

One Reason Teens Respond Differently to the World: Immature Brain Circuitry

By FRONTLINE producer Sarah Spinks

We used to think that teens respond differently to the world because of hormones, or attitude, or because they simply need independence. But when adolescents' brains are studied through magnetic resonance imaging (MRI), we see that they actually work differently than adult brains.



Many teen subjects failed to interpret the emotion in faces like this one as fear.

At the McLean Hospital in Belmont, Mass., [Deborah Yurgelun-Todd](#) and a group of researchers have studied how adolescents perceive emotion as compared to adults. The scientists looked at the brains of 18 children between the ages of 10 and 18 and compared them to 16 adults using functional magnetic resonance imaging (fMRI). Both groups were shown pictures of adult faces and asked to identify the emotion on the faces. Using fMRI, the researchers could trace what part of the brain responded as subjects were asked to identify the expression depicted in the picture.

The results surprised the researchers. The adults correctly identified the expression as fear. Yet the teens answered "shocked, surprised, angry." And the teens and adults used different parts of their brains to process what they were feeling. The teens mostly used the amygdala, a small almond shaped region that guides instinctual or "gut" reactions, while the adults relied on the frontal cortex, which governs reason and planning.

As the teens got older, the center of activity shifted more toward the frontal cortex and away from the cruder response of the amygdala.

Yurgelun-Todd, director of neuropsychology and cognitive neuroimaging at McLean Hospital believes the study goes partway to understanding why the teenage years seem so emotionally turbulent. The teens seemed not only to be misreading the feelings on the adult's face, but they reacted strongly from an area deep inside the brain. The frontal cortex helped the adults distinguish fear from shock or surprise. Often called the executive or CEO of the brain, the frontal cortex gives adults the ability to distinguish a subtlety of expression: "Was this really fear or was it surprise or shock?" For the teens, this area wasn't fully operating.

Reactions, rather than rational thought, come more from the amygdala, deep in the brain, than the frontal cortex, which led Yurgelun-Todd and other neuroscientists to suggest that an immature brain leads to impulsivity, or what researchers dub "risk-taking behavior." Although it was known from animal studies and brain-injured people that the frontal cortex matures more slowly than other brain structures, it has only been with the advent of functional MRI that researchers have been able to study brain activity in normal children.

The brain scans used in these studies are a valuable tool for researchers. Never before have scientists been able to develop data banks of normal, healthy children. Outlining the changes in normal function and development will help researchers determine the causes of psychiatric disorders that afflict children and adolescents.