Critically consider the contribution that the information processing approach has made to psychological knowledge

The information processing approach is a paradigm in experimental psychology used to examine cognitive processes. The approach evolved in the 1950s and 1960s as a result of the development of the computer, and as an alternative to the prevalent behaviourist theories which had come to be seen as a "substantial oversimplification" (Eysenck, 1998). While behaviourist theories treat an "observable response as a function of observable stimuli" (Igou, 1999), the information processing approach is concerned with the mental processes occurring between the stimulus and response, and the causes of a specific response.

The increasing availability of computers in the 1960s led to the computer being seen as a metaphor for the mind. As the computer had been invented to replicate human thought, it was a fair assumption to perceive the mind as processing information in the same way a computer. From this premise, models were developed detailing cognitive processes, such as memory, and attention. Each model breaks the overall cognitive process into discrete stages: one of the earliest examples is Broadbent's (1958) model of selective attention, devised to explain Cherry's (1953) findings in a study on the cocktail party effect. As with all information processing models, each individual stage relies on the others, and the individual's experience and prior knowledge also have an input to their response. French and Coleman (1995) suggest that the information processing approach "implies a somewhat mechanistic view of the mind, which is seen as being enormously flexible and adaptive, but nevertheless as a rule-governed automaton". It is due to the mechanical nature of the approach, and the parallels drawn with computing, that models are illustrated in flow charts, detailing the movement of information between the stages, and within feedback loops. The very use of such a technical style of diagram emphasises the connection between the mind and a computer; indeed, Evans (1983) described the information processing approach "as an attempt to understand the software of a very complex computer".

The majority of models display each individual stage occurring on its own at any particular time within the process, this is referred to as serial processing. While this is very much in accordance with the computers of the 1960s, the concept of parallel processing, where more than one process is happening at any one time, cannot be ignored. Eysenck (1993) stresses the importance of “the amount of practice that an individual has had on a particular task”, as this experience means that parallel processing is more likely to occur than when someone is learning a new task. The notion of parallel processing has only been possible for computers since the 1980s, and as such, it is only more recently that the similarity between computer programs and human cognitive processes have become more widely accepted.

The information processing approach has allowed cognitive processes to be studied in more depth, indeed one of the major advantages of the approach is that each proposed stage of the process can be manipulated and experimentally observed. Hockey, MacLean, and Hamilton (1981) carried out an experiment in which subjects were presented with four letters which they then had to transform by working a predetermined number of letters through the alphabet (for example, ‘RHCL’ plus four would give ‘VLGP’ as the result). The time taken to complete the task was the same when the experiment was conducted with white noise, and without white noise. Applying a behaviourist approach, this outcome would indicate that the white noise has no effect on the task whatsoever. However, by dividing the task into its discrete operations (encoding – where the relevant letters are retrieved from long term memory, transformation – where the new letter is deduced, and storage – where the accumulating result is stored in memory), getting the subjects to perform the transformation aloud, and pressing a button to indicate the completion of each transformation, Hockey *et al.* were able to see that the white noise reduced the transformation time, but increased the storage time. Therefore, while the overall time remained the same, this more mechanistic approach revealed that the white noise did have an effect on the task.

While it can be seen that it maybe useful to address a process in such detail, there are caveats to the approach. In 1997 a computer, Deep Blue, defeated a grandmaster, Garry Kasparov, at chess: while this may appear a great achievement, it must be remembered that their methods of play were totally different.

The computer (due to phenomenal processing power) was able to assess approximately two million potential moves per second to select a move to play, however, the human approach is to study a few moves in great depth. A human is able to adopt this approach because of the way in which they assimilate information from previous experiences and are able to apply it to another relevant situation. Deep Blue can therefore be seen to be programmed in the most effective way possible with no scope for missing a successful move, however, its inability to mimic the behaviour of a human is clear.

It would be possible to program a computer to mimic a human memory, whereby previous information it has gathered has a bearing on a current problem, but a further problem arises in the difference between the way in which the memories of a computer and of a human function. Guenther (1998) describes a computer as storing information accurately and faithfully, whereas a person does not merely store the memory, they change the way in which they understand the world based on new learning and experiences. A computer maintains a detailed record and can perform hugely complex tasks because of the amount of data it can store and access immediately, but human retain the "gist" of a situation making their learning more beneficial. This is just one of the operational differences that causes a problem with computer modelling: it is impossible to examine only a small part of the process in its entirety without reference to the entire process, and to the individual.

The way in which humans and computers treat data is a further difference that would effect modelling. A computer stores all the inputted information as symbols, and a program simply manipulates the necessary symbols. A human is able to look at a symbol and discern a meaning from it that can be applied to other symbols: again the way in which prior knowledge is used is critical to human cognitive processes.

Although the computer can provide a very basic analogy for the mind, it is very limiting and considerably unrealistic. More recent work has led to the development of models of neural networks, which more accurately embody the physical activity of the brain. As with other models, computers can be used to simulate this behaviour and indeed are. Being able to utilise technology to form and study cognitive processes is proving important both in enabling psychologists to understand the biology of the brain, and to allow computer scientists to move further into the field of artificial intelligence. Boden (1998) writes "the time is long past where one could expect psychologists to be deeply impressed by just any computer model whose input-output performance mimics aspects of human behaviour".

A computer has been developed by a Tel Aviv company that is currently being trained to "understand everyday language and converse with humans" with the ultimate aim of the project being to give the computer the "linguistic skills of a five year old" (Uhlig, 2001). At present, the computer is able to respond to questions based on information it has been taught, rather than data with which it has been programmed, in much the same way as a 15 month old child can. Although this machine sounds to be a great help in understanding the learning process, Boden's psychologists are unable to learn much from it as the project's chief scientist explains that "instead of telling it how to learn language, Hal [the computer] figures this out for itself. The whole point is that we don't know how it's doing it". As such, the "input-output performance" must be seen as too advanced to be comprehended.

The information processing approach can be seen to have benefited psychology in that it enables psychologists to study the minutiae of cognitive processes. Such study leads to a greater comprehension of cognitive processes which (as has been illustrated) increases the understanding of many other psychological processes through its application. Due to the on-going technological advancements of computers, it is difficult to asses the benefits to psychology, as the information processing approach becomes increasingly pertinent as computers are more successfully able to behave like humans.

The intrinsic link with computing which may initially have been somewhat tenuous, is rapidly becoming a link that will aid the development of increasingly complex neural computers. This development of computers more able to learn from their own 'experiences' and store information as humans do, combined with the processing power available, could begin to explain the biology involved, at every level, in the way in which humans really do think – much in the way that the pioneers of the technology may originally have envisaged.

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