

Prenatal Memory and Learning

By David B. Chamberlain, Editor

Memory is the quintessence of human experience without which we cannot make progress, cannot learn from experience, and cannot develop a personal identity. Learning and memory are interlocked: learning depends on memory, and learning is evidence of memory.

Psychology traditionally placed the beginnings of memory at about age three because few people have conscious recall of events before that time. However, an accumulating volume of research demonstrates memory in the first years of life and in the prenatal period as well. Some children spontaneously recall birth events (even secrets) but expression of these memories is delayed until they can speak. Before they use words they can express their memories non-verbally by drawing pictures, acting out scenes using pantomime, pointing to body locations, and by providing authentic sound effects for equipment (like suction devices) used at the birth. These children warn us that early memory and learning are real.

The documentation of learning and memory months before birth is surprising. Some of this has been made possible by direct ultrasound observations of fetal behavior. Twins can be seen developing certain gestures and habits at twenty weeks gestational age which persist into their postnatal years. In one case, a brother and sister were seen playing cheek-to-cheek on either side of the dividing membrane. At one year of age, their favorite game was to take positions on opposite sides of a curtain, and begin to laugh and giggle as they touched each other and played through the curtain. Parents interested in prenatal communication have taught their prenatals the "Kick Game." When babies kick, the parents touch the abdomen and say, "Kick, baby, kick!" When the baby kicks, they move to a different location and repeat the invitation. Babies soon oblige by kicking anywhere on cue.

In a famous experiment by Anthony DeCasper and colleagues at the University of North Carolina, Greensboro, mothers read the Dr. Seuss story, *The Cat In the Hat*, at regular intervals before birth. At birth, babies were hooked up to recordings which they could select by sucking on a non-nutritive nipple. After a few trials, babies cleverly sucked at whatever speed was necessary to obtain their mother's voice reading "The Cat in the Hat. Similarly, in utero, musical passages repeated regularly--such as theme music for the British soap opera *Neighbors* or the bassoon passage from *Peter and the Wolf*--are identified and preferred immediately after birth. In a recent experiment, French mothers repeated a children's rhyme each day from week 33 to week 37 of gestation. At the end of this time (still inside the womb) the babies showed memory and learning for this particular rhyme as opposed to similar rhymes they had not heard.

Babies are learning their native language before birth. This is made possible by the development of hearing as early as 16 weeks gestational age. A mother's voice reaches the uterus with very little distortion as the sound waves pass directly through her body. Acoustic spectroscopy, which makes possible elaborately detailed portraits of sound similar to fingerprints, has documented prenatal learning of the mother tongue. By 27 weeks of gestation, the cry of a baby already contains some of the speech features, rhythms, and voice characteristics of its mother. Newborn

reactions to language are based on the sounds heard in utero: French babies prefer to look at persons speaking French while Russian babies prefer to watch people speaking Russian.

Unexpected evidence for prenatal learning and memory comes from studies of taste and olfaction (See The Fetal Senses). Until recently, olfaction was thought to require air, hence, learning of odors was not considered possible before birth. Current understanding, however, recognizes the complex interaction of chemosensory receptors in utero. Many chemical compounds, including those from the mother's diet, pass through the placenta and reach the baby in utero while others flow in the capillaries of the nasal mucosa. By breathing and swallowing amniotic fluid, a baby becomes familiar with the mother's diet, including things like garlic. Even before post-nasal exposure to breastmilk, babies already know and prefer their own mother's milk. Abrupt changes in her diet during the perinatal period can confuse babies and upset breastfeeding.

Traumatic events in neonatal intensive care are indelibly imprinted in memory and intrude on adult life, often in the form of fear. Edward, who was born prematurely and entered the NICU at 29 weeks, learned to fear the sound and sight of adhesive tape. He learned this from the experience of having sections of his skin accidentally pulled off during removal of monitor pads. When he was a young man, he still feared adhesive tape.

Babies can learn their mother's emotional state. Experiments in Australia revealed that unborn babies were participating in the emotional upset of their mothers watching a disturbing 20-minute segment of a Hollywood movie. When briefly re-exposed to this film up to three months after birth, they still showed recognition of the earlier experience. Studies of a thousand babies whose mothers had experienced various degrees of depression during pregnancy themselves displayed depression at birth and in proportion to the depression scores of their mothers.

An important message of these diverse findings is that memory and learning seem to be a natural part of being human, including the first nine months in the womb and the years of infancy, defined as the time before speech. Perhaps the biggest surprise is that life in the womb is extremely active and interactive and the womb is, in fact, a classroom.