be predicted by the theory. Zajonc believes a possible explanation may be that only children have few opportunities to act as teachers.

The confluence model also addresses the question of differences in intellectual test performance among different national, regional and ethnic groups. In 1960 white families in the United States had an average of 2.27 children. Black families averaged 3.05. The interval between children is longer in white families, and the average age of white mothers at the birth of their first child is three years older than for black mothers. The rate of father absenteeism among black families is about three times that of white families. "It would be surprising," says Zajonc, "if these differences in family configuration between whites and blacks were not seriously implicated in the differences sometimes found between these groups in intellectual test performance."

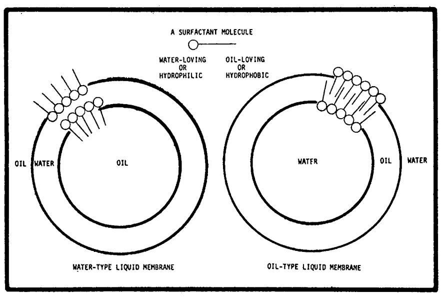
With all of the data conforming to the theory, Zajonc turned to SAT scores. After World War II, the dramatic increase in the birthrate changed the configuration of the average family. When children from these more crowded families began taking the SAT, scores began to go down. But the birthrate has since decreased and the number of children per family has gone down. If the theory holds, the SAT scores should begin to go back up within the next four to six years, according to Zajonc's projections. An increase in scholastic performance is already evident beginning with children born in 1962.

This theory, of course, is good for more than predicting general intelligence test performance. It has implications for family planning, education, population growth and the composition of day-care centers. But, Zajonc cautions, "IQ isn't everything. Large families may contribute to growth in attributes other than intelligence: social competence, moral responsibility or ego strength, for example.'" □

Liquid membranes trap assorted poisons

One man's chance discovery made 10 years ago may soon aid poisoning victims and drug addicts, help persons with kidney diseases and clean up polluted waste waters in Japan—among other things.

Chemist Norman N. Li of Exxon Research and Engineering Co., of Linden N.J., described his discovery of liquid membranes to the American Chemical Society meeting in New York last week. Several other researchers, developing promising new applications for liquid membranes, reported their latest progress.



Norman Li/Exxon

Poison eaters: Liquid membrane systems

Li was studying the nonmixing characteristics of oil and water in 1966, and investigating the way surfactants such as detergents affect the normal interface formation of the two components. He was doing a routine measurement when he noticed liquid membranes forming in his flask. Detailed study revealed that these membranes are composed either of oil or water and are "nailed in place," Li says, by the surfactants.

Surfactants are molecules with a hydrophilic or water-loving end and a hydrophobic or oil-loving end. Surfactants line up at the oil-water interface (oil-loving end toward the oil and water-loving end toward the water). This forms thin membranes, either water membranes that surround droplets of oil suspended in an oil medium or thin oil membranes that surround droplets of water in a water medium.

Li found that he could make spherical liquid membranes of either oil or water and surfactants by emulsifying the ingredients at high speed—the higher the mixing speed, the smaller the spherical membranes and contained droplets. He and co-workers also found that various solutions such as acids and bases can be contained in the droplets and will trap and remove unwanted molecules from the surrounding medium. He discovered, too, that additives can control the physical properties of the membranes: Certain additives make the membranes very sturdy. Others control the passage of molecules, allowing some to diffuse through the membranes but not others. And still other additives can control the rate of this diffusion.

"It is gratifying," says Li, who now owns 16 patents for liquid membrane systems, "to see the growth in basic research on liquid membranes and the many potential applications being studied all over the world."

Treatment of poisoning victims is one of the most promising of these applications. There are more than one million poisonings per year in the United States, and 10,000 poisoning victims die. One of four suicides involves a drug overdose (usually a barbiturate) and 70 percent of accidental poisonings occur among children, usually taking aspirin. Existing treatments, says Exxon chemist J.W. Frankenfeld, are unpleasant, antiquated and sometimes ineffective. He and University of Rhode Island pharmacists Christopher Rhodes and George C. Fuller are therefore developing alternative antidotes based on liquid membrane systems. A variety of solutions can be contained in oil membranes and will remove drugs, petroleum products and other poisons from surrounding media. The team tested both aspirin and phenobarbital and found that liquid membrane solutions will remove 95 percent of each drug within five minutes from acidic solutions (such as those found in the stomach). He envisions a series of dry ingredients that could be stored on home or hospital shelves and mixed in a blender to treat emergency poisonings. Animal tests will begin soon and clinical trials are expected within two years, he says.

Drug addicts might be on the receiving end of another liquid membrane application. Multiple emulsions (oil in water in oil) containing the narcotic antagonist Naltrexone are being developed as "timed-release" drug systems for addicts. Naltrexone blocks the opiate "high," but must be injected too frequently for successful use in outpatient treatment centers. Research pharmacist Sylvan G. Frank from Ohio State University told the ACS division of Industrial and Engineering Chemistry that Naltrexone, when encapsulated in tiny liquid membranes and injected into muscle tissue, escapes slowly into the blood stream. Trials show that an intramuscular injection can sustain the antagonistic effect for two weeks, Frank says.

Another potential biomedical application is the treatment of chronic uremia (kidney insufficiency). W.J. Asher, also of Exxon's Linden, N.J., laboratories, is working on a liquid membrane system that could be ingested to cleanse the blood of toxic urea. This could reduce the number of times per week kidney patients must undergo painful, time-consuming dialysis, Asher says. In his experimental system, urea that has accumulated in the blood will pass through the mucosa of the small intestine to the lumen, where it can be trapped by liquid membranes moving through the gastrointestinal tract. The membrane system functions well in dog intestines, he says, but improvement of urea-trapping rates must be achieved before clinical trials can begin.

A very different application—removing heavy metal pollution from industrial waste water—is being explored in Japan. Toshio Kitagawa of Takuma Co., Ltd., Osaka, reported the intial success of a liquid membrane pilot plant in that city. Chromium, cadmium, ammonium, mercury and copper can be removed effectively, Kitagawa finds, and he expects to use the process in a full-sized plant soon.

Other applications, Norman Li says, include separation of organic compounds (such as the upgrading of petroleum products), extraction of metals from ore and oxygen-carbon dioxide exchange in an artificial lung. □