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Information Processing Theory

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Information processing theories explain how people work with or perform mental operations on information they have received. These operations include all mental activities that involve noticing, taking in, manipulating, storing, combining, or retrieving information. This approach to human development emphasizes the fundamental mental processes involved in attention, perception, memory, decision making, and reasoning. Basically, information processing theory attempts to explain how humans think. Prior to the evolution of information processing theory, the field of psychology was dominated by behaviorism, a school of thought in which emphasis was placed solely on externally observable behaviors. Because mental processes were not directly observable, they were not a concern among behaviorists. Cognitivists representing a contrasting theoretical school based on cognition, on the other hand, postulated that internal cognitive processes serve as the basis for understanding many human behaviors and that these cognitive processes could be understood by analyzing the ways in which people think. Consequently, in the late 1950s, cognitivists suggested that behaviorists' explanations of behavior were inadequate because they did not account for human thought processes. As a result, an upsurge in theories resulted that detailed models of human thinking and problem solving. Cognitivist models typically placed an emphasis on serial, or step-by-step, processing of information and adopted the computer as a model of human cognitive activity.

Theories of Information Processing

In 1956 George A. Miller was among the first to apply a step-by-step theory to information processing by relating it to the way that high-speed computers processed information. He proposed that, similar to a computer, the human mind takes in information, performs operations on it to change its form and content, stores and locates the information, and then generates output of some type. According to Miller's theory, information processing in humans involves gathering and representing information (encoding), holding information (retention), and getting at the information when necessary (retrieval). In addition to comparing information processing of humans to that of computers, Miller made a significant contribution to the understanding of information processing with his concept of chunking as related to short-term memory. He proposed that individuals could only store five to nine chunks, or meaningful units, of information in their short-term memory. Anything from digits to words to people's faces were considered to be chunks of information. The concept of chunking was one of Miller's major contributions, because it became a basic element of later theories of memory.

A later development, the *three-stage information processing model*, is now perhaps the most accepted model among information processing theorists. This model was first developed by Atkinson and Shiffrin in 1968 (referred to as the Atkinson-Shiffrin model). This model was then modified by others, including Loftus and Loftus, producing various versions. Generally, this model proposes that there are three stages involved in memory: input or sensory registry, short-term memory, and long-term memory. Sensory registry involves input from sight and sound and processing at this level occurs in 3 to 5 seconds. During the short-term memory stage, information is transferred to short-term memory, where it can remain for 15 to 20 seconds. Typically, five to nine chunks of information can be recalled from short-term memory. Short-term memory capacity can be increased by chunking information into manageable units or by rehearsing information until it is committed to memory. During the third and final stage, information

for future reference is stored in long-term memory, which is thought to have an unlimited capacity.

In addition to the three stage information processing model, there are three more models that have been widely adopted. The first, *levels of processing theory*, is based on the work of Craik and Lockhart in 1972. The major premise behind this theory is that people use different levels of elaboration as they process information during the learning process. Elaboration involves taking simple information and applying meaning to it in a way that increases the chance of remembering that information. Different levels of processing or elaboration can make it easier for an individual to retrieve a piece of information that is stored in memory.

The two remaining models have been labeled the *parallel-distributed processing model* and the *connectionistic model*. These models were proposed as alternatives to the three stage model. According to the parallel-distributed processing model, information is processed by several distinct parts of the memory system in a simultaneous fashion. This is different from the three stage model because it proposes a simultaneous process, as opposed to the step-by-step process proposed by Atkinson and Shiffrin.

The connectionistic model was proposed in 1986 by Rumelhart and McClelland. This model assumes that bits of information are stored in numerous locations throughout the brain in the form of networks or connections. According to this model, the more connections there are to a single concept or bit of information, the more likely that concept is to be remembered. For example, according to this theory and its supporting research, trying to find your keys after misplacing them can be difficult if you cannot remember where you were the last time you saw them. If you *can* remember where you were the last time you saw them *and* you can also remember at least three places you went after you last saw them, you may be more likely to find your keys.

Developmental Issues

Some information processing theorists suggest that children differ from adults primarily because they have had less experience. These theorists believe that, with proper training or education, children can learn to succeed at various cognitive tasks. Thus, exposure to the environment affects cognitive development. Other theorists believe that children's natural maturation processes influence the complexity of their thinking. Therefore, as children grow older and naturally mature, they are able to perform cognitive tasks of increasing difficulty and complexity. Information processing theorists assume that development involves qualitative and quantitative changes. Examples of these changes have been seen in children's performance in several domains. These include perception, memory, verbal comprehension, mathematical skills, problem solving, and reasoning.

With regard to perception, studies have shown that young children have trouble distinguishing between appearance and reality. That is, when asked to describe something, young children will describe the way it appears to them, rather than what is really in front of them. Memory has been found to be better in older children than in younger children. When learning new material, young children are likely to use very simple strategies, while older children employ more elaborative strategies to aid in memorizing information.

Verbal comprehension is the ability to comprehend words, sentences, paragraphs, and other forms of spoken information. Children's verbal comprehension appears to increase with age. The ability of children to generate useful strategies that improve verbal comprehension also increases with age.

These findings indicate that, as humans get older, there is a trend for us to develop more sophisticated ways of acquiring, processing, and retaining information. Thus, information processing skills become more developed with age. This aspect of change implies that, when teaching children new things, it is important to consider where they are in the developmental process and to adjust teaching techniques so that they are compatible with children's information processing capabilities.

Information Processing Research Methods

In the late 1980s, David Klahr characterized information processing research as falling along a continuum ranging from “soft-core” to “hard-core” approaches. Soft-core research involves describing a child's processing of information as a flow diagram or in some way that is not as complex or formal as a computer program. Hard-core approaches, on the other end of the spectrum, involve writing computer programs that imitate a child's output as that child processes information. A program that successfully matches the child's output is considered to be a theory of how the child's mind operates.

The first computer simulation program used to understand information processing was developed by Allen Newell and Herbert Simon in the late 1960s and early 1970s. This program, originally called the *Logic Theorist* and later termed the *General Problem Solver*, was essentially a theory of human problem solving stated in the form of a simulation program. This theory was tested by comparing the results of the computer simulation with human behavior in a given task.

The information processing approach has gained considerable popularity in recent years. Nevertheless, weaknesses in this approach have been noted. A primary weakness is that there is no guarantee that flow diagrams or computer programs that predict behavior actually represent the way human cognitive processes really work. There may be reason to believe that the differences between computers and the human mind far outweigh the similarities. Furthermore, because information processing studies are conducted in highly controlled laboratory settings, such findings may be unequal to results that would result from studying children in their natural environments.

- short term memory
- information processing
- information processing theory
- information theory
- process theory
- long term memory
- memory

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Further Readings and References

Bransford, J. (1979). Human cognition: Learning, understanding and remembering. Belmont, CA: Wadsworth.
Gagne, E., Yekovich, C. and Yekovich, F. (1993). The cognitive psychology of school learning. New York: HarperCollins.
Huitt, W. (2003). The information processing approach. Retrieved from http://chiron.valdosta.edu/whuitt/col/cogsys/infoproc.html
Kearsley, G. (1994). Information processing theory: G. Miller. Retrieved from http://www.gwu.edu/~tip/miller.html
McShane, J. (1991). Cognitive development: An information-processing approach. Cambridge, MA: Blackwell.
Open Learning Technology Corporation Limited. (1996). Information-processing theory. Retrieved from http://www.educationau.edu.au/archives/cp/04h.htm
Sternberg, R. J. (1998). In search of the human mind. Orlando, FL: Harcourt Brace.
Stever, F. B. (1994). The psychological development of children. Pacific Grove, CA: Brooks/Cole.
Wade, C. and Tavris, C. (1990). Psychology. New York: HarperCollins.