COGNITIVE SCIENCE AND ARTIFICIAL INTELLIGENCE
Briefing to George (Jay) Keyworth

Keyworth's office
1100:1200 29 Sep 83
Allen Newell
Carnegie-Mellon University

Introduction [2 min]

> Let me assume you've read the document

> We are talking about a joint field
  > Cognitive science (human side) & Artificial intelligence (computer science side)
  > We took some space to lay out some of the central ideas in the field
    > Seemed a chance this was a scientific story you were not very familiar with

> Then we laid out five clusters of research that are both interesting and pregnent

> Finally, in accordance with our understooding of your wishes, we just touched on support and resource issues in a qualitative way

> All that is there and we can go back and pick it up
  > I'd rather spend my minutes giving you a better feeling for the science
  > Let me pick up a few examples in more detail than the document
  > Then emphasize a couple of theoretical ideas that seem critical

Example # 1. Rotation experiment (Shepard) [3 min]

> The experiment: Compare pictures of 3D objects
> The result: Linear response — in 3D
> What it means: What mechanism is responsible for this regularity?
  > Imaging. Analog rotation (maybe?)
> What it typifies: Great quantitative data that begins to show how the gears work

Example # 2. Bacon induction sys (Langley & Simon)[3min]

> The experiment: Induction from classical scientific data
> The result: Repeat the inductions for quite a few experiments
> What it means: Some
> What it typifies: The throw-away program as the style of research in AI

Example # 3. Large STM (Chase & Ericsson) [3 min]

> The experiment: Digit span — training to 87 digits (1 digit/sec)
  > Pick it apart: mnemonic system, retrieval structure
> The result: Predict what does good/bad, etc
> What it means: A web of evidence that shows the understanding is basically right

Example # 4. Expert behavior in elementary physics [3min]

> The experiment: Program for novice behavior, expert behavior
> The result: Two representations: Mechanical, Science based (qualitative)
> What it means: Can begin to plot the course of learning
> Related experiment: Naive qualitative theories (impetus theories)
> What it means: Getting direct lessons about education from fundamental studies
> What it all typifies: Theory driven research building up coherent picture

A couple of theoretical notions [2 min]

> If I had to pick two basic ideas for you to remember:

> #1. We have discovered how to build physical systems with symbolic behavior
> > My impression is that few people outside field understand what has happened
> > The sort of symbols in a computer are basic mechanism the symbols in humans
> > > This is a hypothosis — but the one this whole field is building on

> #2. The power of intelligence comes through knowledge
> > So CogSci/AI much concerned with structures that encode large amounts of knowledge
> > > And make it accessible — semantic nets, production systems, ...

Research Clusters [5 min]

> #1. Architecture
> > 1.1. Computer architectures
> > 1.2. Massive parallelism
> > 1.3. Human cognitive architectures

> #2. Sensory information processing
> > 2.1. Visual perception
> > 2.2. Speech recognition

> #3. Natural langauge
> > 3.1. Learning natural language
> > 3.2. Understandging natural lanuage

> #4. Intelligent systems
> > 4.1. Systems with full expertise
> > 4.2. Learning

> #5. Science and mathematics education
> > (Turns out to be good area for basic work, though important applied issue)
> > 5.1. Tutorial systems
> > 5.2. Mental models and the problem of transfer