Exercise: Key to motor neuron development

Why is your 15-month-old child walking all over the place while mine is still crawling and can barely stand alone? Parents (and researchers) have asked similar questions, and the answer usually has been that maturation and learning play about equal roles in motor development. In other words, training and practice are necessary if a child is to learn to walk, but training and practice will not help much if the child does not have the necessary physical maturity. Then in 1972 the answer shifted slightly in favor of training when it was reported that walking exercises can help infants learn to walk at an earlier age than would be expected. Now there is physiological evidence to help explain that finding: Exercise may stimulate the development of motor neurons in the brain. J. J. Pysh and G. M. Weiss of Northwestern University Medical and Dental School in Chicago report in the Oct. 12 SCIENCE that baby mice given an opportunity to exercise develop more robust motor neurons than do mice that don't exercise.

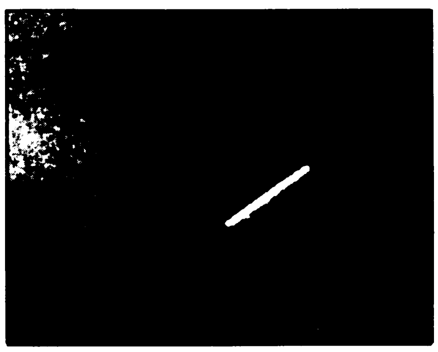
Although the development of neurons is largely under genetic control, it also seems to be influenced by environmental stimulation. For instance, the dendritic branches of visual neurons have been found to be larger in rats raised in a visually stimulating environment than in rats raised without such stimulation. Pysh and Weiss have now attempted to determine whether the development of motor neurons is influenced by environmental stimulation.

They raised one group of mice in a large cage in which they were able to engage in various physical activities. The mice in this group were also trained to swim, walk a tight wire, run on several types of running wheels and to climb vertical poles. Another group of mice was raised in a small cage in which movement was severely restricted, allowing just enough freedom to gain access to food and water. At 35 days of age the brains of the animals were compared for weight and for differences in motor neurons, or Purkinje cells, in the cerebellum. The researchers had previously studied the normal and abnormal development of Purkinje cells.

Pysh and Weiss found the brains of the exercised rats to be about three percent heavier than those of the nonexercised rats and the molecular layers of cerebellar tissue from the exercised animals to be about 10 percent heavier than those from the nonexercised animals, suggesting that cerebellar neurons had increased in weight through exercise. The dendritic branches of Purkinje neurons were no different in shape or orientation between the active and inactive animals, but the branches were about 10 percent larger in the former. In addition, the dendritic spines of the Purkinje neurons were found to be about 16 percent more numerous in the exercised animals than in the nonexercised ones, suggesting that exercise was also able to increase connections between Purkinje neurons.

Thus it appears that early environmental stimulation in the form of physical exercise *can* enhance motor neuron development. And as Pysh told SCIENCE NEWS, his and Weiss's findings may have implications for the rearing of young children. The researchers suggest that early physical stimulation can help a child achieve his or her full motor potential. The challenge now, Pysh explains, is to determine how much of early motor neuron deprivation can be reversed by later physical stimulation and what the effects of physical stimulation are on fully mature motor neurons. "There are indications," he says, "that the mature nervous system is more plastic than we appreciated." □

Another Jupiter satellite discovered



JPL

Newly found satellite of Jupiter is seen against planet's ring in Voyager 2 photo.

A tiny streak of light in a photo taken by the Voyager 2 spacecraft during its July encounter with Jupiter has turned out to be a previously unknown satellite circling the planet. This brings the total of known Jovian moons to 14, with a possible 15th (discovered several years ago in earth-based photographs) still awaiting confirmation.

The delay in announcing the new find occurred because the object was at first taken to be a star. After an exhaustive search of known star positions, however, California Institute of Technology graduate student David Jewitt and scientist G. Edward Danielson concluded that there was no known star in that location. A subsequent check of a higher-resolution photo showed that the lengths and directions of the light streaks produced by known stars in the same region were different from those of the target object, confirming that it was indeed in orbit around Jupiter.

In the two photos, the object is shown by the planet's recently discovered ring system, and in fact it orbits almost at the ring's outer edge, about 57,800 kilometers above the Jovian cloudtops, making it the planet's innermost known satellite. It is estimated to be about 30 to 40 km in diameter, which makes it, though tiny, not the smallest of the group. Although the biggest of Jupiter's moons, Ganymede, is larger than the planet Mercury, there are half a dozen known to be smaller than the latest addition, which is temporarily identified only as 1979J1.

Calculations done independently by Jewitt and by Stephen Synnott of Jet Propulsion Laboratory indicate an orbit that would make 1979J1 the fastest-moving satellite in the solar system, hurtling around its host world at a speed of about 108,000 kilometers per hour. It also has the shortest orbital period, completing a trip around Jupiter every seven hours, eight minutes.

A special analysis is now underway to see if the satellite can also be located in any of the photos taken by Voyager 1, which preceded Voyager 2 to Jupiter by about four months. It was a single Voyager 1 photo, in fact, that originally revealed Jupiter's ring system, prompting additional photos of the region to be added to Voyager 2's schedule, and possibly setting the stage for the new satellite's discovery.

Voyager scientists are now speculating about whether the close-in satellite may be influencing the ring system's composition, by either sweeping out or supplying particles to it. □

Ocean info via satellite

The first U.S. satellite monitoring system devoted entirely to ocean studies began operation October 12 at the Scripps Institution of Oceanography in La Jolla, Calif., according to an institution spokesperson. The Scripps Satellite-Oceanography Facility — consisting of a nine-meter-tall base with a five-meter dish antenna, a computer and a color-image display system — will collect global atmospheric and oceanic data from three currently orbiting U.S. satellites.

Satellite-gathered information, such as ocean temperatures, wave conditions, water vapor and winds, had previously been available to oceanographers, but only weeks or months after it had been received and processed by stations elsewhere. The Scripps facility will allow immediate data collection in order to coordinate at-sea research vessels as well as provide the ability to store data. The facility will track the National Oceanic and Atmospheric Administration's TIROS-N and NOAA-6 satellites and NASA's NIMBUS-7 satellite. Among other things, the satellites can pick up and transmit data from ocean buoys and measure sea-surface temperatures, current patterns and chlorophyll levels. □