, who I'm talking to and which language should I speak". In these kinds of scenarios, it's more cognitively demanding, and they have to practice on switching between languages and inhibiting other non-target languages.
- **Z:** Of course, older adults will have more challenges in this because they have all sorts of cognitive decline. But for those spontaneous code switchers, as they can freely choose whatever language comes easier for them, then I would say age might not make that much difference.
- **K:** I think there's also a really interesting question that arises about aging and code switching, which is about how life changes with aging. And one of the things that changes is that the social environment of language use changes. And so, some people retire from work, and that changes the opportunities to use it for languages. Some people live in an environment where they live alone. Others live in an environment where they may move to an assisted living community, for example, where they may have increased opportunities to switch with other people. It depends on who they're with.

And so, I think that what's interesting, and I know it would be interesting to hear your view on this, but my impression is that very little of the research on bilingualism and aging has actually taken into account the social change and the social networks that are crucial as people age. There's been a lot of interest in social networks in young adults, and looking at who you talk to and how you use it [social media] turns out to be critical to languages in the way you use them and what the consequences of that might be. But [there has been] much less consideration of that for older adults.

- **Z:** Yeah, there are very few studies on the change of social environment or socio-cultural environment with older adults. So as people get older, it's not just the language habits that affect language abilities, it's the environment that they live in that also changes. For example, [people in parts of the US] when they are younger, they need to

speaking English or Spanish in the work environment. But after they retire, they don't have to use this official language. They can just speak their dialects or native language to their friends. It's not just a matter of the change of language habits. It's also related to the change of social environment and networks, as Judy mentioned.

You've got a very interesting paper where you were looking at the effect of the social environment on speakers, and you were comparing Pennsylvanian and Californian speakers? Tell us about that study because it sounded really interesting.

- **K:** Yes, I was on the faculty at Penn State before I moved to California about 10 years ago. And one of my graduate students at Penn State, Kinsey Bice, was in the middle of doing her dissertation. And for a graduate student working on their dissertation, I sometimes say it is a kind of nightmare to imagine that your advisor walks in one day and says, "I'm moving to California." And I said to Kinsey, "I'm moving to California. Do you want to come with me?" And she said, "Yes." Now she had collected half the data for her dissertation in Pennsylvania, and half of it then was collected in California.
- **K:** And little did we know that this was going to be a serendipitous finding that would be so fascinating. She did a study where she did something a bit unusual. She taught people Finnish vowel harmony, we don't need to go into the details of that here. But the point of it is to say, let's have a language learning, a novel language learning feature that's rather difficult, and not just a simple "associate this word with another word and we'll see how well you do on the task." And she studied Spanish-English speakers who were in Pennsylvania, and monolingual English speakers in Pennsylvania.
- **K:** She taught them this rule, where they heard this Finnish rule -- it's a rule that exists neither in English nor in Spanish. And people learnt it. And what she did is she monitored their brainwaves. She used electrophysiology, EEG, to monitor their brainwaves, and to ask: "What happens when you learn, you hear these words, and you learn to judge what is acceptable in Finnish and not anything part of your normal life experience?" And it turns out people can learn this pretty well. And then what she does is a week later, she brings people back into the laboratory and gives them another set of examples that they haven't heard before. She asks that they can generalize to the new context.
- **K:** And what happened in California was shocking. What happened in California is that

the monolinguals, when you brought them back, they produced brain data that looked bilingual-like. So, the monolinguals in California were able [to do this] -- no one, either in the monolinguals in California or the monolinguals in Pennsylvania, was able to judge this consciously, behaviorally, a very hard task to perform. But the brains of the monolinguals in Pennsylvania showed no sensitivity to the rule that they had learned. The brains of the monolinguals in California are sensitive. So, what is it? And our hypothesis (we didn't do this study for that reason so, we have to be very cautious that we're not making up a very interesting story that maybe our fiction) but what we think, after ruling out a number of alternatives, is we think that the linguistic diversity of the environment in California -- California is very linguistically diverse, and we think that most of the monolinguals in California had actually lived in California their entire life. They [Californians] had grown up hearing this. Whereas Pennsylvania, is a very monolingual English environment, if you walk on campus at Penn State, you don't really hear other languages; you hear English. If you walk on campus in any of the campuses in California, you hear many, many different languages. So, we think that being exposed in the environment to other languages, even if you don't speak those languages yourself, tunes your brain to be more open to language. And other studies in other people's labs have more recently suggested that there is, in fact, evidence for that, that being in a linguistically diverse environment is good for your brain and good for learning.

How good for your brain? And how good is it for learning? What are the benefits of being in a multilingual environment or of being bilingual or trilingual yourself?

- **Z:** So there have been many studies showing that speaking multiple languages is good for your brain and for your cognition. I will comment from an aging perspective. There was a phenomenal paper several years ago, by Dr. Ellen Bialystok. Her data shows that as people get older, some of them will be diagnosed with having dementia or Alzheimer's disease. But bilinguals started to show the symptoms of, or be diagnosed with, dementia or Alzheimer's disease five years later than the monolingual group, meaning that speaking two languages or multiple languages is really protecting your brain to make you less likely to develop, or develop those diseases much later, than monolinguals. So that's one piece of evidence from older adults.
- Across all the ages, not just older adults, but for infants, children, and younger adults,

there have been many studies showing that speaking multiple languages is beneficial for your general cognitive abilities, including, for example, inhibitory control, working memory, things like that. So those abilities are not necessarily related to your linguistic ability per se. There are more kinds of non-language cognitive abilities that are benefited from the experience of speaking multiple languages.

So why do you think that is?

- **K:** What happens? And this is really the main focus of research now, to understand how this arises. Some people don't believe it. And some people use the word "debate". I use the word "controversy". We think that there are multiple experiences. Not all bilingual speakers will necessarily show all these benefits. It really depends upon how the two languages are used and the context and the extent to which the environment is either supporting or not supporting the two languages. But there are some clues. There are clues in the work that, as Payan said, work by Ellen Bialystok, which was really quite foundational, revolutionary really in this area of research, suggests that there may be changes to attentional networks. If we look at the work, and there is fascinating work on bilingual babies, you could argue they're not bilingual when they're babies, but they're bilingual-learning in context, they're crib bilinguals. They're bi-literally exposed. And what we see in babies who are bilingually exposed is that they develop reader sensitivity to speech, even in non-native speech that's presented to them. So, what you see is that for babies who are exposed to more than one language from birth, far from the idea that they would be confused, what happens is that they maintain an open speech system for a longer period of time, developmentally, than what we see among monolingually exposed babies. Does that confuse them? Does it hurt them? No. It makes them more open to learning new languages for longer.
- **K:** And so, we see that phenomenon and we see, in a related way in the studies that have been done on babies, that babies who have been exposed to more than one language are more likely to direct their attention differently in the environment. For example, studies that have compared monolingually and bilingually exposed babies show that the bilingual exposed babies are more likely to look at adults' mouths than their eyes when they speak. What comes out of their mouths? Language. And so, there's an intentional strategy that is changing almost from the start. Studies that have looked at talker identification at whether babies can figure out [who is who]. And you

have to use very clever experimental methods to figure out what a baby is looking at and how they're making sense of things. [Studies are finding] that bilingually exposed babies are better able to match the speaker with the language coming out of their mouth than monolingually exposed babies. So, we see these intentional strategies that kick in immediately. And one hypothesis is that it is a network of attentional control cognitively that is changing as a function of becoming bilingual.

- **K:** Another piece of this, though, is about how bilinguals use language. And one of the things that we have been, that we have actually collaborated on, and that we are very interested in in our current research, is how bilinguals learn to achieve this regulation that we referred to earlier that seems to occur so seamlessly, but that is doing a massive job to be able to use the two languages code switching, but keep them separate. And the word that we've used to describe this is we use the word "regulation". And the idea is that bilinguals come to regulate their two languages.
- **K:** Now, what are the clues about which features of this language use might be critical? In the finding that Haoyun mentioned about dementia, bilingualism doesn't prevent dementia. If it's in the cards for you, I guess it's in the cards. But what we see is that, as Haoyun described, bilingualism has been shown to delay the symptoms of dementia by four to five years. And there's no drug that does that. Even in 2026, there is no drug that has achieved that finding. Now, what's interesting is that there is a clue in the few studies that have been done that look at what happens when bilingual patients with dementia show up in the clinic. So, when they can no longer compensate when there are others around them and they recognize that they have this cognitive decline, it turns out they can't speak their second language anymore. There is a selective loss of the second language.
- **K:** Well, we think the reason why is that to speak a second language, you have to be able to regulate your stronger first language. So, if what happens when you speak, I mean, in an extreme case, you can imagine that what you're doing is inhibiting your first language. Imagine you have a very strong first language and a somewhat weaker second language. How do you ever speak a second language? Well, you have to somehow have that first language sit in its place and be controlled. The hypothesis is that if as you age, and in the event of facing pathology like dementia, you lose the ability to inhibit cognitively, you may lose the ability to regulate your stronger language, to speak the weaker language. If you can't control your stronger language, you're not

going to be able to speak the second language anymore. And this is a hypothesis, this is speculation at some level, but there is active research that's ongoing trying to identify the clues in language use that might tell us what it is about bilingual language use that is creating the protections that we see in older adults.

- **Z:** And I would also add that every bilingual person is different. Although we now speak of bilinguals versus monolinguals as categories, bilingual itself is not really a category; not every bilingual is the same. We use languages differently in terms of how we learn our languages, how we maintain our languages, how we keep our language and how we lose our languages is very different.
- **Z:** Some bilinguals are equally proficient in their languages. So, for them, there may not even be a native versus non-native language that is equivalent. But for some kind of non-proficient bilinguals, they need to be more cautious or pay more attention or be more effortful to speak their non-native language. In this case, they need to try harder, inhibiting their native language. The age-related change or age-related change in trajectory in terms of how they lose their languages will be different. I just want to add that not every bilingual is the same.

And in terms of the age of acquisition of the other language? (You were obviously talking about bilinguals from more or less birth who have been in a context listening to both languages or more than two languages.) What happens to people, to adults, who acquire a language later on? Do they also experience the same benefits or is it different for them?

- **K:** It's different, but it's also the same. And I think the evidence that we have suggests that you see many of the same changes in the brain for late acquirers. You see some different things for early acquirers, but you see changes that occur right away in the brain for adults learning a second language. And you see the consequence of the second language for the native language, right away.
- **K:** What that means is that you may, as an adult, you may not develop the same proficiency that someone who's been bilingual in both languages since birth or early childhood, but you can, in fact, become reasonably proficient. And you can also demonstrate the consequences of that proficiency. I think that the traditional view in linguistics and in psychology was that there was a kind of critical period for learning a language. And that if you were past that critical period, your brain was frozen and you

might as well forget it. And what we now know is that that's simply not true. We know that learning is a much more adaptive process. But as Haoyun said before, it's not just about what's going on in the head of the learner, it's what's going on in the environment that interacts with it. We tune to the environments we live in and those environments shape who we are and we use the two languages. And so, you end up with a great deal of variation in what bilingual experience looks like.

- **K:** For example, where I live in Southern California, there are many heritage speakers, which means individuals who know a second language other than English, but they learned that language at home. And often they learn their language at home as their first language, but then in the society they live in, they become dominant speakers of English, which is the language in the community and the society around them. They go to school in English, but they often maintain Spanish. And they have a reversal in the dominance of what was the native language, which is no longer the dominant language.
- **K:** And so, what we see is that the pattern of this kind of regulation process is very different for them than it is for someone who lives in a context where they have acquired a second language, but they live in a very dominant first language environment and they maintain that first language environment. And we and others have done many studies that show that the nature of that environment is really crucial. And also that when someone is immersed, so you can get there if you travel or emigrate, it can be by choice or it can be by requirement, but if you find yourself in an environment where the language in the majority context is not your native language, what we see is that there are changes not only to learning the language of the environment, but also to the native language. And we see that those changes are dynamic.
- **K:** And I think one of the things that's really most surprising about the research and most exciting about the research is that it's not a matter of just acquiring proficiency and checking it off the list and saying, "I've acquired this and so I'm going to get my badge in whatever the language happens to be." But rather that from day to day, from week to week, there are changes.
- **K:** And what we see, and we've done quite a few studies on immersion learning, when someone is immersed we see this, which could be interpreted as a decline to their native language. And some people have said, "Oh, this is a loss. This is what's been

called language attrition." And we have fought to the nail with those people to say, "This is not attrition. This is actually the normal dynamic of being bilingual, that you regulate the two languages up and down as a function of the extent to which the environment is providing support for them and our minds and brains go with it. They adapt very easily to that information and they change.

- **K:** So, it's not a matter of acquiring a static state or I think in many traditional language learning contexts, people taking foreign language classes or thinking about trying to become proficient in a language other than their native language, often think about it as acquiring some fixed level of achievement. And what we now know is that that's simply not accurate, that it's constantly changing.

So many interesting points there. I would like to come back to the idea of the heritage speakers. Do we know what happens to them in their old age? Because we've been talking about dementia before. Do we see the same things happening to them?

- **K:** I think actually we know very little, even in their young age. I think that it's only recently that there has been attention to the idea that being a heritage speaker is, first of all, that it's not a deficit. At least in the US, there is a lot of politics around this. There was a report almost 10 years ago in 2017, the American Academy of Arts and Sciences published a document that was a report on the state of language learning in the US, in the 21st century. And one of the things they reported is that they reported data on heritage speakers. And they said that in the US, people who speak a language other than English, of those people, 75% learn that language at home, which means that the majority of bilinguals in the US are heritage speakers of a home language.
- **K:** And until recently, they were not the people who had been studied. The people who have been studied are typically late second language learners in classrooms or in tutored instruction, or people who are early bilinguals and come of age with both languages. So, it's only very recent. I think we are just beginning to see that not only is being a heritage speaker not a deficit, but we're beginning to see that, to the contrary, heritage experience may provide a model for science for understanding how language and cognition work together to accomplish the kinds of outcomes that we've been discussing.

So, a lot of work still to be done. What about the situation here in Macau, Hong Kong, because here we see a completely different pattern than what we see in the US? Have there been many studies with people here in this area?

- **Z:** That's what I'm trying to do after I moved here. So, one of the main reasons I decided to come to this area is because of the multilingual and multicultural environment. I was telling Judy earlier today that in Macau, when we take the bus, the announcement will be made in four languages: Mandarin, Cantonese, English, and Portuguese. If you randomly get someone in Macau, it's impossible that they would be just monolingual. They would at least speak another language or dialect.
- **Z:** But in older adults, Cantonese will be their dominant language. And in my experience working with older adults in Macau, most of them can understand Mandarin Chinese, but they don't really use Mandarin Chinese that much. This comes to another definition of how we define bilinguals. For those people, they have the knowledge of another language, but they rarely use that language. Are they bilingual or are they monolinguals?
- **Z:** I think the important thing is not to give them a label, but more importantly, to understand the language profile of that population and then see the linguistic or cognitive consequences associated with that profile. That's, I think, what makes Macau, Hong Kong, and California fantastic places to do bilingualism research, is that, population-wise, we have such a diverse, different bilingual or multilingual population.

So basically, the takeaway here is that being bilingual, trilingual, and so on, this is a good thing. I think quite a number of parents tend to be worried, as you mentioned before, that "Ooh, if we speak two languages at home, the child is going to get confused." So that is not the case, is it? And then at school, again, from what you're saying, it seems that we should be encouraging more than one language being taught and used at school. Is that the case?

- **K:** That is the case. And the evidence that exists that I know of suggests that when children enter school in a dual language immersion environment, there is not only a benefit for maintaining a home language, but there is a benefit for maintaining the society language, the societal language. And it's very counterintuitive. It's counterintuitive to parents, and it's counterintuitive that the idea that having two languages may help both languages, because think about it. If a child comes to school

with a home language, and there is a language of the community that's a majority language, but the home language is their stronger language, well, you want them to be able to start learning with their stronger language. And they can then use that stronger language in acquiring the language of the community.

- **K:** There is an amazing study actually reported in that same report from the American Academy of Arts and Sciences that shows that between, I think it's between fifth grade and eighth grade for elementary school children, that if you compare children in dual language immersion with children in English-only schools, the children in dual language immersion do better in English than the children in English-only schools. So, I think that it's perfectly easy to understand why parents might think, I want my child to do well in English, I'm going to put them in English only. It turns out that's not the best thing to do. And the evidence that's emerging is consistent with that. So having more than one may be initially more difficult in some ways, may pose a challenge in some ways, but ends up with a much better result.

I think that is a really good point to finish on. But before we do, is there anything else that you're working on now that you have done recently that you would like to share with our listeners?

- **K:** We're very excited about what we're working on. And I think that we think that the point that Haoyun made earlier about variation and bilingual experience is really the message that I would like to see us come away with. And what we've said today, which is that, you know, bilinguals are not a single category that we need to ask people: "Are you bilingual or not?" We need to understand that the language is learned and used and to understand that in some cases, the experience people have will have massive consequences for their brain, for aging, for all of the things we've been discussing. And in other contexts, it might not matter that much. And that we should accept that complexity and begin to try to understand and identify the factors that are critical. Sometimes when people hear us say this, they say, "Oh my goodness, it's too much to study. How can you even begin?" But I think that what's encouraging is that there is regularity in the science. There is a set of very clear messages in what's emerging that really make this a new path to understanding how bilingualism becomes a vehicle, a lens for understanding the mind and the brain and language.
- **Z:** Yeah. And I would also like to add that I think about bilingualism as a mental

exercise from a lifespan perspective. So, for children who are infants, as a parent, don't worry, if you put them in a bilingual environment, children they will figure it out. In addition to the linguistic abilities, they will also be exercised or practiced on other mental aspects or cognitive abilities.

- **Z:** And then for older adults, think about bilingualism as a mental exercise too, and think of it as a way of cognitive training or a way that you could protect your brain or your cognition. It's a good thing to have.

Thank you very much, Professor.

- Thank you for having us.

It's been a pleasure to have you with us today.

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