What are heuristics? How do they help us make decisions or solve problems? How do they hinder decision making and problem solving? What does the study of heuristics tell us about how our mind works?

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In psychology, the term "heuristics" is used to describe cognitive shortcuts that our mind takes in order to save time and effort while solving problems and making decisions. Although this rule of thumb technique does not guarantee the solution, it is highly likely to solve the problem. These congnitive shortcuts differ from algorithms as algorithms will definitely solve the problem, although they would consume more time in the process. Thus, heuristics are shortcuts that eliminate the need to consider unlikely possibilities or irrelevant states to reach the final solution.

From that perspective, heuristics are useful in making decisions or solving problems. One of the most important heuristic methods was explored by Newell & Simon. They called this method the means-ends analysis. This method implies that the problem solver will note the difference between the current state of the problem and the goal state, the solution. He would then create a subgoal to reduce the difference between the two states. A path, or an operator, would be selected to reach the subgoal. Egan & Greeno(1974) used the Tower of Hanoi problem to investigate this heuristic method. They found that subjects with prior experience with the problem who used the means-ends analysis solved more difficult versions of the problem faster than subjects who did not make appropriate subgoals. Subjects who changed their strategy to means-ends analysis produced better results than those who did not. Overall heuristics are useful in solving problems and making decisions as they reduce the complexity of different solutions that are possible. They do yield good results when they are used in the appropriate context.

However, heuristics can also hinder decision making and problem solving. For example, Anzai & Simon(1979) found that many subjects used domain dependent strategies while solving the tower of Hanoi problem. This hindered their process to the solution as they avoided certain states in the puzzle that they believed would not help them, rather than move towards a definite goal/ subgoal state. Subjects were more interested in the goal state and focused on reaching that rather than reaching the subgoal state first. As Thomas(1974) found, this could actually hinder process. Thomas used the missionaries-cannibals puzzle and adapted J.R.R. Tolkien's hobbits and orcs to replace missionaries and cannibals. To reach the solution quicker, subjects had to move away from the goal state. However, not many were willing to do that. This distraction to reach the goal state caused the subjects to take longer solving the problem. If the subjects found themselves moving away from the goal state, they typically thought they reached a back alley and backtracked. As a result, subjects took longer to solve the problem as they were using the domain dependent heuristic and avoided moving

away from the goal.

Another heuristic which could hinder correct decision making and problem solving is the availability heuristic. We use data that we can remember better or that which had a bigger impact on us rather than complete data. Thus subjects can make judgements based on what is easier remembered than an unbiased judgement. One availability heuristic that is commonly used is the media bias. The media presents such a great number of fatal accidents that most think that death is more likely to be caused by an accident rather than diabetes. This is not the case, yet because an accident is easier to remember and had a greater impact on the mind most would consider the statement above to be true.

Another problem with heuristics is that they become so deeply remembered in our minds after having dealt with a similar problem, that most subjects are not able to ignore the heuristic to solve a different problem quicker. An example of this is the monster-globe problems investigated by Simon& Hayes(1974). This is an isomorphic problem to the Tower of Hanoi problem with the same problem space. Since isomorphism ensured that both the problems had the same problem space features such as size and minimum solution path length, the experiment could focus on the difference presentations of the problem can make. Subjects had difficulty solving this problem even though they already had experience with the Tower of Hanoi problem. They were unable to solve the problem as the problem was presented to them in a different way. This hindered their decision making. The water-jug problem is similar as prior experience with a similar problem caused difficulty for subjects solving the problem. The subjects were first presented with several problems that they solved by one method. They were then presented with another problem which could be solved using a different method which would save them time and effort, yet most subjects did not follow that method as they automatically used the first method. This experiment showed that heuristics are hard to unlearn thus they make hinder problem solving as they prevent the subject from finding an easier way to reach the solution.

On the one hand, heuristics emphasise the mind's ability to make a selective judgement based on given information to solve a problem or make a decision faster. Unlike computers, the mind is constrained in its capacity to look at all possible solutions and if it did, it would take a lot longer to make a decision. Thus the mind is able to create shortcuts in order to save time. Heuristics are a prime example of this as the mind uses heuristics in order to find these shortcuts.

However, heuristics also demonstrate that there are limitations to our working memory. Atwood&Polson(1976) found that subjects only look ahead to a depth of one move through the water-jug experiments. They use the loop avoidance heuristic to avoid moves that they believe would return them to previously visited states, even though it might be easier to reach the solution by going back. Thus they are unable to look ahead more than one move. However, they also found that subjects used the means-end analysis as they compared their actual state to the goal state, which is helpful in decision making. After identifying the difference

between the two states, they would compare moves to see which would bring them closer to the goal state, yet again demonstrating the mind's inability to accept that not all moves towards a goal would be a shortcut to it but rather that the goal could be reached by moving away from it. They discovered that there were definite limitations in the mind to offer a greater number of possible alternate moves that can be stored in the working memory. This could be adjusted by transfering information into the long term memory. A demonstration of this is proffessional chess players. Because the information they need to make a move while playing chess is stored in the long term memory due to a great number of past experiences with similar problems, they are able to present a greater number of moves than an average human.

However, as Atwood, Masson&Polson found in 1980, there are greater limitations to our decision making ability than just a limited working memory. In an experiment to prove this theory, they presented the subjects with a problem and divided them in groups. They then presented all the possible moves to reach the solution in order to avoid overloading working memory. By doing this they hoped that there would be more space for more long term planning. However most subjects used the moves to avoid going back in the problem rather than find a quicker solution by more planning. There was no massive improvement in planning to find the solution. This experiment demonstrates that our mind is usually not efficient in long term planning.

Overall, although heuristics can have a positive effect on our decision making and problem solving, they can also hinder decision making as they are too based on assumptions. Heuristics show that our mind takes the most logical shortcuts to solving a problem to save time and effort, although it is limited in its capacity to always find the right solution.