



Brain Imaging

What does it tell us about reading?

Interview with Guinevere Eden
Georgetown University Medical Center

Interviewer: At the Center for the Study of Learning – that you direct in Washington, D.C. – you use brain scans to learn more about dyslexia. How does this technology help you see what’s going on in the brain when someone is reading? Is it safe?

Guinevere Eden: Functional Magnetic Resonance Imaging, or fMRI, is a fairly new way of looking at the brain, and it is safe for children. Positron Emission Tomography, or PET, was the technology of choice for brain imaging in the early 1990s. Because PET involves a radioactive tracer, healthy children could not participate in these studies. With fMRI technology, we don’t need to use radioactive tracers. We can safely use fMRI to learn how sensory and cognitive processes are represented in a child’s brain.

Interviewer: How does brain imaging work?

Eden: When the nerves in the brain are active, they require more glucose and oxygen. This is delivered through an increase in blood flow to that specific region. It is the increase in blood flow that we are able to capture, and from this image, we infer which parts of the brain are actively involved in a given task.

Interviewer: If you can see a change in the pattern of brain activity, does that mean the person is learning?

Eden: Brain imaging is a good tool for assessing how a person learns – when it is used in the context of an appropriate study design. What we do at Georgetown is evaluate reading interventions – so we compare the brain activity of persons who have received special instruction with those who have not or who were taught math instead of reading. We look for greater brain activity caused by the reading intervention.

Interviewer: What should parents know?

Eden: They have the right to ask about research-based evidence on any program that claims to help children with dyslexia. Just as we know that certain medications help to treat specific diseases, we now need to provide the evidence – using randomized controlled studies – that reading intervention programs have been proven effective.

Interviewer: Before we go any further, tell me, what exactly is dyslexia?

Eden: Children with dyslexia have difficulty reading. They usually have severe problems in understanding the relationship between letters and their sound representations, and

this impacts their ability to decode words. The condition is not caused by low IQ, and it happens despite adequate classroom instruction.

Interviewer: How do you collect data about reading that is meaningful?

Eden: The rigor of the experimental design is very important. It isn't enough to ask someone to read parts of a book while lying in the scanning machine. As scientists, we need to dissect the components of reading and narrow down the relationship between these components and the brain regions being used by the person. That's why it is useful to have very specifically designed tasks that can be easily interpreted.

Interviewer: What kinds of things do you ask the person to do?

Eden: We may ask children to repeat a word, and then in another brain scan, we ask them to repeat the word but delete the first sound. When we subtract the data from those two tasks, we should be able to identify the areas of the brain that were involved in manipulating the sound structure of the word.

Interviewer: What other factors do you have to consider when setting up a study?

Eden: We would not ask someone with dyslexia to do a very complicated task that would be difficult or impossible for them. We are not interested in measuring brain activity related to their anxiety or frustration. Instead we are interested in observing what happens when they perform at a level appropriate for them. This means coming up with tasks that are suitable for the population under study.

Interviewer: What other design issues are you concerned about in this kind of research?

Eden: Including dyslexic control groups in studies examining the efficacy of an intervention. It is important to have two groups – one group that is receiving the intervention and one that is not – but the children in both groups should have dyslexia. Researchers are reluctant to set up their studies this way because it is hard to explain to the parent that there is a 50% chance her child won't get the intervention. However, if the intervention is reasonably short in duration, the study can be designed in such a way that the dyslexic control group receives the intervention after the first session of the study has been completed.

Interviewer: Why are you doing intervention studies?

Eden: We want to give clinicians tools for determining the appropriateness of commercial reading programs for a child. Right now, there is not a good basis for people to make informed decisions. Clinicians will tell you what they intuitively think works. Their intuition may be correct but it is not research-based evidence.

Interviewer: How do you find families who want to do the intervention studies?

Eden: We are working with a school in Baltimore for children with dyslexia – the Jemicy School – and a commercial program called Lindamood-Bell. This company provides the

tutors and they deliver the intervention at the school in a fashion that was laid out by our research design plan. The children receive different interventions – different kinds of training in reading, and some get the math intervention instead of reading – all in a randomized fashion. Our scientists collect the data (behavioral data and brain imaging data), and we rely on the time and willingness of the children and their families to participate in the study. Several times a year, the children come to Georgetown where they are given the fMRI scan. Every two months we enroll a new group of children.

Interviewer: What are the children's ages?

Eden: In this study they are between the ages of seven and twelve years old. In another study, we work with adults with dyslexia. They fly in from North Carolina where they've been participating in studies by Lynn Flowers and Frank Wood at Wake Forest University since they were in kindergarten or first grade.

Interviewer: Why are you studying adults?

Eden: We are studying this group of adults because the Wake Forest scientists have carefully examined and characterized their difficulties with language over the years. This allows us to determine that they meet the criteria for certain reading problems, not only in their adulthood, but also based on their developmental history from childhood.

Interviewer: Do you think dyslexia is genetic?

Eden: It is likely that dyslexia involves several genes. There are no definite answers yet about where on the chromosome these genes are located. What we do know is that children with one parent who is dyslexic have a 40% chance of also having dyslexia. It is important to start working with children in this circumstance early on. If it turns out they don't have dyslexia, the interventions won't harm them.

Interviewer: If it is genetic, does that mean intervention can't really change anything?

Eden: Many children can benefit from appropriate interventions, but the problem is feasibility. In our Baltimore school project, the intervention lasts 3 hours a day, 5 days a week over an 8-week period. How many schools can set aside this kind of time and afford to deliver instruction in small groups? A cheaper way would be to deliver the intervention to a larger group or to place the child in front of a computer that delivers some sort of reading intervention – but I don't believe there is sufficient evidence to suggest this kind of approach is effective.

Interviewer: Are there any areas where reading clearly does not improve even with intervention?

Eden: Fluency – or speed of reading – has been a difficult nut to crack. When you teach someone with dyslexia how to sound out words accurately, they may get better, but it comes at a cost. They take more time to sound out the word, and slow readers are often poor comprehenders. By the time they read something carefully and get to the end of the sentence, they don't have a clue what the sentence was about because they have

spent all their energy on decoding. However, researchers like Maryanne Wolf at Tufts University are working on programs that will hopefully elicit fluent reading skills.

Interviewer: Which components of reading do you look at to decide if the intervention is successful?

Eden: Reading accuracy, reading rate and reading comprehension. We ask someone to read a paragraph and we score how many errors they make, how long it takes them to read it, and whether they can answer questions and understand what they've read. Those are 3 different measures. If a scientist measures improvement on only some of these aspects of reading, we have to ask – how effective was the intervention?

Interviewer: What other factors should be considered?

Eden: After an intervention has taken place, you have to make sure that the child spends a significant amount of time reading and building up sight word vocabulary. Hopefully the child will continue to make gains, and this could be measured in follow-up studies.

Interviewer: Which universities have centers like yours that are funded by the National Institutes of Health?

Eden: The University of Washington in Seattle, Tufts University, Yale, and the University of Texas are all conducting intervention studies to see what helps to improve reading. The University of Colorado has a strong emphasis on the genetics of dyslexia. Each center has its particular focus. Our studies at Georgetown University all involve brain imaging. At Wake Forest University, they ask other kinds of questions – about the long term outcome of dyslexia and the relationship between dyslexia and affective disorders. There are many more sites, each investigating different aspects of dyslexia. One thing we all have in common is that we are funded by the National Institute for Child Health and Human Development at NIH and compete for funding through a peer-review process. Overall, what we hope to do is replicate one another's findings, and bring about a more complete knowledge of dyslexia.

Guinevere Eden was interviewed in 2004 by Joy Simpson, a member of the National Association of Science Writers. Dr. Eden is the Director of the Center for the Study of Learning and Associate Professor of Pediatrics at Georgetown University Medical Center.

For more information on dyslexia, visit the web site of the Center for the Study of Learning – <http://csl.georgetown.edu/dyslexia/what.shtml> or the International Dyslexia Association – www.interdys.org.

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