Language and Thought

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Naveen Kashyap, PhD
Indian Institute of Technology Guwahati
Email: naveen.kashyap@iitg.ac.in

Language and Communication

- Language is our primary means of communicating thought
- Levels of language – production & comprehension
  - Production of language: begins with thought, which is translated into a sentence, and ends with sounds expressing that sentence
  - Comprehension of language: begins by hearing sounds, attaching meaning to sounds (words), & attach meaning to combinations of words (a sentence).

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Language and Communication

- Language units and processes
  - Language structured at three levels
  - Speech sounds
    - Speech is a sequence of phonemes (shortest segment of speech that carries meaning) when phonemes are combined in right way we perceive them as words

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Language and Communication

Word units

When listening, we perceive not phonemes but words.

Morphemes are small linguistic units which carry meaning

Most morphemes are words

Grammatical morphemes: words that make sentences grammatical processed differently to content words

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Language and Communication

- ...Language units and processes
  - Sentence units
    - Correspond to parts of a thought (proposition) and allow listener to “extract” propositions from sentences
    - Proposition can be divided into subject & predicate (description)

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Language and Communication

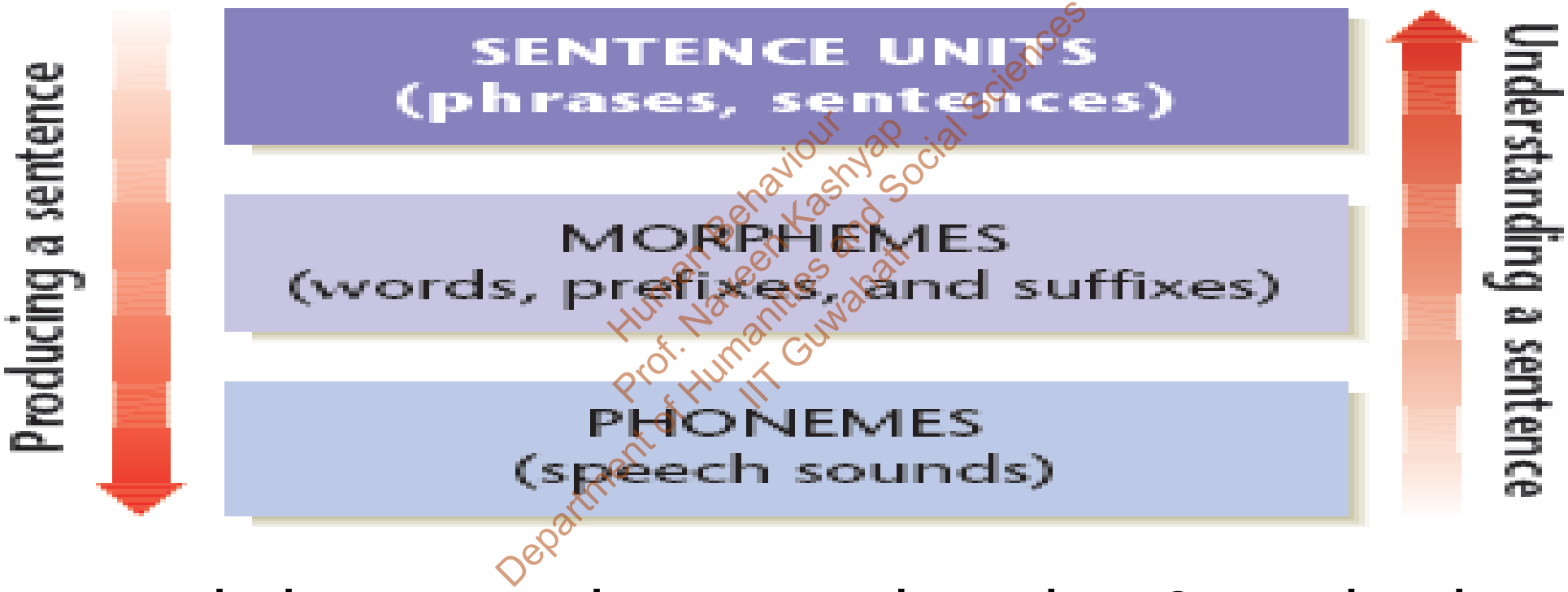
Syntactic analysis: when listening, we divide sentences into nouns phrases, verb phrases etc., then extract proposition from phrases

Syntax deals with relationship between words in phrases & sentences

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Language and Communication

- Effects of context on comprehension & production



Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

  - Context is important in comprehension & production for setting the scene & giving insight into a speaker's intentions

Language and Communication

- The neural basis for language
  - Two regions of the left hemisphere critical for language – Broca's area (in the posterior part of frontal lobes) & Wernicke's area (in the temporal region)
  - Damage to either of these areas leads to specific kinds of aphasia (breakdown in language)
    - Broca's aphasia: disruption at syntactic stage
    - Wernicke's aphasia: disruption at level of words & concepts

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

The Development of Language

- What is acquired?
  - Phonemes & combinations of phonemes
    - Children discriminate among different sounds that correspond to different phonemes
      - during first year children learn which phonemes are relevant (for their language)
      - over next few years learn how to combine them

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

The Development of Language

Words & concepts

When children start to speak (around 1 year), first use words that relate to familiar concepts, e.g. family, animals, etc.

Around 1½ years children use around 25 words, by 6 years children use around 15,000 words

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

The Development of Language

- ...What is acquired?
  - From primitive to complex sentences
    - Between age 1½ –2½ children acquire sentence units – starts with combining single words into two-word utterances & rapidly progress to more complex sentences to express propositions more clearly

Human Behaviour
Prof. Praveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

The Development of Language

Learning processes

- Imitation & conditioning
  - Possibilities that children learn by imitating adults (imitation) or by being rewarded for producing sentences correctly & punished for mistakes (conditioning)
  - Problem with these possibilities is that they focus on specific utterances

Human Behaviour
Dr. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

The Development of Language

- ...Learning processes
  - Hypothesis testing
    - Children appear to form a hypothesis about a rule of language, test it, and retain it if it works
    - Hypotheses are generated according to a few operating principles, e.g., paying attention to word endings, looking for prefixes & suffixes that indicate change in meaning, avoid exceptions etc.

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

The Development of Language

- Innate factors
  - The richness of innate knowledge
    - One indication of this richness – children in all cultures seem to go through similar processes in acquiring language
  - Critical periods
    - First months of life are a critical period for learning phonemes for native language. It is harder to learn sound system for a second language later in life

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Indirect evidence for critical period for language acquisition from children who experienced social isolation

Critical period for learning syntax (studies of deaf people)

Can another species learn human language?

Other species have communication systems but most argue these are qualitatively different from our language system

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

- Thought
  - "Language of the mind" – two modes: propositional thought (expresses proposition/claim) & imaginal thought (relates to images that we "see" in our mind)
- Functions of concepts
  - Concept: represents entire class with set of properties – divides world into manageable units
  - Categorization: assigning an object to a concept
  - Predictive power: concepts allow us to predict information not readily perceived

Human Behavior
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

- Prototypes
  - Two sets of properties related to concept
    - Prototype: best examples of concept
    - Core: most important properties for being member of concept

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

Core properties are used to determine membership of well-defined category (e.g. parent), while prototype properties used to determine membership of fuzzy concepts (e.g. dog)

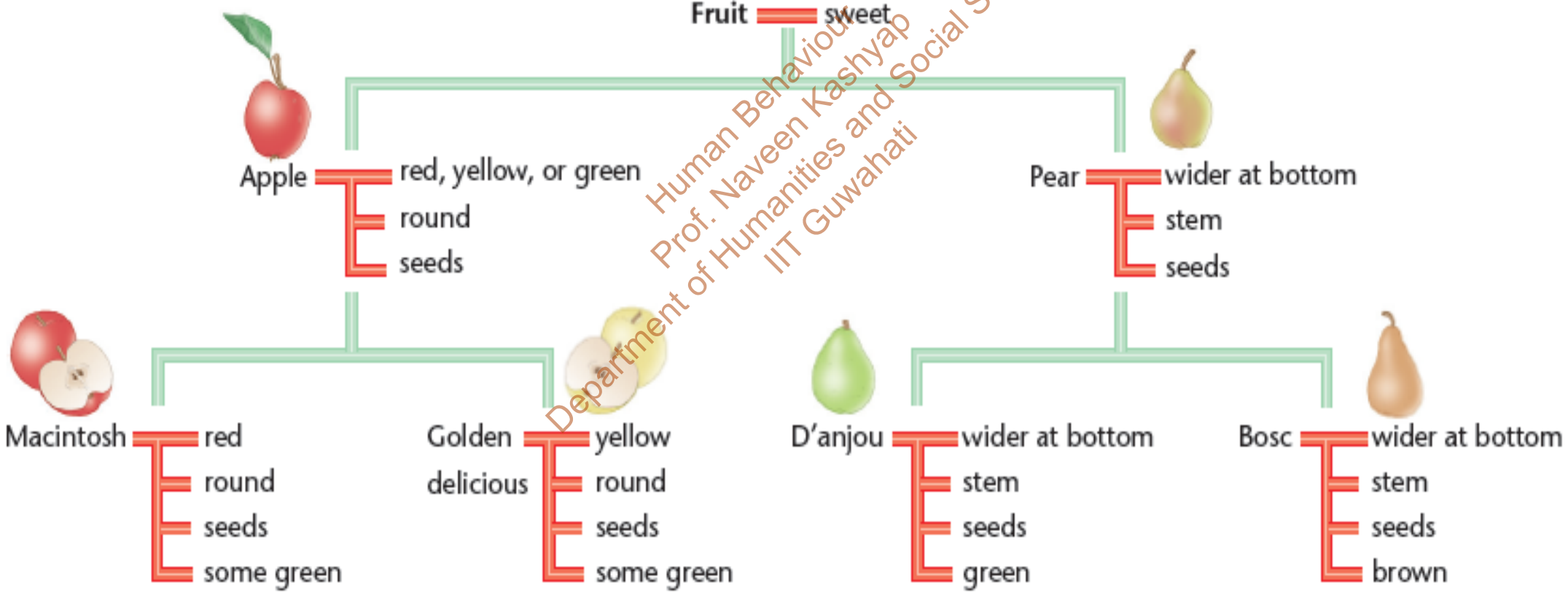
Universality of prototypes formation

- For some concepts, such as “parent,” the prototype is heavily influenced by culture
- For other concepts, such as colors, prototypes appear universal

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

- *Hierarchies of concepts*



Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

- Different categorization processes
  - For well-defined concepts, use rule-based categories
  - For fuzzy concepts, rely on similarity (similarity to prototypes & similarity to stored exemplars)
- Acquiring concepts
  - Learning prototypes & cores

Human Behaviour
Prof. Navdeep Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

Can learn about concept in different ways – either explicitly taught something about concept or learn through experience

Learning through experience

Use exemplar strategy: compares to stored exemplars, or

hypothesis testing: common properties characterize a concept

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Concepts & Categorization: The Building Blocks of Thought

- The neural basis of concepts & categorization
  - Different neural regions may mediate different kinds of concepts and categorization
    - Within the fuzzy concepts, research suggests the brain stores animal concepts and concepts of artifacts differently.

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

e.g., *perceptual regions* may be more involved in representing animals from artifacts while *functional and motor regions* play larger role in representing artifacts from animals

Neural differences between categorization based on prototypes and categorization based on stored exemplars

Also, rule-based categorization relies on different neural processes than categorization based on similarity

Human Behaviour
Dept. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Reasoning

- Deductive reasoning
  - Logical rules
    - Deductive validity: for logicians, it is impossible for conclusion of the argument to be false if its premises are true
    - Best evidence that people use such rules is that the number of rules argument requires, indicator of argument's difficulty

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Reasoning

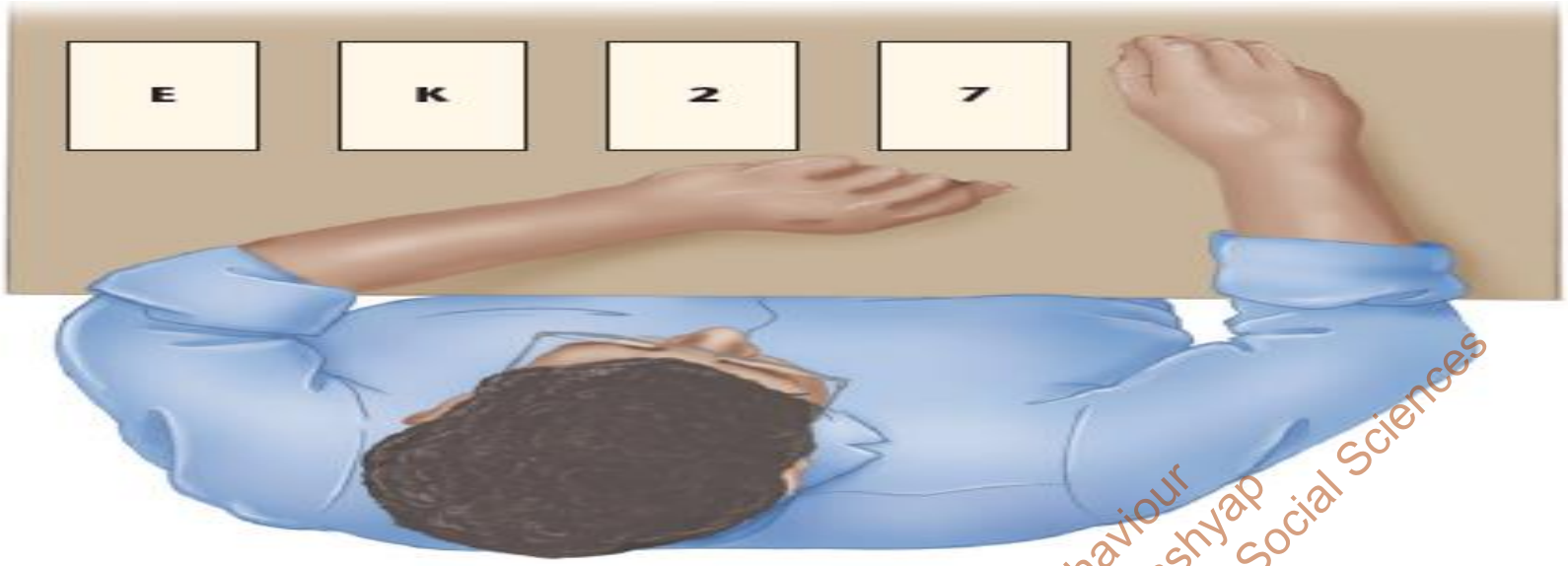
Effects of content

Ability to evaluate a deductive argument often depends on content of propositions as well as logical rules

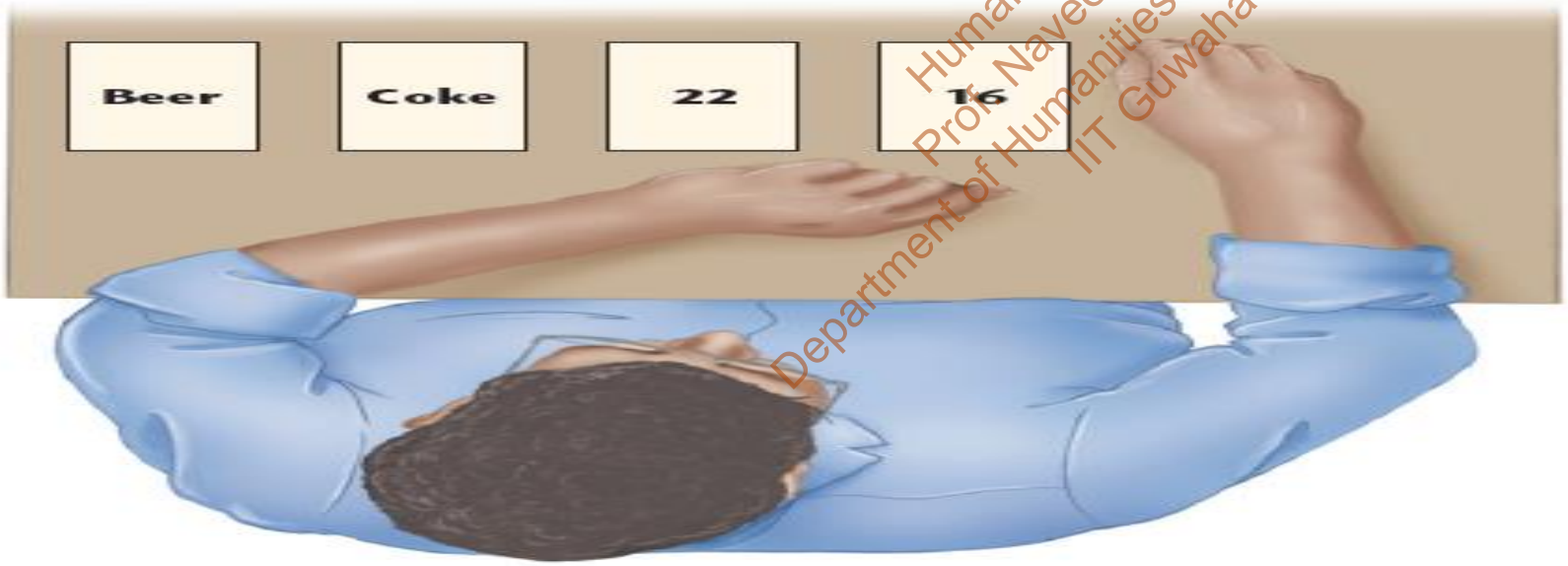
Sometimes we use rules that are less abstract and more relevant in everyday problems – pragmatic rules; or we can problem-solve by creating mental model

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Reasoning



a) Hypothesis: If a card has a vowel on one side, it has an even number on the other side.



b) Hypothesis: If a person is drinking beer, he or she must be over 19.

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Reasoning

- Inductive reasoning
  - Logical rules
    - Argument can be good even if not deductively valid
      - inductively strong arguments are where it is improbable that a conclusion is false if its premises are true
    - Rules of probability include base-rate rule & conjunction rule

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Reasoning

Heuristics

Heuristic: short-cut procedure that is relatively easy to apply & can often lead to the right answer but not inevitably

Different heuristics include: similarity heuristic, causality heuristic, availability heuristic, representativeness heuristic

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Reasoning

- The neural basis for reasoning
  - Research supports distinction between deductive and inductive reasoning
    - Different parts of the brain were activated when people evaluated deductive validity compared to inductive strength

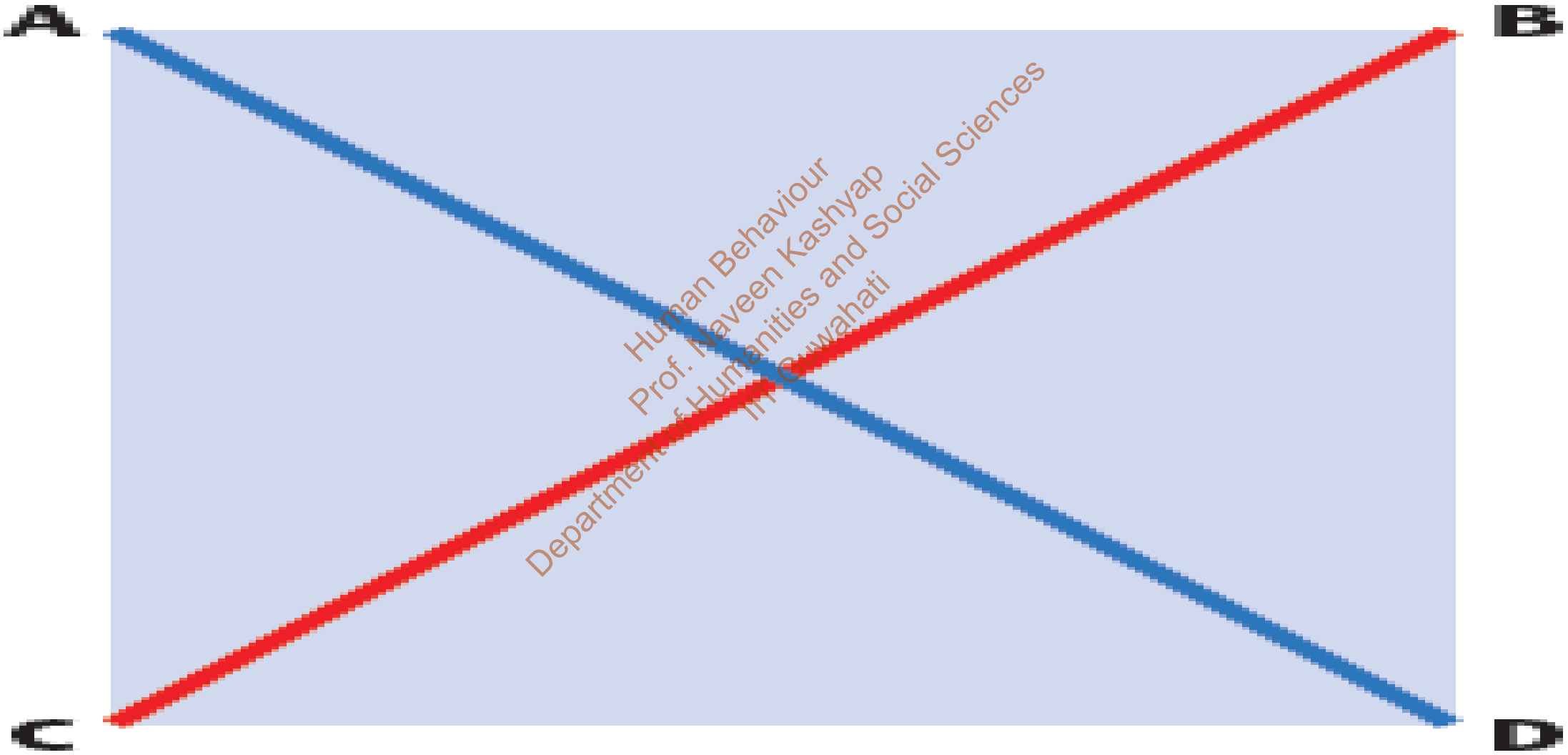
Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Imaginal Thought

- Imaginal thought
  - Thoughts that are manifested in images involve same representations and processes used in perception
  - Imaginal thought relies on analogical representations while propositional thought relies on symbolic representations
- Imaginal operations
  - Mental operations performed on images analogous to those carried out on real visual objects, e.g. mental rotation and scanning an object/array

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Imaginal Thought



Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Imaginal Thought

- The neural basis of imagery
  - Both imagery and perception are mediated by the same brain structures
    - Imagery is like perception with both activating the visual cortex – when neural activations are directly compared, there is more activation in an imagery task than a perception task, presumably because an imagery task needs more “perceptual work”

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Thought in Action: Problem Solving

- Problem solving
  - In problem solving there is an initial state & a goal state
  - Need to break problem down into sub-goals that can be more easily obtained
- Problem solving strategies
  - Difference-reduction method
    - Reduce the difference between our current state in the problem & the goal state

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Thought in Action: Problem Solving

- …Problem solving strategies
  - Means-end analysis
    - Find key difference between current state & goal state & then eliminating that difference is the main sub-goal
  - Working backward
    - Working backward involves reasoning from the goal to a subgoal, from that one to another subgoal etc. until finding subgoal we can readily obtain

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Thought in Action: Problem Solving

...Problem solving strategies

Representing the problem
Visual representation is better for some problems, propositional representation better for others
What is represented is also key – functional fixedness
Restructuring a problem can help as can finding an appropriate analogy

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Thought in Action: Problem Solving

- Expert versus novice
  - Experts in domain solve problems qualitatively differently than novices do
  - Differ in following ways:
    - Experts have more specific representations in memory to use
    - Experts represent novel situations in terms of solution principles rather than surface features
    - Experts form a plan first before taking action
    - Experts tend to work in a forward direction, from the problem to the solution

Human Behaviour
Prof. Naveen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati

Thought in Action: Problem Solving

- Automaticity
  - Automatic processes can be carried out without conscious control
  - much of our thinking processes become automatic with experience, e.g. reading

Human Behaviour
Prof. Nareen Kashyap
Department of Humanities and Social Sciences
IIT Guwahati