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The universe, dark matter, and streaming intelligence

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ABSTRACT

After decades of university appointments, I only recently taught my first course on intelligence. It was for the Great Courses Company. Questions concerning audience, key points to make, approach to teaching, and topic controversies were all part of the planning for 18 30-minute lectures now available on DVDs or streaming. The course tells my version of modern intelligence research, inspired in part by Cosmology.

One of life's pleasures is to find inspiration. Recently, David Lubinski asked who inspired me to study intelligence (ISIR interview, 2012; http://www.isironline.org/meeting/archive.html or http://www.youtube.com/watch?v=QbwTsW1WmCo). In truth, I cannot remember an "aha" moment when I decided to focus my general interest in psychology (it was my college major) on intelligence. I was always more interested in individual differences (why, I do not know although I remember the first issue of *Psychology Today* I read in high school) and I began graduate school at Johns Hopkins studying personality. There, I had the good fortune to work on the first Study of Mathematically and Scientifically Precocious Youth directed by Julian Stanley. Later, I used evoked potentials to find correlates to scores on the Raven's Advanced Progressive Matrices (RAPM) and years after that when I had the opportunity to use Positron Emission Tomography (PET) for the first time in a study of my choosing, I chose the RAPM as the "activation" task. This was in 1988 and the unexpected finding of "deactivation" (i.e. inverse correlations between glucose metabolic rate and RAPM scores) resulted in the brain efficiency hypothesis of intelligence (Haier et al., 1988). Intelligence has been my main research focus ever since.

More recently, my interest in intelligence is inspired by Cosmology. In my mind, the brain is the universe—there are trillions and trillions of synapses and infinite combinations of neuronal firing in a single human brain. The *g*-factor is like dark matter—we infer it must be there but we cannot yet measure it directly.

I never taught a course on intelligence during the decades I was a university professor (I am now Emeritus). My academic appointments were always in medical schools so my teaching obligations were limited to occasional lectures on brain imaging to first or second year medical students and some pharmacology and some engineering students but never included undergraduate or graduate courses[1]. No faculty member from social science or cognitive science or from the education department ever asked me whether I would be interested in teaching a course on intelligence despite my well-known interest in the field, and I did not volunteer.

I have given many public lectures about intelligence. In 2010, I gave a keynote address about brain imaging and intelligence at a conference of 1200 educators (my title was,

[1] When I was on the medical school faculty at Brown University in the Department of Psychiatry, I did teach an undergraduate course in the Psychology Department called "Freud's Social Theory". It was an interest of mine; the students enjoyed it but the Brown psychology faculty, mostly experimentalists, were less enthusiastic and their commitment to academic freedom was tested (they passed). That's another story.

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Neuro-imaging, neuro-intelligence, and education: Is it time to require students have a brain scan?). A recruiter from the Great Courses (formerly The Teaching Company) was in the audience and I was asked to propose a video course based on my presentation. I saw this as an important opportunity to disseminate the latest research and thinking about intelligence. My proposal led to an audition lecture that was sent to a sample of about 1000 customers. Based on their feedback, The Great Courses concluded that there was a considerable interest and a sizeable market for such a course and I was asked to prepare and record 18 30-minute lectures for a course called *The Intelligent Brain*. This took two years of honing topics, researching details, and doing practice lectures in a television studio. I recorded the final version of all 18 lectures in five consecutive afternoons in early December, 2012 and the course became available for sale in April, 2013 (http://www.thegreatcourses.com).

When I began planning this project, four questions came to mind. First, who is the audience? The Great Courses has a large customer base—mostly middle age and older, often professionals, and in general, people who have broad intellectual interests, as illustrated by the breadth of courses offered. There is no academic or certificate credit. The courses are offered only for personal interest. This is considerably different than traditional university courses for students and it offers a unique opportunity and challenge to tell the intelligence story to sophisticated people who, in all likelihood, have preconceived ideas that are probably wrong.

In addition to this general audience, I targeted my lectures to particular groups including educators and public policy-makers, and even to the minority of cognitive psychologists who may be pursuing individual differences research. Parents and grandparents are also an important group because maximizing a child's intelligence/achievement is typically a high priority whether explicit or implicit. Finally, wherever possible, I aimed for a level of explanation that would be comfortable for undergraduate students.

The second question for constructing the course was, what are the key points I want to get across. I am not neutral. I have a point-of-view. I am, in the words of James Flynn, one of those "*g*-men". In my view, this is not remotely a pejorative term. If I had a *g*-man badge, I'd wear it. This is because I find the data on *g* to be convincing and this is the main story I wanted to tell. It is a story with many intriguing subplots and characters. The story has suspense, drama, mystery and even sex (i.e. male female differences).

So, my lectures include the mysteries of savant mental abilities, the noble intentions of Binet, the drama of longitudinal studies of high IQ children (how do they turn out?), and the whodunit suspense of Burt's .771 immutable correlations.

But the course is not focused on the old controversies of whether intelligence can be defined for scientific study (it can) or whether intelligence test scores are meaningful (they are), or whether there is an important genetic component to intelligence (there is), or whether intelligence is determined in part by early childhood experience (surprisingly difficult to demonstrate). The research data that deals with these issues are summarized in some detail. The viewers of the course are invited to see how researchers think and how the field is progressing. I did not see a need to present all sides of an issue when, in my judgment, the weight of evidence clearly favored a particular interpretation. I made this lack of "balance" explicit at several points. I did give references to other interpretations should the viewer want more information about them. A list of all 18 lectures and their descriptions is appended.

The new science of intelligence is the main focus of the course. This begins with new genetic data, especially as it is combined with powerful brain imaging. IQ scores correlate with brain structure and function. Brain structure and IQ have genes in common–now we're getting somewhere–the pace of research is quickening. There is a neurobiology of intelligence and we are beginning to explicate it. We are beginning to know where intelligence is in the brain and we can see the sequence and timing of information flow millisecond by millisecond in the brains of people as they solve complex problems. Comparing such data in high and low IQ individuals is underway.

A key question in the public mind is, can we increase intelligence? We have tried and so far failed using various environmental/educational interventions. How about cognitive training—is the n-back test the key to increasing IQ (not likely)? What about the possibility of manipulating the brain using drugs to increase *g*? If we could raise intelligence, should we? All these issues are covered.

If I had more than 9 hours and was teaching a conventional college classroom course, I would augment each 30-minute lecture with class discussions and presentations (see Earl Hunt's paper in this issue for terrific examples). I would also add lectures on mental retardation, evolution of intelligence, more cultural/social research, and an additional lecture on other intelligence tests (and their use in personnel selection).

The third question about designing this course was, how do I get these points across? A key feature of the course is explaining actual research studies and showing the actual data that address all these topics. The Great Courses got appropriate permission to reproduce many graphs and figures from published papers and they had talented graphics people of their own to create clever, easy-to-read charts, brain renderings, and animations to illustrate other key points. The animations showing how the n-back test works, for example, are quite helpful in conveying the procedure beyond the typical slide show. I hope some of these graphics can be posted online (perhaps at the ISIR website) for use in any course without charge and I am working with the Great Courses to make this happen.

So far, none of the comments from people who have viewed the lectures suggest that the use of actual studies and data was overly complex or difficult to understand. Dumbing down lectures on intelligence would be ironic and it is unnecessary, but so is presenting too much technical (including statistical) detail. Even the most complex studies (including genetic and brain imaging techniques) have fairly simple stories to tell if explained with no jargon, and zero tolerance for jargon was a primary consideration for me. Everyone who teaches knows this, and over the years, I have developed non-technical explanations for brain imaging/intelligence research. Nonetheless, in practice lectures in the TV studio, I found that my extemporaneous explanations were not nearly as smooth as I thought they were based on innumerable PowerPoint presentations I have made over the years. I wound up writing out my lectures in full…including