Brain Plasticity

Monday 26 January 1998 12:00AM (view full episode)

Research from Germany has shown that the adult brain is almost as malleable and plastic as a child's.

Health Report – ABC Radio National (Australian Broadcasting Corporation)

Research from Germany has shown that the adult brain is almost as malleable and plastic as a child's. Research from Germany is showing that virtuoso violin playing can make the brain too smart for its own good, but also that the adult brain is almost as malleable and plastic as the child's. The way people learn to play the violin has shown that the adult brain is far more adaptable than many experts have thought in the past, and the researchers from the University of Konstanz have extended their findings to Braille readers.

Brain plasticity means the ability of the nervous system to adapt to changed circumstances, to find new ways of learning, sometimes after an injury or a stroke, but more commonly when you want to acquire a skill for, say, a hobby or even a new job.

One of the scientists who's worked on this and how our brains respond to environmental demands, is psychologist, Professor Thomas Elbert.

Thomas Elbert: Twenty years ago people thought that the structure of the brain develops during childhood and once that organization in the brain has been developed that there is very little room for changes and for plastic alterations. Now we know that there is enormous capacity.

Norman Swan: Now you, earlier on, in exploring this idea that the adult brain is still very plastic, you looked at violin players.

Thomas Elbert: Well, violin players use the left hand and their fingers to finger the strings, and they do so several hours a day, and these fingertips get stimulated, and what we see there is that the representation of the left-hand fingers and the right hemisphere of the brain —

Norman Swan: I should explain here that the opposite side of the brain dictates the movements and perceives sensation from the actual side of the body where the movement or sensation occurs – it crosses over.

Thomas Elbert: Right, exactly. It crosses over, so in many string players the hand representation in the brain gets enlarged. So the brain assigns more tissue, more neural elements to the processing of these fingers.

Norman Swan: And that's compared to non-string players, obviously.

Thomas Elbert: That’s compared to non-string players and also compared to the right-hand in these musicians, because the right-hand moves the bow and there’s much less finger movement and much less stimulation of the fingertips involved.

Norman Swan: So the fingertip representation on the right side of the brain is just much, much larger than the one on the left?

Thomas Elbert: Exactly. And what we see is that if you start early in childhood playing the instrument, then this change is greater. But what is really now amazing and interesting and fantastic is that also if adult people start playing the instrument, they also change their representation, not to the extent as we see it when you start early playing the instrument, but it still occurs in adulthood.

Norman Swan: What’s the technology that you use to measure this? Because in the old days there was a famous Canadian neurosurgeon who, when he just happened to be operating on the brains of his patients, he would measure with electrodes physically, and get them to move their hands. Presumably you’re not doing this with violin players?

Thomas Elbert: No, we didn’t find anyone who would allow us to open their skull, you know! So as neural elements function electrically, and with every electric process, every electric current has a magnetic field which is induced by the electric current, and we can detect this magnetic radiation.

Norman Swan: Tell me about the study you did with people who read using Braille.

Thomas Elbert: Yes, we have investigated several Braille readers, and there are those who used just one finger and others use several fingers at a time. And those who read Braille for several hours a day, and use several fingers simultaneously, instead of having several separate representations of the different fingertips develops a kind of merged, giant large finger, or a large representation of all the fingers simultaneously in the brain.

So to speak a super highway of information from the fingertips to the centres of the brain where all that information is merged and so these people perceive at the same time, all the information from the different fingertips.

On the other hand, they are no more able then to determine where the information comes from. I think normal people have a little bit the same kind of fusion and disorder representation of their toes, because they stimulate the toes simultaneously usually in the shoes and we do not develop separate representation of the toes. Whereas with the fingers we develop separate representations in the brain.

Norman Swan: So what’s happening then with Braille readers who use three fingers, is it that three fingers act as one? And I notice from your research that if you in fact touch their fingers… in other words if my finger or your fingers were to be touched, we would know which finger’s being touched. But in fact blind Braille readers who use three fingers, they’re not sure which finger’s being touched of those three fingers.

Thomas Elbert: Correct. If I do that with your toes, it's the same thing. If I touch your toes, your middle toes, you will not be able to tell me which one has been touched. Whether you believe it or not, you can try this. The same thing happens with these brain readers. Only those who use several fingers with the reading at the time, then the information fuses and merges in the brain, and then of course they're no more able to tell where the information at a given location comes from.

Norman Swan: With one-fingered Braille readers? What happens with them?

Thomas Elbert: They don't have this 'fused' representation of the fingers, but actually the finger used for Braille reading, this finger has an enlarged representation.

Norman Swan: So it becomes a super finger.

Thomas Elbert: It becomes a large finger, yes.

Norman Swan: Are three-fingered Braille readers better Braille readers than one-fingered Braille readers?

Thomas Elbert: It seems to be so, yes. They seem to be faster.

Norman Swan: Going back to the original reason for doing the experiment in terms of whether the adult brain is plastic, most of these people would have learnt to read Braille as children. What about people who learn to read Braille as adults?

Thomas Elbert: We basically see the same thing. Again, the amount of adaptation is smaller than compared to the ones who start as children, particularly before the age of ten. But we still see very significant changes, and a rough estimate is that the plasticity is about half as large as an adult but still it's clearly there.

Norman Swan: So what are the implications of these findings?

Thomas Elbert: Well first of all it's very interesting from a basic point of view, but we also hope to apply this information to certain types of disorders. For example, in the musicians, if they are virtuosos, then they can move their fingers very quickly, very fast, and it's like a simultaneous input to the fingers, and the brain's integration time may then think that there's simultaneous input to two fingers at a time and as a consequence these people may no more be able to move fingers so quickly. This order is called focal dystonia of the hand, and then like a hand-cramp may develop and this is of course very fatal for a musician.

Norman Swan: So you have a violin player in whom not only are his or her fingers being 'read' in the brain as one, but in fact they start in a physical sense, in a 'muscle sense', to act as one.

Thomas Elbert: Exactly.

Norman Swan: How do you fix this up?

Thomas Elbert: We know that the synchronous input basically causes such problems, and these people of course first think it's maybe a peripheral problem, problems of the muscles, so that they can no more move the fingers separately, whereas in fact it is the brain representations that meld together. And we just then have a training schedule that stimulates the fingers and there they have to move the fingers in a certain very defined manner in order to separate these brain regions again.

Norman Swan: Mind boggling research there, so to speak. Thomas Elbert is Professor of Psychology at the University of Konstanz in Germany.Guests

Guests: Thomas Elbert

Thomas Elbert is Professor of Psychology at the University of Konstanz in Germany.

Further Information: Changed perceptions in Braille readers

Sterr A. et al. Changed perceptions in Braille readers. Nature 1998; 391:1