

# A HANDBOOK OF COGNITIVE PSYCHOLOGY

Michael W. Eysenck



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*To Chris, Fleur,  
and Willie With Love*

*Though syllogisms hang not on my tongue,  
I am not surely always in the wrong!  
'Tis hard if all is false that I advance—  
A fool must now and then be right, by chance.*

*William Cowper*

## Preface

Over the past 20 years or so, experimental psychology has increasingly become synonymous with cognitive psychology. That is to say, most laboratory research attempts to identify the processes and mechanisms that underlie human cognition. How did cognitive psychology achieve its current pre-eminent position? Some people are inclined to regard the publication in 1967 of Neisser's book, entitled *Cognitive Psychology*, as the crucial event that provided the greatest impetus to the field of cognitive psychology. However, it seems to me that Broadbent's book *Perception and Communication*, published in 1958, has had greater seminal influence. Whatever its precise origins, there are good grounds for supposing that the intellectual dynamism of cognitive psychology has proved extremely fruitful. I hope that the reader will agree with this supposition when he or she has read this book.

One of the more intractable problems that any author has to face up to when attempting to chart the progress of cognitive psychology is the extremely diverse and sprawling nature of the current scene. What we may loosely term the 'cognitive approach' is to be found increasingly in such disparate areas as neuropsychology, artificial intelligence, applied and 'real-life' research, developmental psychology, and social psychology. Of course, only a knave or a villain would claim to possess expertise in all of these areas, and I would not be so presumptuous as to make that claim. What I have endeavoured to do between these covers is to provide as extensive a coverage of the expanding field of the psychology of human cognition as my knowledge permits me to do.

I am very grateful to various people who contributed useful ideas while I was engaged in the lengthy business of writing this book. They include Bob Hockey, Margaret Harris, David Jones, Paul Barber, and Gill Cohen. Needless to say, any deficiencies that are present in the text are entirely the responsibility of the author.

Finally, I would like to express profound gratitude to my family. I have been far more blessed than I deserve to have such a wonderful and beautiful wife, who put up with the long hours that I spent away from my family,

during the writing of this book, with great tolerance and good humour. My children Fleur and Willie did their best to prevent Daddy writing at all, but in spite of that they are both sources of immense pride and pleasure to me, and it will be delightful to have more time to be with all of my family. For these (and many other) reasons, this book is dedicated to them with my love.

Michael W. Eysenck  
London, 8th December 1983

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# 1 Introduction

Anyone attempting to come to grips with the booming, buzzing confusion that is contemporary cognitive psychology is likely to be left with an actual or metaphorical headache. Among the headache-inducing qualities of cognitive psychology are its tremendous range, covering most of human experimental psychology; the huge volume of published research into human cognition; and the fragmentary and disorganised nature of much of this research. Cognitive psychology often seems to resemble the messenger in *Alice in Wonderland* who went in all directions at once. The author would like to be able to transform all of this confusion and uncertainty into systematic coherence, but has instead opted for the more modest (and more achievable!) goal of describing contemporary cognitive psychology as clearly as possible.

This chapter fulfils a scene-setting function for what follows. It begins with a discussion of the nature of cognitive psychology, including some key theoretical issues. After these rather abstract matters, there is a fairly detailed consideration of some of the main methods and techniques used by cognitive psychologists as they attempt to understand how people perform cognitive tasks.

## WHAT IS COGNITIVE PSYCHOLOGY?

If the health of an academic discipline can be judged by the number of its adherents, then cognitive psychology is certainly thriving. Indeed, in a recent survey of academic psychologists in America, over three-quarters of them claimed to be cognitive psychologists! However, at least part of the reason for the growing army marching behind the banner of cognitive psychology is the increased vagueness with which the term is used. Virtually all those interested in perception, learning, memory, language, concept formation, problem solving, or thinking call themselves cognitive psychologists, despite the great diversity of experimental and theoretical approaches to be found in these various areas.

Paradoxically, it may help to decide what cognitive psychology is by considering what it is not. There is no doubt that contemporary research in the field of cognition represents a strong reaction against the facile approach of Behaviourism. In its pristine form, Behaviourism was a school of psychology based on the notion that psychology can only be scientific if it focuses on what is observable (i.e., environmental stimuli and behavioural responses). As a consequence, early Behaviourists made considerable theoretical use of stimulus-response connections. Later Behaviourists, such as Hull and Tolman, were prepared to include organismic or intervening variables in their theoretical formulations. However, the kinds of variables which were proposed (e.g., drive, habit) typically had marginal relevance to cognitive processes. One of the few points of agreement among cognitive psychologists is the need to provide as detailed and explicit an account of these internal cognitive processes as possible.

There are various ways in which cognitive psychologists have attempted to conceptualise the workings of these cognitive processes. Much of the early impetus was provided by the computer analogy. The computer is an example of a complex machine that processes information efficiently by means of a variety of internal mechanisms. The way in which a computer functions can be represented in a flow chart showing the sequence of processing stages and indicating the interrelationships between the various internal component functions. As a direct result, psychologists began to produce similar-looking flow charts designed to reveal the internal functioning of human beings when confronted with various problems. However, the manifold differences between computers and humans have led many cognitive psychologists to abandon the computer analogy. Despite the problems there is still much interest in simulation techniques, which attempt to program a computer to perform tasks in the same ways as people do them.

Cognitive psychologists differ enormously in the extent to which they rely on the computer in their endeavours to understand human cognition. Some cognitive psychologists prefer to make extensive use of physiological findings when constructing theories, whereas others depend on data collected from studies in social psychology or from work on sub-human primates. One of the aims of this book is to compare different approaches with respect to their relative success in furthering our understanding of cognition.

These heterogeneous approaches are likely to make the task of understanding cognitive psychology appear rather daunting, particularly because of the rather fragmentary nature of much research and theory, in which apparently interdependent processes, such as perception, attention, and memory, are rarely discussed together. In view of these complexities, the reader may find a brief discussion of general theoretical views about cognition of some use.

For a period of several years, covering the 1960s and much of the 1970s, it was the fashion to regard much of cognition as consisting of a sequential series of processing stages. When a stimulus is presented (so the reasoning went), basic perceptual processes occur, followed by attentional processes that transfer some of the products of the initial perceptual processing to a short-term memory store. Thereafter, rehearsal serves to maintain information in the short-term memory, and some of that information is transferred to a long-term memory store. One of the most sophisticated theories of this type was put forward by Atkinson and Shiffrin (1968).

This kind of theoretical orientation, in which information processing involved an invariant sequence of stages, provided a simple and coherent framework for writers of textbooks. It was possible to follow the stimulus input from the sense organs to its ultimate storage in long-term memory by means of successive chapters on perception, attention, short-term memory, and long-term memory.

One slight problem with this theoretical approach is that it cannot readily accommodate quintessentially cognitive activities, such as thinking or problem solving, but many textbook writers dealt with this in a robust manner by simply omitting such topics. A far more significant difficulty is that the sequential stage model is a gross over-simplification and is demonstrably wrong in several respects. In particular, the model appears to make the erroneous assumption that stimuli impinge on an inactive and unprepared organism. In fact, while processing is substantially affected by the nature of presented stimuli, it is also affected crucially by the individual's past experience, expectations, and so on.

Matters can be clarified by reference to a distinction that is often made between bottom-up or stimulus-driven processing and top-down or conceptually-driven processing. Bottom-up processing refers to processing directly affected by stimulus input, whereas top-down processing refers to processing affected by what an individual brings to a stimulus situation (e.g., expectations determined by context and past experience). As an example of top-down processing, it is easier to perceive the word "well" when poorly written if it is presented in the context of the sentence, "I hope you are quite ----," than when it is presented on its own. The evidence discussed in this book demonstrates conclusively that most cognitive activity involves these two kinds of processing in combination. The sequential stage model deals almost exclusively with bottom-up or stimulus-driven processing, and its failure to consider top-down processing is its single greatest inadequacy.

According to contemporary thinking (e.g., Neisser, 1976), what normally happens is that cognitive activity comprises concurrent and interactive bottom-up and top-down processes. This appears to be the case for virtually all cognitive processes. On the face of it perception and remembering might seem to be exceptions, because perception obviously depends heavily on the

precise stimuli presented (and thus on bottom-up processing) and remembering depends crucially on stored information (and thus on top-down processing). In fact, perception is also much affected by the perceiver's expectations about to-be-presented stimuli, and remembering depends far more than was thought at one time on the exact nature of the environmental cues provided to facilitate recollection.

In spite of the fact that cognition typically involves an amalgam of bottom-up and top-down processing, it is still true that the relative importance of these two kinds of processing varies considerably from one cognitive activity to another, and from one task to another. The details will be fleshed out at several points during the book.

Another general issue that is relevant to most of cognitive psychology concerns the way in which the several component processes involved in the performance of a complex cognitive task relate to each other. If, for example, a task necessitates the use of five separate cognitive processes, then one possibility is that one process is completed before the second process starts, the second process is completed before the third one starts, and so on. This is what is known as serial processing, in which different stages of processing occur in a sequential manner. Alternatively, all five cognitive processes might take place during the same period of time, in which case parallel processing would be occurring. It is also possible that what is really happening is some mixture of serial and parallel processing.

Cognitive psychologists differ among themselves as to the relative importance of serial and parallel processing in cognition. While the distinction between serial and parallel processing seems clearcut, it turns out to be disappointingly difficult to decide which kind of processing is used on any particular task. Indeed, Anderson (1976) has shown convincingly that it is always possible to produce a serial processing model that will make the same predictions about behaviour as a parallel processing model, and vice versa.

The power of the brain's processing mechanisms suggests that parallel processing is the norm rather than the exception. However, some kind of central control system operating in a serial way seems essential to prevent chaos resulting from several independent parallel processing operations. In addition, it sometimes seems obvious that a problem will be solved by means of sequential processing stages, because the later stages cannot occur until the results of earlier processing stages are available. From the psychologist's point of view, serial processing models tend to be much more tractable than those allowing for the possibility of temporal overlap of processing stages. Partly for this reason, most of the techniques for identifying processing stages assume that processing stages are sequential.

A further general issue relates to the nature and organisation of the processing system. It has often been assumed that there is a hierarchical system of processes or capacities involved in information processing. The



workings of the system stem from a central processor at the top of the hierarchy. This central processor has limited capacity, and is often referred to as “attention.” This hierarchical view can be contrasted with the notion that there are many processes involved in performance, none of which can be identified uniquely with attention. What happens is that different capacities assume executive control at different times, and so the system is hetarchic rather than hierarchical. These issues remain unresolved, but the relevant evidence is considered in detail later in the book.

Psychologists attempting to increase our knowledge of human cognition have to make several decisions about the kind of research that they undertake. It is important to realise that most cognitive psychologists have made the same decisions, and this has greatly influenced cognitive psychology as it is today. Some of these decisions relate to the following issues:

1. *Basic versus applied research.* It is possible to examine human cognition either “for its own sake” (basic research) or in the context of real-life problems (e.g., academic failure, dyslexia). Advocates of basic research typically confine their activities to the laboratory, whereas applied researchers are more likely to explore cognition in “real-life” settings. Cognitive psychologists (at least until quite recently) have decided to concentrate on basic research.

2. *Specific versus general focus.* Cognitive psychologists can devote their research and theoretical efforts to relatively narrow and specific problems (e.g., analysis of a single task) or to broader and more general problems. Most cognitive psychologists have decided to deal with rather specific problems.

3. *Interest in motivation and emotion.* Philosophers of yesteryear used to distinguish between cognition, conation (or motivation), and affect (emotion). Cognitive psychologists have the choice of attempting to keep the motivational and emotional states of their subjects constant (so that these factors can be ignored), or of systematically manipulating both motivation and emotion in order to observe their effects on cognition. With very few exceptions, cognitive psychologists have made the former choice.

The reader may find it worthwhile, as he or she reads this book, to question the contemporary emphasis on basic research into specific problems that is conducted with a total disregard for emotional and motivational factors. The author’s personal opinion is that all of these decisions are ill-advised, and the treatment of cognitive psychology in this book reflects this opinion. Basic laboratory research is extremely important, but there is an obvious danger that such research may lack ecological validity (i.e., direct relevance to normal, everyday experiences and events). There is too often a failure to distinguish between statistical and practical significance. For