The 2018 Constance Holden Memorial Address given at the annual meeting of the International Society for Intelligence Research.

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I want to begin by expressing my gratitude to The International Society for Intelligence Research, its distinguished membership, and our hosts this year Drs. Michelle Luciano and Timothy Bates. I cannot imagine better circumstances with which to undertake my first visit to Scotland, to this venerable location—The Royal Society of Edinburgh—and to this remarkable gathering of people. No one would mistake me for a journalist. Most days, I’m happy if someone mistakes me for a passable social scientist. Previous honorees like Susan Pinker and Alice Dreger set a remarkably high bar, and the namesake of this award, Constance Holden, embodies science journalism at its finest.

Public Science

Writing about science for the public isn’t something I’ve done for very long, honestly. Most of what I’ve written in my career has been primarily for all of you—researchers and scientists—and published in the form of peer reviewed articles and book chapters. Yet, this foray into public science has offered a unique opportunity to speak directly to interested lay people, many of whom can’t access the pages of our journals. One thing I learned quickly was that I would have to press a slightly different skill set into service when addressing this broader audience. There’s an imperative to simplify. But, this should never mean running rough shod over important details. Yet, as someone far wiser than I once said, if you can’t explain it simply, you don’t really understand it.’

There has been some superb science writing about our topic, human intelligence, some of it by folks gathered here. And, like other topics, there is no shortage of misinformation, confusion, and outright falsehood that often proliferate the pages of magazines and newspapers. Still, what I’ve realized is that the science writing I enjoy the most addresses topics that are often complicated, potentially controversial, yet clearly important and impactful, and distills them in such a way that excites the reader. It provokes not only the layperson, but also the grizzled expert, moving them to think about an old topic in a new way. In some cases (the best cases) it coaxes a new mind into a field that they may otherwise have never stumbled in to.

Contrary to my own initial intuitions, the most fertile ground for igniting a passion in your audience doesn’t always reside in covering the most attention-grabbing finding emerging from the pages of Science or Nature. In fact, if the replication crisis has reminded us of anything, it’s that attention grabbing doesn’t always mean correct. Instead, what has captivated me the most is when an author can take the most basic bits of knowledge about a given subject, and through sheer force of will (it seems), entice me to be excited by them. This approach has an added benefit, moreover, of cutting through controversy and misinformation, and reminding us why we ended up in our chosen profession to begin with. I’m going to suggest that the topic of intelligence, among all of the other topics in the social and psychological sciences, is poised for a revival of interest and excitement among the public and within the academy. Richard Feynman, Nobel Prize winning physicist and one of our most beloved science writers, has provided a roadmap to that end.

Feynman’s Brand of Public Science

It is because of Feynman that I developed a love of physics (sadly, just without the requisite g to add anything of substance to that field). Years ago, I happen to pick up Feynman’s Six Easy Pieces, a book based on his lecture series at Caltech. In his preface, Feynman reveals early on what his aim is; to immediately grab the attention of bright students and to get them excited about the grander vision of the field. Excited enough, in fact, that they would persist in their studies and weather the tedious coursework required along the...
way. Like any good academic, Feynman was worried about his enrolment numbers.

The ancillary goal, he would add, was to sneak in enough of the mystery—the problems yet to be solved—that even the most gifted among the pupils would find something to latch on to. This corollary of foundational knowledge—the “easy pieces”—included discussions of atoms, energy, and gravitation, six easy pieces in total. It was elementary by design, but it was exciting for me. We are primed to do the exact same thing with the topic of intelligence. We have a century of research, extremely well replicated research, at our backs, and some incredible discoveries currently being made on our horizon. And we have plenty of unanswered questions.

It’s what I’ve called the “easy pieces of intelligence” that allow us to discuss “the harder pieces of intelligence.” And it’s there, I think, where we can show a new generation of students and journalists that our topic is foundational to understanding the human condition. Equally important, we can continue to abate the misunderstanding and myth that sometimes assail our topic still today.

What are “The Easy Pieces” of Intelligence?

After some thought, I’ve arrived at four easy pieces. Feynman only had two more than us, so I think we’re in pretty good shape. The first easy piece is that intelligence is a familiar part of everyday life, and is thus easy to define.3 It’s the set of skills that infuse and fuel our ability to navigate the world we inhabit; it is our ability to problem solve, to learn, and to organize bits of information that otherwise may seem disparate and incongruous. In Six Easy Pieces Feynman4 notes the following:

“Experiment is the sole judge of scientific “truth.” But what is the source of knowledge? Where do the laws that are to be tested come from? Experiment, itself, helps to produce these laws, in the sense that it gives us hints. But also needed is imagination to create from these hints the great generalizations—to guess at the wonderful, simple, but very strange patterns beneath them all, and then to experiment to check again whether we have made the right guess.”

The lecture I’m standing at is solid, but it is also shot through with empty space and comprised of tiny atoms. We know this bizarre truth because, as Feynman notes, we have the ability to experiment, to imagine, and to theorize about how the world might exist, even at levels we can’t observe with our eyes. Intelligence is not the only trait that underpins this incredible ability that our species enjoys; but it seems blazingly obvious that it is foundational to the entire enterprise.

At the same time, it is not just the ability to do experimental physics, algebra, calculus, or linear regression. It is certainly involved in all of those things, yet it also powers our ability to master pressing problems in the real world, absent any formal schooling or instruction. To loosely paraphrase prior eminent intelligence researchers “life is an intelligence test.”5 And if some social science work is to be believed,6 it may become increasingly important in an economy shifting ever more toward cognitive innovation as a primary means of making ones way in the world. So in short, the first easy piece is that intelligence is something we already have an intuitive understanding of. But more importantly, it is a quality that is not only fundamental to navigating our world, but it provides us the ability to make sense of the world. Our home planet is less mysterious, less frightening, and made all the more amazing by our capacity to understand it.6

The second easy piece is that we know how to measure intelligence. In fact, we do it quite well. None of us think that a given test is free of measurement error, perfectly reliable or completely valid. But in psychology, and indeed all of the social sciences, you would be hard pressed to find better measurement tools than intelligence tests. Our audiences, who ever they might be, should know that. The fact that the public (and even some academics) sneer at the measures psychologists have spent decades refining is unfortunate. Yet, it can be fixed. And many of you are well on the way toward examining the image of intelligence testing in the public eye.

The third easy piece is that we know where intelligence comes from: the brain. That’s an obvious, even banal point, of course. Yet, I think it’s worth considering, nonetheless. Divine revelation, divination, astrological signs, and the soul (as explanations of where wisdom about the universe might “come from”): all have been forced to take a back seat to neurological functioning, gray and white matter distributions, and speed of connectivity, among other key qualities. We can count this as an important victory, in fact, that most people now acknowledge that altering brain structure and function past a certain point affects our ability to think deeply, to problem solve, to reason and to navigate the world effectively. Many of you are hard at work studying intelligence across the life span in order to better understand how our cognitive abilities break down over time. This work is essential if we ever hope to delay, or even reverse the savaging effects that aging has on our intellectual lives. The import of this work is magnified by the fact that the ability to understand complex topics, use technology, and problem solve become all the more imperative as we age and are forced to confront difficulties with our health and well-being. Preserving our cognitive abilities is paramount for living a good life, and is a topic that bleeds into medicine, public health, gerontology, and many other fields. At its core, intelligence research is brain research. And because our brains represent the hub of our emotional and social lives, we all have skin in this part of the game.

The fourth, and final, easy piece is that intelligence varies. Humans differ in their intelligence levels just as we differ in our personalities, heights, weights, religious preferences, and political leanings. Difference—variation—is nothing to be maligned; of course, it is simply a feature of the process that landed us at this point. To be sure, this is easier to discuss for some traits than others, and intelligence (by virtue of the first easy piece) is a bit trickier to talk about when paired with the issue of variation. Yet, variation in intelligence is associated with variation in life success. Difficult as it may be, it is nonetheless an easy piece, simply because we have such a rich and clear understanding that variation not only exists, but also of its source.

Intelligence adheres to the four laws of behavior genetics (Law 1: virtually all complex behaviors are partly heritable, Law 2: the shared environments of children typically explain less variance than that of genetic factors, Law 3: non-shared environments consistently explain significant portions of variance in complex outcomes, Law 4: variation across complex phenotypes is the product of numerous polymorphisms all exerting very small effects).7,8 One could make a convincing case, however, that the most interesting point here has nothing to do with laws 1, 2, and 4, but rather centers on law 3, which is that the unique environments of humans always seems to explain a significant portion of variation in life success.6,8 We don’t fully know what this means—what constitutes these mysterious “non-shared” effects that

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2 For references on all easy pieces, see Ritchie, S. (2015). Intelligence: All that Matters. Hodder & Stoughton
always seem to matter. But one day we might. And what if this knowledge void coaxes an undeclared college major into the field of psychometrics, intelligence, or differential psychology? What if that little piece of the unknown attracts the next great intelligence scholar? That would be a great victory for us all.

Being interested in genetics, though, I can’t help but mention the portion of variance attributable to genetic differences. Indeed, we await publication of the first study to include a sample of over 1 million participants in a genome-wide analysis of one outgrowth of intelligence: educational attainment. To date, we have already made headway in discovering and replicating numerous SNPs associated with intellectual functioning. Doubtless, we are poised to discover even more with this new paper, as well as the ones that will follow in its wake. Heritabilities that were once “missing” will be, and are being, found. I can’t imagine a more exciting time to be working in and around the field of human intelligence across the history of our species? Why do we even start turning locks on the "not so-easy pieces" that still populate our field.

A Few of the Harder Pieces

There might be other easy pieces, my list isn’t meant to be exhaustive, but these are the four that—after a century or so of research—emerge time and again as robust. I also happen to find them particularly exciting because their simplicity thinly masks the depth of relevance that each has for all of us as human beings. I particularly find them exciting because their simplicity thinly masks the depth of problems. They, along with others, comprise the harder pieces of intelligence research from a genome-wide association study of educational attainment. To date, we have already made headway in discovering and replicating numerous SNPs associated with intellectual functioning. Doubtless, we are poised to discover even more with this new paper, as well as the ones that will follow in its wake. Heritabilities that were once “missing” will be, and are being, found. I can’t imagine a more exciting time to be working in and around the field. More importantly, I can’t imagine a scenario in which this easy piece fails to excite at least some promising new scientist, convincing her to start turning locks on the “not so-easy pieces” that still populate our field.

One Hard Piece: Consciousness & Intelligence

What I would like to do, however, as I begin the task of closing this lecture, is to indulge myself a bit by talking about a harder piece of intelligence research that I see as being at the core of what it means to be human. I’m talking about consciousness. What quality of human experience is more fundamental than consciousness? That feeling, to borrow from the neuroscientist Sam Harris, of “riding around perched behind our eyeballs.”12 Experiencing the redness of red or the sunset on the moors—what would life be without those things? And as a topic, consciousness resided for many years firmly with the philosophers and the theologians. The last several decades, however, have witnessed a surge of consciousness research across other scientific fields.

I can recall when I first spent more than a passing minute contemplating the topic of consciousness. I read a passage (probably one well known to all of you) from the Nobel Laureate Francis Crick:13

“The Astonishing Hypothesis is that “You,” your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules.”

As is typical of good science writing, I had never seen this idea rendered so fully naked and so clear. We could dispense with talk of souls, and of mystery, and zombies when it came to consciousness. We could talk about brains, and nerve cells, and signal pathways, and so on. And that’s precisely what has happened, the tools of neuroscience, cognitive science, computer science, and artificial intelligence have been pressed into service to try and understand this core feature of our species. We have made progress.

At least most of us agree that the topic of consciousness is a scientific one—not a spiritual one. Consciousness is product of something the brain is doing; to throw the power switch on the brain is to halt “the movie in our head.”14 We have cogent theories of consciousness: Attention Schema Theory15, Integrated Information Theory16, and others as well. Indeed, consciousness resides in the realm of brain science, and it is there where it needs to meet up with intelligence research.

Golden Braids, Individual Differences, & Douglas Hofstadter

What’s the connection with intelligence and consciousness? I don’t have the foggiest idea. But let me try to tease around the edges a bit, and maybe it’ll be this harder piece that attracts someone with higher g than what I currently possess. I recently wrote a paper expanding on an idea from the Pulitzer Prize winning cognitive scientist Douglas Hofstadter.17 In his book18, I Am a Strange Loop, Hofstadter pondered the following (note, he takes a little literary license here, using “souledness” as analogy for consciousness):

“There is an average tallness for adults, but there is also a considerable spread around that average. Why should there not likewise be an average degree of souledness for adults (100 hunekers, say), plus a wide range around that average, maybe (as for IQ) going as high as 150 or 200 hunekers in rare cases, and down to 50 or lower in others?”

Much like when I read Crick’s astonishing hypothesis, I was floored, and spent the next several months thinking about this, and little else. I won’t hammer you with the details of my paper, but essentially I argued—in the vein of Hofstadter, that consciousness (however we might measure it) does in fact vary across individuals in a population (just like height, weight, and personality). Moreover, I argued that variation in consciousness, like virtually every other complex human trait, accords with the 4 laws of behavior genetics. And trust me, the case I make in my paper is knock down, so I won’t even encourage you to read it, you can simply take my word.

In the time I spent working on that paper, another idea started to germinate. What, if anything, did consciousness have to do with intelligence? Sadly, there’s just not much out there on this topic. Richard

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12 Used often in various outlets as a heuristic for the experience of conscious awareness.
17 https://psyarxiv.com/cbxgm/
Haier, in his excellent primer on intelligence and neuroscience, spent time briefly musing on the intersection of intelligence and consciousness. And as many of you may know, Rich did some of the first neuroimagining work with anesthetic drugs to try and localize regions of the brain implicated in conscious awareness.

Quite a bit of work has followed in recent years, providing us with what we call the neural correlates of consciousness—but not surprisingly, many of those “NCCs” are implicated in intelligence. What are some other reasons to suspect some intersection between topics? I think it’s uncontroversial to say that as we age, our conscious experiences change from when we were younger. This reality is rendered ever more stark when we observe the ravages of neurodegenerative diseases, like Alzheimer’s. It is doubtless true that patients suffering this malady are conscious, that it is “like something to be them” to paraphrase Thomas Nagel. But what its like to be them now, is likely not what it was like to be them before the disease. Cognitive abilities, including intelligence levels, have declined—there will be no learning of a new language or mathematical skill set, and intuitive solving of problems is rendered nearly impossible.

We continue to nibble around the edges of this topic in the study of intelligence and Alzheimer’s disease. At a minimum, there seems to be an inverse correlation between early life intelligence and later Alzheimer’s. Something about the nature of intelligence—and how it’s instantiated in the brain—almost seems to combat some aspects of the disease. Beyond that, it’s difficult to say very much more at all. Yet, the relationship between intelligence and various neurodegenerative disorders seems likely to shed light whether intelligence intersects at all with how human beings generate conscious awareness.

Let’s switch gears briefly, and think about this from a different angle. Have you ever met a machine that’s smarter than you? In some sense you have. Presumably, you all have smart phones (for those of you who do not, god bless you). The raw computing power in your phone surpasses anything locked away in your skull. Tools like Watson and Siri are at your disposal for searching troves of data. And if you were ever convinced you’d truly mastered chess, even the version of Deep Blue from Kasparov’s day would likely make short work of you. And yet, as Douglas Hofstadter has noted time and again, these machines aren’t really “thinking” nor are they really “intelligent” in the sense that we are. They are brute force titans, crushing and crunching through algorithms to accomplish the end goals that we set for them.

Can we imagine a truly conscious machine—one that we’re convinced has experiences, feelings, and emotions; one that intuits the true meanings of our body language and voice inflection, and thinks recursively along with us—yet, lacks what we would recognize as human intelligence? That seems difficult to do. Thus, to the extent that we can engineer machines that actually do embody human intelligence—surely we have some West World fans in the room—we may back door ourselves in to understanding if, and how, what we define as intelligence is interlocked with our conscious experiences. Just to clarify, I’m not suggesting that the two are the same by any stretch of the imagination, only that they are related. And I do think they are (related), but even being proven wrong would be an exciting journey to undertake.

Concluding Remarks

Our field has something truly great to offer. While that may sound grandiose, it is most decidedly not. We study a core trait that fits into the mosaic of traits that make the human experience what it is. Any fulfillment Feynman’s students derived from understanding some arcane physics topic was the result, in great measure, of the intellectual capacities they possessed for learning. Our ability to understand the world doesn’t mean that we get the answer right the first time, it means that we keep trying variations of the puzzle until the pieces align themselves. As Feynman noted, we imagine, and we experiment, and we course correct, and we keep going until the pieces fall together.

In many core respects, that is what intelligence is—the ability to manipulate the puzzle pieces until they fall into place. Our collective lives on this planet may indeed constitute the most important intelligence test, and we will need all of our cognitive energies to preserve it, and each other, moving forward. Whether your focus is on aging, child development, educational attainment, or some other aspect of intelligence, your work is important, and it means that the public need to be exposed to blatant untruths about the field in their introductory textbooks. This is disconcerting, but it’s never too late to right the ship. We have the easy pieces of intelligence, and what a boon that is for us. As Feynman demonstrated—the easy pieces stoke the appetite for the harder ones. And the harder pieces in our field have the potential to unlock deeply mysterious insights about what it is to be human. How truly lucky we are.

Thank you!

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23 See various interviews given by Hofstadter in a range of media outlets.
25 I should note that the text has been edited, in places, for clarity based on helpful suggestions from the editor-in-chief, and thus may diverge a bit from the speech delivered live in Edinburgh.