Mammal birth signal cues tadpole to morph

The western spadefoot toad lives most of its life underground in arid parts of the western United States. Like many desert organisms, it pops up in abundance in spring, when rain creates the puddles and ponds in which it breeds before returning to its burrows.

"They're known as explosive breeders," says biologist Robert J. Denver of the University of Michigan in Ann Arbor. "You can find puddles that are just filled with masses of tadpoles."

The tadpoles don't linger very long, however. As soon as the ponds start to dry up, the amphibious creatures begin the metamorphic process that gives them the legs they need to escape the pond and go underground. The environmental change is translated into the physiological response via the same brain hormone that triggers the exit of a mammalian fetus from the womb, Denver has found. He describes his results in the recently released April issue of HORMONES AND BEHAVIOR.

Researchers have long known that hormones from the thyroid play a big role in amphibian metamorphosis. In a 1912 experiment, tadpoles began to change form when they were fed thyroid glands from horses.

Denver manipulated the tadpoles with a hormone produced by a part of the brain called the hypothalamus. When he injected a synthetic version of corticotropin-releasing hormone (CRH) into the tadpoles, their thyroid hormones increased and metamorphosis proceeded faster than normal. When he injected molecules known to block the activity of CRH, metamorphosis was slowed.

More evidence of CRH's control came from altering water levels in the tadpoles' aquariums. As the water was gradually decreased, the tadpoles increased their CRH production and went through metamorphosis within 26 days of hatching. Tadpoles kept in high water remained immature after 36 days.

In all vertebrates, CRH "is exquisitely sensitive to stress in the environment," says Denver. When the brain registers trouble, whether in a shrinking pond or on a rush-hour freeway, it churns out the hormone. CRH exerts its influence by acting on the pituitary, which then produces hormones that fire up the thyroid and renal glands. These two glands produce additional hormones that help an organism cope with the stress—in the toad's case, by turning on the growth of limbs, including the spadelike spurs on its feet that enable it to burrow underground.

As other researchers have shown, CRH also comes into play in mammalian pregnancy (SN: 9/21/91, p. 182). The hormone rises just before the start of labor and delivery; in preterm births, it rises even more.

"Like the tadpole," says Denver, "the fetus produces CRH when things are becoming unfavorable. It's time then to make the transition into the next stage of the life history."

Peter W. Nathanielsz of Cornell University's Laboratory for Pregnancy and Newborn Research says Denver's analysis "makes very good sense. . . . Here is a very old system of metamorphosis in tadpoles which utilizes CRH, and that same system has been put to use in labor and delivery."

Salmon also seem to use the CRH signal to move into the adult stage, Denver adds. Other vertebrates must be studied to find out whether CRH has always been evolution's way of saying "move on." — *C. Mlot*

D. Bay

Denver

Ready for landing: The tadpole (right) of the western spadefoot toad loses its tail and grows limbs when water starts to disappear. The 5-day-old juvenile (above right) will grow to be about 2.5 inches long, like its adult companion.

Language disorder tied to sound perception

The conversational stream of daily life may flow by so quickly that it drowns out the ability of some children to distinguish discrete sounds and words and, as a result, to make sense of speech, a new study suggests.

An impairment of this type may set the stage for specific language impairment (SLI), a marked inability to use and understand speech that occurs in as many as 1 in 20 children, reports a research team led by neuroscientist Beverly A. Wright of Northwestern University in Evanston, Ill.

"This study provides a basis for early identification of [specific language impairment] and helps us to define the condition more precisely," says coauthor Michael M. Merzenich of the University of California, San Francisco.

The finding also coincides with evidence that SLI involves a broad range of problems, such as difficulties in pronouncing sounds of all kinds (SN: 2/4/95, p. 70). Other investigators, however, theorize that SLI stems from disturbances in brain circuits devoted specifically to grammar.

Wright's group studied eight children diagnosed with SLI and eight youngsters who displayed good language skills. The participants averaged 8 years of age. Each listened to a brief tone that was presented just before, during, or just after either of two "masking" sounds, one of a frequency similar to the tone and the other of a contrasting frequency.

In similar-frequency masking trials, language-proficient kids found it easiest to detect a tone that preceded the masking sound and hardest to detect a tone that occurred simultaneously with it.

In contrast, the researchers found, children with SLI could not hear any of the test tones unless the tones were substantially louder than those played for the control children.

Moreover, SLI-diagnosed participants had as much or more difficulty detecting a loud tone when it was presented before the noise as when it occurred during or after the noise.

Compared to controls, children with SLI were also less able to exploit a frequency contrast between the tone and a masking noise to enhance their detection of the tone, regardless of the order in which it was presented.

In children with SLI, such hearing deficits can obstruct perception of the individual speech sounds made by someone talking at a typical pace, Wright's group contends in the May 8 NATURE.

The group's data elaborate on research by neuroscientist Paula A. Tallal of Rutgers University in Newark, N.J., which indicates that SLI involves a deficiency in perceiving the rapidly changing acoustic frequencies of certain consonant sounds, such as "ba" and "da."

"Wright's study suggests that in SLI, the stream of speech interferes with the perception of separate sounds and words," Tallal says.

Other studies of people with SLI find deficits in grammar understanding that are unlikely to spring from hearing impairments, argues linguist Myrna L. Gopnik of McGill University in Montreal. Subgroups of SLI arising from different causes may exist, she suggests. — *B. Bower*