# Reasoning and Judgment

The process of complex thinking involves the three processes of reasoning, judgment and decision making

*Reasoning involves evaluation of a conclusion based solely on given information*

*In Judgment reasoning is applied on the given information to arrive at a conclusion*

*Decision making evaluation of the given information is done to arrive at a judgment and based on the judgment a choice among several possible alternatives is achieved.*

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# The focus on Errors

The emphasis in research on reasoning, judgment and decision making has been on mistakes people make. Daniel Kahneman (1991) believes errors provide us with informativeness. The conditions under which our thinking fails us reveal important aspects of cognitive processing and inform us how the process of reasoning, judgment and decision making process works

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How exactly do we know that a given chain of reasoning, judgment and decision making is in error?

one approach *normative approach* describes how we ought to think in a given situation, while a second approach *descriptive approach* describes how we actually think.

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# Bounded Rationality

Adherence to or deviance from rational thoughts and behavior depends on a variety of factors (an important one is how we define rational). Baron (1999) believes rationality in not necessarily the same as accuracy and that irrationality is not the same as error. Rationality involves choosing the methods that help us attain our goals. We can reason well but still have a decision work out badly; conversely we can reason badly yet still luck into a good outcome. The simple notion that there are limits to our powers of reason is termed *bounded rationality.*

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# Dual process views

According to this view the human thinker operates in one of the two modes depending on the particular nature of the situation. In *heuristic mode (system 1)*, the process used for thinking operate quickly and without much deliberation (automatic) while in *analytical mode (system 2)* the processes are relatively slow, deliberate and controlled. The analytical mode is more cognitively demanding than the heuristic mode in that it demands more working memory

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# Reasoning

***Deductive reasoning* –** involves determining if a specific conclusion is valid based on general principle or assertions (premises). Deductive reasoning problems involve a large degree of constraint and the conclusion is easily assessed using the algorithmic approach. Two primary types from Evans (2002) are discussed

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## Syllogistic Reasoning

*All students are bright*

*All bright people complete assigned work on time*

*Therefore, all students complete assigned work on time*

1) Syllogisms consists of two premises and a conclusion.

2) The premises & conclusions may begin with a *universal quantifier (all)* or a *particular quantifier (some).*

*3)* Also the terms within a syllogism may be stated positively (“All A are B”) or negatively (“All A are not B”).

Syllogism are either valid or not valid – that is the conclusions either does or does not hold, given the premises

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Valid arguments imply that the conclusions does follow from the premises. However it says nothing about whether the premises themselves are true. The truth value of an argument depends on *both* the validity of the argument form and the truth of the premises. Consider

All professor are comedians
All comedians are funny
Therefore, all professors are funny

All A are B
All C are B
Therefore, All A are C

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No oranges are apples
No lemons are oranges
Therefore, no apples are lemons

Are these conclusions valid based on their respective premises? The reasoning errors are caused by

a) Atmosphere effects – according to this explanation the quantifiers used in the premise combine to form an "atmosphere" within which the validity of the conclusion is assessed. For instance the premises in syllogism 1 create

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a “positive universal atmosphere”. This produces an erroneous tendency to claim that the universal and positive conclusion are valid.

b) Belief bias – our beliefs about truth interfere with our ability to assess argument validity.

All intelligent beings are Simpsons fans
All dolphins are intelligent beings
Therefore, all dolphins are Simpsons fans

The tendency to allow belief to interfere with the evaluations of conclusions in syllogistic arguments has been termed *belief bias*

All smart people are reasonable
All Democrats are smart people
Therefore, all Democrats are reasonable

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## Conditional Reasoning

the second form of deductive reasoning is called *conditional reasoning (or if –then reasoning*) and involves evaluating whether a particular conclusion is valid given that certain conditions (premises) hold. Consider

1. if someone likes Winnie-the-Pooh, they are a sensitive person.
2. Mary likes Winnie-the-Pooh.
3. Therefore, Mary is a sensitive person

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Another version of the reasoning problem is

1. if someone likes Winnie-the-Pooh, they're a sensitive person
2. Mary is a sensitive person
3. Therefore, Mary likes Winnie-the-Pooh.

Conditional reasoning conclusions can be evaluated quite easily if one applies a set of logical rules.

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<u>Conditional statement</u>

if a person likes Winnie-the-Pooh, then they're a sensitive person

(Antecedent) (Consequent)

Four conditional scenarios

| | Affirm | Deny |
|---|---|---|
| Antecedent | Mary like Winnie-the-Pooh<br>Therefore, Mary is a sensitive person (*Modus Ponens*) | Mary does not like Winnie-the Pooh<br>Therefore, Mary is not a sensitive person |
| Consequent | Mary is a sensitive person.<br>Therefore, Mary likes Winnie-the-Pooh | Mary is not a sensitive person.<br>Therefore, Mary does not like Winnie-the-Pooh (*Modus Tollens*) |

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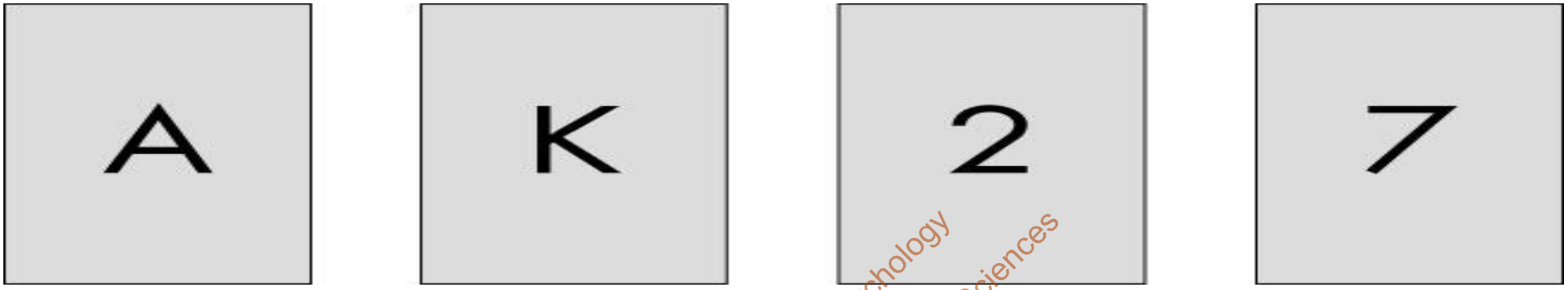
People run into fair amounts of difficulty when judging the validity of conclusions derived from *if –then* statements. One tendency people have is to interpret the initial conditional statement as *bi-conditional*- thinking that *"if p, then q"* also means *"if q, then p"*

**Wason's Selection task**

the classic version of the task is requires the reasoner to decide which of the four cards needs to be turned over in order to determine whether the following *if-then-statement* holds:

*if a card has a vowel on one side, then it must have an even number on the opposite side*

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The selection tendencies of WST reveal *confirmatory bias* – which refers to our tendency to seek out or notice evidence that is consistent with a particular hypothesis rather than evidence that would be inconsistent with the hypothesis.

# Rules or Models of deductive reasoning

Explanations' of how we reason deductively generally fall into two main camps

1) *strict or rule based account* (Rips, 1994) – which contends that people possess the representational equivalent of logic rules. These rules are applied to the premises to determine if the conclusion is valid

2) *mental model view* (Johnson-Laird, 2002) – which believes that we first form a mental model based on the information in the premises and out own previous experiences. Next we search for a mental model in which the premises would be true but the stated conclusion would be false. If successful we deem the conclusion invalid; if we don't we deem the conclusion valid.

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## *Inductive Reasoning*

In inductive reasoning we reason from specific pieces of data or information towards a general conclusion. Unlike deductive reasoning where conclusions are labeled as *valid/invalid* with absolute certainty, inductive reasoning leads to uncertain conclusions that vary in their strength

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Professor X gets upset when asked if she'll issue paper extension

Professor Y won't accept late papers

Professor Z takes 20% off each day a paper is late

Bisanz, Bisanz & Korpan (1994) describe some characteristics that seem to typify inductive reasoning

1) The product of inductive reasoning is not necessarily correct. Inductive arguments are evaluated in terms of their strength rather than in terms of their validity.

2) Ripps (1990) points out that with inductive reasoning there is a need for constraint on the conclusion to be reached

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# Rules or Instances?

*what mental structures & processes underlie inductive reasoning?*

Researchers disagree on whether induction is based on formal, rule-driven processes or on more context-bound, experience based heuristic processing. The rule based view – termed as *strict/syntactic view* – states that inductive reasoning involves special processes and representations that operate in the abstract, outside of any real life context. The experience-based view – termed *loose view* – contends that inductive reasoning involves updating the strengths of one's belief based on the recall of specific instances

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# The Omnipresence of Inductive Reasoning

Inductive reasoning is in some part involved with most of the cognitive processes. Two examples are

*a) Inductive reasoning in Categorization* – inductive reasoning provides another view through which the phenomenon known as the *typicality effect* can be viewed.

1. Robins are susceptible to disease A
   Therefore, all birds are susceptible to disease A
2. Turkeys are susceptible to disease B
   Therefore, all birds are susceptible to disease A

subjects rated argument 1 as more likely to be true because robins are seen as more typical birds than turkeys

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Another interesting phenomenon observed in inductive reasoning about categories might be termed as *diversity effect*. Which of the following arg. is strong

1. Robins are susceptible to disease Y
   Sparrows are susceptible to disease Y
   Therefore, all birds are susceptible to disease Y
2. Cardinals are susceptible to disease Z
   Turkeys are susceptible to disease Z
   Therefore, all birds are susceptible to disease Z

In this case people rated argument 2 as stronger because cardinals and turkeys represent a more diverse set of birds relative to robins and sparrows

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(b) Inductive reasoning and problem solving

another set of cognitive processes that depends critically on inductive reasoning is problem solving – more specifically solving problems by analogy.

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## ***Judgment***

Inductive reasoning involves arriving at general conclusions based on specific pieces of what might be called "data". *Judgment* is an extension of inductive reasoning. Hastie & Dawes (2001) define –

*judgment is the human ability to infer, estimate & predict the character of unknown events.*

Judgment is the process of making educated guesses, based on limited information along with our previous knowledge, expectations and beliefs (stereotypes)

Basing judgment on memory: The availability heuristic

the availability heuristic indicates that we base our estimates of likelihood, or probability, on the ease with which we can think of examples. The availability heuristic is dependent on two main sub processes

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a) biased encoding – leads to overrepresentation of certain facts in memory. This in turn makes bias retrieval from memory as the information stored is memory is biased. (e.g., media overestimation)

b) biased retrieval – availability can lead us astray if the sampling process itself is biased. (e.g., Try the following and state whether there are more of number 1 or number 2)

1. six letter words that have the letter n as the fifth letter

2. words that fit the pattern _ _ _ *i n g.*

c) illusory correlations – when one notices primarily coincidences, two events will seem to be linked even when they're not. This perception is called illusory correlation (sports illustrated jinx)

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A recognition Heuristic – reasoning is adaptive, we simply cannot consider all of the data, nor do we have access to it. The *lack of data* can be informative!. Recognition heuristic is often used when we're faced with two alternatives – one that's recognizable and one that's not.

***The Representative Heuristic: Basing judgment on similarity***

When trying to place a person in a particular category our judgment rely on representational heuristic – the degree to which the object represents our basic idea of that object

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## *Ignoring base rates*

people mostly commit the base rate fallacy – ignore thee rate of occurrence of a particular category in the population or sample (i.e., how often a certain event tends to occur) – there by getting biased by similarities. For example consider the classic demonstration by Kahneman & Tversky (1973).

Subjects were given the following instructions

*a panel of psychologists have interviewed and administered personality tests to 30 engineers and 70 lawyers, all successful in their field. On the basis of this information, thumbnail descriptions for each of these individuals have been written. For each description, please indicate the probability that the person described is an engineer from 1 to 100.*

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Subjects were then given the following description

*jack is a 45-year-old man. He is married and has 4 children. He is generally conservative, careful and ambitious. He shows no interest in political and social issues and spends most of his times on his many hobbies, which include home carpentry, sailing and mathematical puzzles.*

*Subjects were required to rate the probability that jack was an engineer.*

*when not given the profile the probability that a randomly drawn name is an engineer was 30/100 or 30%, however with profile it was 50/100 or 50%.*

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Use of representative heuristic and the concomitant tendency to ignore base rate may relate to the use of the controversial practice known as *racial profiling.*

***The conjunction fallacy***

the conjunction fallacy is another cause of bias which is caused by stereotyping. In a classic study Tversky & Kahneman (1983) demonstrated this fallacy at work. They presented the following problems to subjects

*Linda is 31 years old; she's single, outspoken and very bright. She majored in philosophy. As a student, she was deeply consumed with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.*

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The subjects were asked to decide whether it was more likely that she was (1) a bank teller (2) a bank teller who was active in the feminist movement.

if probability of 1 was 0.5 and that of 2 was 0.5 then since their combined probability (since 1 includes 2) is 0.5 x 0.5 = 0.25

***Misperception of event clusters***

when a given event has two different ways of working out, such as a coin flip, people tend to misconstrue what a random sequence should look like (i.e.,) they tend to underestimate the number of clusters of like event, that would occur in a truly random sequence.

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Examples of misperception of event clusters

a) The hot hand – the tendency to misperceive event clusters as indicating non-randomness may underlie what sports fans terms as hot hand.

b) The Gamblers fallacy – refers to the belief that after a run of bad luck (or a run of a certain type of outcome), a change is *“due”* to occur

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## *The Anchoring-and-Adjustment Heuristic*

In many cases of judgment people start with an idea or standard in mind. This initial estimate or first impression tends to make us overly biased towards it. The heuristic involved in these judgment is termed *anchoring and adjustment.* A good example of this heuristic at work is the *spotlight effect*.

*spotlight effect – refers to our tendency to believe that others notice our actions and appearance more than they actually do – i.e., we believe that the "social spotlight" shines more brightly on us than it actually does.*

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## *Biased Evaluation of Our Judgments*

Biases in judgment can also arise from the fact the at times we're not good at estimating how much we know or when we knew it. A couple of biases of this sort are

a) *Hindsight Bias*: people often seem to be sure after something has occurred that they knew things would work out just that way. This tendency is termed as *hindsight bias (i-knew-it-all-along-effect). [e.g., civil suits]*

b) *Miscalibration of Confidence:* the fact that we overestimate the extent to which we knew something we going to happen demonstrates an insensitivity to what we knew and when we knew it.

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