Teenagers' IQ scores can rise or fall sharply during adolescence

The IQ findings indicate teachers should be wary of predicting academic success based on early educational tests. Photograph: Don McPhee/Guardian

IQ scores can change dramatically in teenage years in parallel with changes to the brain, according to a study that suggests caution in using the 11+ exam for grammar school entrance to predict academic ability.

IQ is thought to be stable across a person's life. Childhood scores are often used to predict education outcome and job prospects as an adult. But the study suggests scores are surprisingly variable.

Robert Sternberg from Oklahoma State University, who studies intelligence but was not in the research team, said: "A testing industry has developed around the notion that IQ is relatively fixed and pretty well set in the early years of life. This study shows in a compelling way that meaningful changes can occur throughout the teenage years."

Our mental faculties are not fixed, he said: "People who are mentally active and alert will likely benefit, and the couch potatoes who do not exercise themselves intellectually will pay a price."

Sue Ramsden from University College London recruited 33 pupils aged 12 to 16, from high achievers at 11+ to struggling students referred for assessments. She tested their IQ in 2004, and again three to four years later, and also analysed their brains using magnetic resonance imaging. The average of all scores stayed the same across the years, but individual IQ scores rose or fell by as many as 21 points, a substantial difference – enough to take a person of "average" intelligence to "gifted" status, or vice versa. "On average it all washes out, but there are fluctuations from individual to individual," said Prof Cathy Price, who led the study.

The teens split evenly between those whose IQ improved and those whose IQ worsened. "It was not the case that young low performers got better, and the young high performers averaged out. Some highs got even better, and some lows got even worse," said Price.

The brain scans found drifting IQ mirrored by changes in density of nerves and other cells in parts of brains, suggesting drifts are real changes in ability, not varying concentration, mood or motivation.

Shifts in verbal IQ – abilities such as memory, vocabulary, arithmetic and general knowledge – were reflected in the left motor cortex, the home of speech. Shifts in non-verbal IQ, problem-solving and the ability to spot patterns came with changes in the anterior cerebellum, for hand movements.

Such areas are a surprise, especially as Ramsden did not see changes in the front brain for advanced mental skills. "These were the biggest changes we could detect, but probably just the tip of the iceberg," said Price. "It's likely that there are many other brain regions affected."

The study contradicts a long-standing view of intelligence as fixed. Alfred Binet, father of modern intelligence tests, believed mental development ended at 16, while child psychologist Jean Piaget thought it ended even earlier.

The team now wants to know what causes IQ drift: the rate of brain change, or educational factors that stimulate some skills but not others; and also if changes are teenage only or whether IQ can vary as dramatically in adults. In the meantime, the message for children, parents and teachers is, as Ramsden writes in Nature, Ramsden says: "This [study is] encouraging to some whose intellect may improve, and a warning that early achievers may not maintain potential."

• This article was amended on 19 October 2011. The original said that Robert Sternberg was from Indiana University. This has been corrected.