Beginning to Conceptualize the Human Cognome Project

by
Robert E. Horn
Visiting Scholar, Stanford University
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When I suggested that we set our vision on a century-long project to understand the "Human Cognome" (1) at the NSF Converging Technologies workshop, I thought that it might provide an umbrella concept for a cluster of research programs. On reflection, a number of streams of research, criteria and priorities, and potentially high-payoff projects have begun to come into focus. This short paper outlines some of my recent thoughts.

In general, the goals of the individual subcomponents of a Human Cognome project should be both ambitious and have rapid practical payoff. Together they begin to give a glimpse of what the project might become. The programs suggested below invite the reader to envision how a world with their accomplishment and implementation would be substantially improved.

Paths and themes for components of the Human Cognome project

What are some of the major themes that the Human Cognome Project should address? I suggest five to start with.

1. **Cognitive prostheses for human limitations.** Cognitive psychology and the social sciences in general have identified a myriad of human shortcomings. To mention only a few such limitations: In perception we are easily distracted. Our memories are notoriously selective and defective. Social influences produce groupthink. Our capacity for conflict and violenceis enormous. Our thinking categories are often skewed and our heuristic judgement about risks is distorted. We make decisions from simplistic models and think we are rational. We can learn only so fast. Emotions cloud our judgements. We have often let short-term gain outweigh longer-term benefits for society. Our individual disciplines have been quite systematic in discovering these limitations, but not comprehensively focused on overcoming or ameliorating them. Could a major, focused effort in the Human Cognome Project help us systematically build cognitive prostheses (tools, systems, concepts, training courses) to overcome or a least diminish the difficulties these human limitations present in critical situations?

2. **Reduce fragmentation of social-psychological disciplines**. It is well understood that disciplines in the modern university are silos and that interdisciplinary degrees are difficult to achieve. It is equally well understood that problems we face in the real world are almost always interdisciplinary. One of the participants at the Converging Technology Conference said that the most important problem he faced at his lab with

several hundred scientists was getting them to understand each other. This fragmentation is particularly evident in the social and psychological disciplines. Psychologists rarely extend their investigations beyond individual and small group interactions. Sociologists and anthropologists have their boundaries, often using culture as the delimiting concept. Economists until recently have avoided dealing with messy irrationalities and externalities, and focused on mathematical models far removed from individuals or cultures. And political scientists have often avoided individual psychology as important to their models. Our nation struggles these days with trying to understand the phenomenon of terrorism and suicide bombers. We all try to understand ethnic conflict. Yet most of the articles and books I read have partial understandings, coming from simplified one-discipline models. We need to address our problems on major interdisciplinary scales and dimensions. I call such investigations "vertical" integration in the sense that they would take as their subject human problems and look, from broadest scale, perhaps evolutionary (in time scales), to cultures, political organizations, world-wide religions and other organizations, small group and individual behavior. How could a subprogram of the Human Cognome Project contribute to the vertical integration of social, political, economic, and psychological aspects of such problems as terrorism and ethnic conflict?

3. Visual language to manage complexity. I have already written a short paper on how I believe visual language (defined as the tight integration of words and visual elements) can serve as one component of this project. (2) One of the ways to think of visual language is that it provides a prosthesis for some of the limitations of human thought. We humans are severely limited in working memory, but human beings are exceedingly good at scanning their immediate environment and forming patterns. Providing systematically organized, wall-size, visual language murals facilitates such an environment for rapid scanning. Currently, such murals may have a thousand visual and verbal chunks of information. Using them, we substitute our ability to scan, focus in on detail, and find patterns for our ability to hold in working memory more than seven plus or minus two chunks of information. Visual language, thus, is an example of a cognitive prosthesis as well as suggesting a separate basic research and development program. A broadscale approach to aiding the management of and communication about complexity would be to focus support systematically on the development of visual language. What are the most immediate requirements to advance human capability to communicate with visual language (especially in the sciences)?

4. Understanding each other's worldviews. It is clear from our current world situation that humanity does not do well in understanding and tolerating differences of worldview. We need only note that in the 20th century approx. 160 million human beings were killed in wars. Our cultures, philosophies, and religions -- those cognitions we hold most deeply -- have not been well analyzed and communicated to each other. We do not understand very well how differently we hold concepts about time, space, what is real, what is and is not possible, how the world came about, etc. And humanity further differs widely along such dimensions as time, authority of law, trust, competition, punctuality, importance of wealth, innovation, justice,

equality, work ethic, intellectual pluralism, tidiness, courtesy, efficiency -- to mention only a few. We do not understand each other and, while considerable research has been done on this in anthropology, little effort has been focused on how to portray and communicate these differences. How could the Human Cognome Project illuminate these and other aspects of humanity's worldviews? Would this be a positive step in the direction of tolerance, stability, and peace?

5. Sequencing the Human Cognome. Our use of the locution "human cognome" intentionally rides on the metaphor of the eminently successful human genome project. What if we extended the metaphor to ask what would a sequencing of the human cognome be like? Undoubtedly there can be many productive answers to such a question. One such would be to provide an identification of human "thought chunks" along the lines I first suggested for the chunking of technical writing. (3) This early work found that there are subject-matter independent types of thought chunks (one kind of sequence of tags) that can be combined with subject matter topics (another kind of sequence of tags) to provide a way of identifying the structure of thought. While this work was focused on helping technical writers and instructional designers analyze and write about complex subject matters (of thousands of pages), the successful results suggest that it would be possible to identify (i. e. "sequence") each element of "thought" as exhibited by sentences and the components of diagrams. This combined with a double tagging system (i.e. topic and function) similar to XML could provide a powerful way to approximate the sequencing of human thought chunks and have powerful effects in items 1 - 4 above. How could the Human Cognome Project initiate pilot studies to achieve this goal?

Beginning to address these broad goals

These suggestions are only a few diverse possible themes. There are undoubtedly more. To get started, the National Science Foundation should convene a series of workshops that would flesh out each of these component programs of a larger Human Cognome project. A conference on cognitive limitations would identify precisely what we need to focus on, set priorities, and brainstorm potential avenues of research, and sketch out requests for proposal areas. Similar conferences on vertical integration, visual language, worldviews, and sequencing the cognome would have similar outcomes. Then we would begin to be able to envision more concretely portions of the first ten years of a Human Cognome project.

Notes

1. I first made the suggestion that we launch a Human Cognome Project at the Workshop on Converging Technology (NBIC) for Improving Human Performance sponsored by the National Science Foundation, the National Science and Technology Council, December 3-4, 2001. It was taken up by the workshop and first appeared in print the NSF draft 2/4/02, "Reports of the Five Breakout Panels."

2. See Horn (1998)

3. This work is described in (Horn, 1989) and was awarded the Diana lifetime achievement award from the Association of Computing Machinery Special Interest Group on Documentation in 2001.

References

Horn, R. E. (1989) Mapping Hypertext, The Lexington Institute (now distributed by **www.infomap.com**)

Horn, R. E. (1998) Visual Language: Global Communication for the 21st Century, MacroVU Press (www.macrovu.com)

Horn, R. E. (2001)Visual Language and Converging Technologies in the Next 10-15 Years (and Beyond) A paper prepared for the National Science Foundation Conference on Converging Technologies (Nano-Bio-Info-Cogno) for Improving Human Performance Dec. 3-4, 2001 (**www.stanford.edu/~rhorn**)

Horn, R. E., Visual Language Path for the Human Cognome Project (Preliminary Scenario) This is a downloadable PDF file. (www.stanford.edu/~rhorn/test/ScenarioVslLnguageFuture.html)