and play with clay. Between the ages of 15 and 23 months there is significant improvement in feeding skills, such as using a spoon and a cup.

**Preschool years**

During the preschool period, hand-eye coordination progresses to the point of near independence at self-care activities. A four-year-old is learning to handle eating utensils well and button even small buttons. Four-year-olds can also handle a pencil competently, copy geometric shapes and letters, and use scissors. By the age of five, a child’s hand-eye coordination appears quite advanced, although it will still continue to be fine-tuned for several more years. He approaches, grasps, and releases objects with precision and accuracy. He may use the same toys as preschoolers, but he manipulates them with greater skill and purpose and can complete a familiar jigsaw puzzles with lightning speed. An important milestone in hand-eye progress at this stage is the child’s ability to tie his own shoelaces. At the age of six, a child’s visual orientation changes somewhat. Children of this age and older shift their gaze more frequently than younger children. They also have a tendency to follow the progress of an object rather than looking directly at it, a fact that has been linked to the practice of some six-year-olds using their fingers to mark their places when they are reading. Even when absorbed in tasks, they look away frequently, although their hands remain active.

**School-aged children**

Hand-eye coordination improves through middle childhood, with advances in speed, timing, and coordination. By the age of nine, the eyes and hands are well differentiated, that is, each can be used independently of the other, and improved finger differentiation is evident as well. Nine-year-olds can use carpentry and garden tools with reasonable skill and complete simple sewing projects.

*See also* Fine motor skills

**Further Reading**


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**Harry F. Harlow**

1905-1981

American psychologist whose major contributions to psychology arose from his work with rhesus monkeys.

Experimental and comparative psychologist Harry Harlow is best known for his work on the importance of maternal contact in the growth and social development of infants. Working with infant monkeys and surrogate mothers made of terrycloth or wire, Harlow concluded that extended social deprivation in the early years of life can severely disrupt later social and sexual behavior. Harlow also conducted important studies involving the behavior of prisoners of war during the Korean War, as well as work concerning problem-solving and learning among primates.

Harlow was born in 1905 in Fairfield, Iowa. Following his education at Stanford, where he earned his bachelor’s degree and a Ph.D. in 1930, he began a long academic career at the University of Wisconsin. His teaching career spanned 44 years, beginning in 1930. He also served as director of the university’s Regional Primate Center from 1961-71. In his work with primates, Harlow developed what he called a “uniprocess learning theory,” which describes how primates learn through a succession of incorrect responses to stimuli.

When Harry Harlow began his famous studies of attachment behaviors in rhesus monkeys, he was able to pit two competing theories of the development of affiliative behaviors against each other. Drive-reduction approaches were based on the premise that bonds between mothers and children were nurtured by the fact that mothers provided food and warmth to meet the infant’s biological needs. Attachment theorists, on the other hand, felt that the provision of security through contact and proximity were the driving factors in the development of attachment.

Harlow devised a series of ingenious studies in which infant rhesus monkeys were raised in cages without their natural mothers, but with two surrogate objects instead. One surrogate “mother” was a wire form that the monkey could approach to receive food. Another form offered no food, but was wrapped in terry cloth so the infant could cling to a softer and more cuddly surface. What happened when a large, threatening mechanical spider was introduced into the cage? The infant monkeys ran to the terry cloth surrogates, demonstrating that contact comfort was more important than just meeting basic hunger needs for the establishment of a relationship from which the infant might derive security.

In a series of related experiments, Harlow studied the effects of maternal and contact comfort deprivation across the monkey’s lifespan, uncovering unexpectedly harmful effects of such deprivation on the monkeys’ own childrearing abilities at maturity. Later, Harlow’s student, Stephen Suomi, and his colleagues demonstrated...
that these longstanding effects could be improved by introducing a nurturant “foster grandmother.”

Harlow’s conclusions about maternal bonding and deprivation, based on his work with monkeys and first presented in the early 1960s, later became controversial, but are still considered important developments in the area of child psychology.

Harlow served for many years as editor of the *Journal of Comparative and Physiological Psychology*. In 1960, he received the Distinguished Scientific Contributions Award from the *American Psychological Association*, and in 1967, he was awarded the National Medal of Science.

Doreen Arcus, Ph.D.

**Further Reading**


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**Health psychology**

A subfield of psychology devoted to health maintenance, including research on the relationship between mental and physical health, guidance in improving individual health through lifestyle changes, and analysis and improvement of the health care system.

Health psychology is a diverse area with a variety of emphases. Medical psychology focuses on the clinical treatment of patients with physical illnesses, offering practical advice people can use in order to improve their health. While there is special emphasis on psychosomatic disorders—those that have traditionally been most closely related to psychological factors—the current trend is toward a holistic perspective that considers all physical health inseparable from a patient’s emotional state. As part of this trend, psychologists and pediatricians have joined forces in the growing area of pediatric psychology, collaborating to meet the health and developmental needs of children and their families. Another focal point is rehabilitation psychology, which teams mental health professionals with health care providers who care for patients with physical disabilities and chronic conditions, often in institutional settings.

Another province of health psychology is the study of “health behavior”—how people take care of or neglect their health, either in a preventative context or when they are ill. This area includes such concerns as drug abuse, utilization of health care resources, and adjustment to chronic illness. Health psychology also addresses the health care system itself, including analysis of the outreach, diagnostic, and prescription processes, provider-patient interaction, and the training of health care personnel.

*See also* Applied psychology

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**Hearing**

The ability to perceive sound.

The ear, the receptive organ for hearing, has three major parts: the outer, middle, and inner ear. The pinna or outer ear—the part of the ear attached to the head, funnels sound waves through the outer ear. The sound waves pass down the auditory canal to the middle ear, where they strike the tympanic membrane, or eardrum, causing it to vibrate. These vibrations are picked up by three small bones (ossicles) in the middle ear named for their shapes: the malleus (hammer), incus (anvil), and stapes (stirrup). The stirrup is attached to a thin membrane called the oval window, which is much smaller than the eardrum and consequently receives more pressure.

As the oval window vibrates from the increased pressure, the fluid in the coiled, tubular cochlea (inner ear) begins to vibrate the membrane of the cochlea (basilar membrane) which, in turn, bends fine, hairlike cells on its surface. These auditory receptors generate miniature electrical forces which trigger nerve impulses that then travel via the auditory nerve, first to the thalamus and then to the primary auditory cortex in the temporal lobe of the brain. Here, transformed into auditory but meaningless sensations, the impulses are relayed to association areas of the brain which convert them into meaningful sounds by examining the activity patterns of the neurons, or nerve cells, to determine sound frequencies. Although the ear changes sound waves into neural impulses, it is the brain that actually “hears,” or perceives the sound as meaningful.

The auditory system contains about 25,000 cochlear neurons that can process a wide range of sounds. The sounds we hear are determined by two characteristics of sound waves: their amplitude (the difference in air pressure between the peak and baseline of a wave) and their frequency (the number of waves that pass by a given point every second). Loudness of sound is influenced by a complex relationship between the wavelength and amplitude of the wave; the greater the amplitude, the faster the neurons fire impulses to the brain, and the louder the sound that is heard. Loudness of sound is usually expressed in decibels (dB). A whisper is about 30 dB, normal conversation is about 60 dB, and a subway train is about 90 dB. Sounds above 120 dB are generally painful...