Sea lion makes waves with logical leaps

If psychologists soon credit many animals with markedly greater mental dexterity, you can blame it on Rio — not the city, the sea lion. Although not trained to do so, Rio makes logical judgments of a type formerly thought possible only by humans.

Rio's feat seems fairly simple. She learned that pairs of objects go together — say, a ring and a baseball bat, and the same baseball bat and a clothes hanger — and then realized on her own that the ring, bat, and hanger form a group of interchangeable objects. Thus, if she saw the hanger, she knew it belonged with the ring because both of those items belonged with the bat.

Scientists refer to this as the ability to form an equivalence class. Categorization of this type depends on making the logical assumption that if A equals B and B equals C, then A equals C.

Over the past 20 years, numerous investigations have failed to uncover evidence of equivalence thinking among chimpanzees, monkeys, pigeons, and other nonhuman animals. Psychologists often assume that language allows humans to devise equivalence classes.

Rio's performance challenges that theory, asserts psychologist Ronald Schusterman of the University of California, Santa Cruz. However, equivalence concepts may represent a prerequisite for learning language, he argues.

Schusterman presented his findings at the First International Congress on Behaviorism and the Sciences of Behavior, convened in Guadalajara, Mexico, earlier this month. Researchers familiar with the study endorse his conclusion, with varying degrees of confidence.

Unlike other scientists investigating equivalence thinking in animals, Schusterman exposed Rio to training and testing that gradually increased in complexity. He devised 30 equivalence classes, each consisting of three different objects presented on large signs. For each class, Rio first learned that when shown object A (for instance, a ring), she should press a paddle if shown the same object again. She then learned to choose object B (the baseball bat) upon seeing object A. At that point, Schusterman presented object B first and gave Rio several choices for a match; she correctly chose object A in eight of 12 trials.

He then repeated the same training process with object B and object C (in this case, a hanger) for each equivalence class. When shown object C first, Rio correctly chose object B on 11 of 12 trials.

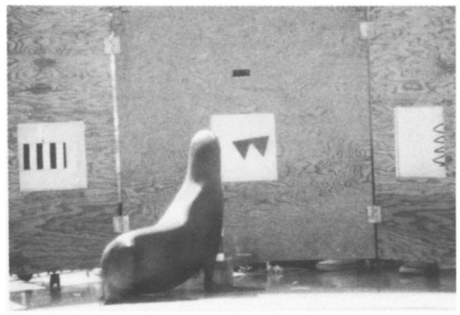
Finally, Rio demonstrated equivalence thinking. She matched the appropriate object C with object A on all 12 trials presented by Schusterman, although she had not been trained to do so. She also reversed this skill, matching the appropriate object A with object C on 17 of 18 trials.

"I'm quite excited about Schusterman's findings," says psychologist Murray Sidman of the New England Center for Autism in Southborough, Mass. Training in the relations between pairs of objects prior to equivalence testing appears critical to Rio's success, Sidman notes. In studies of monkeys and baboons that did not include such training, Sidman has found no evidence of equivalence thinking.

Schusterman's study "is really quite impressive," remarks psychologist William K. Estes of Harvard University. Rio displays a surprisingly agile mind, "but that doesn't mean sea lions think just like humans do," he cautions.

Schusterman's results coincide with increasing evidence that children begin to develop equivalence classes within the first few years of life, before extensive experience with language, Estes notes.

"Schusterman may have shown that equivalence concepts are not mediated by language," asserts psychologist Steven C. Hayes of the University of Nevada-Reno. "But I want to see this study in writing after it's gone through peer review."



Schusterman

Rio ponders the cues that form an equivalence class.

At that point, researchers may begin using Schusterman's technique to test for equivalence classes in a variety of animals, according to Hayes.

Sea lions and other animals that live in social groups probably identify family members and neighbors by using a variety of sensory cues that make up equivalence classes, Schusterman theorizes.

— B. Bower

Breast cancer risk traced back to the womb

Prenatal exposure to high concentrations of the sex hormone estrogen may foretell a woman's future breast cancer risk, according to research by a team of U.S. and Swedish investigators.

Epidemiologist Dimitrios Trichopoulos of the Harvard School of Public Health in Boston first proposed the link in 1990. Now, he and his Swedish colleagues have collected the first empirical evidence to support that theory.

"The most dramatic finding is that events so early in life may program the female breast with regard to a future cancer risk," says co-worker Hans-Olov Adami of the Uppsala University Hospital in Uppsala, Sweden.

The team began by studying the birth records of 458 women who had developed breast cancer and a control group of 1,197 women who had not. All the women had been delivered at Uppsala University Hospital, where midwives have routinely recorded extensive maternity and delivery information since 1874.

To estimate fetal exposure to estrogen, the researchers looked for babies with a birth weight of eight pounds or more. Scientists believe that heftier infants are more likely to have been exposed to high concentrations of growth-promoting maternal estrogen. Analysis revealed that study participants who weighed eight pounds or more at birth were 30 percent more likely to develop breast cancer than participants who weighed less at birth.

That finding, reported in the Oct. 24 LANCET, hints at estrogen's role in promoting breast cancer but is not sufficient to establish a clear link between birth weight and a future cancer risk. Researchers must conduct a much larger study to rule out the possibility that birth weight and the risk of breast cancer are associated by chance, Adami cautions.

Next, the team homed in on cases of maternal toxemia, a pregnancy-induced hypertension associated with low concentrations of estrogen. They discovered that daughters of women who had experienced toxemia during pregnancy were 75 percent less likely to develop breast cancer than daughters of women who did not have toxemia. That statistically significant finding raises the possibility that the lower estrogen concentrations associated with toxemia conferred a cancer protection on the breast cells of the fetus, Adami says.

Some scientists believe that chronic exposure to estrogen may cause breast cells to proliferate, thus increasing the risk that cancer will develop (see p.298). However, the new study provides the first hint that estrogen may influence the breast cells of the fetus, perhaps priming those cells to develop cancer years later, Trichopoulos notes.

Still, the new study doesn't prove the link between prenatal exposure to estrogen and future breast cancer risk, Adami cautions. For example, toxemia remains a complex and poorly understood condition. Some other factor associated with toxemia — but not with low estrogen concentrations — may give the female fetus an edge against breast cancer, Adami says. Both Adami and Trichopoulos say additional research is needed to confirm their findings.

— K.A. Fackelmann